BIOLOGICAL OPINION
of the
U.S. FISH AND WILDLIFE SERVICE
for
ROUTINE MILITARY TRAINING and TRANSFORMATION
of the
2nd BRIGADE 25th INFANTRY DIVISION (Light)

U.S. ARMY INSTALLATIONS

ISLAND of OAHU

October 23, 2003
(1-2-2003-F-04)

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United States Department of the Interior

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TAKE PRIDE IN AMERICA

In Reply, Refer To:
1-2-2003-F-04

OCT 2 3 2003

Colonel David L. Anderson
U.S. Army Commander
Department of the Army
Headquarters, United States Army Garrison, Hawaii
Schofield Barracks, Hawaii 96857-5000

Re: Biological Opinion on Routine Military Training and Transformation of the 2nd Brigade 25th Infantry Division (Light), U.S. Army Installations on the Island of Oahu (1-2-2003-F-04)

Dear Colonel Anderson:

This biological opinion responds to your request for formal consultation with the U.S. Fish and Wildlife Service (Service) pursuant to section 7 of the Endangered Species Act of 1973, as amended (Act). Your request was dated April 25, 2003, and was received April 28, 2003. The statutory deadline for completing this consultation, September 10, 2003, was extended by mutual agreement until October 24, 2003, due to the complexities associated with finalizing a biological opinion of this magnitude. At issue are the impacts that the proposed actions may have on threatened and endangered species and their habitats on six Army installations on Oahu to include: 37 plants, 11 snails, 1 mammal, and 2 avian species, and designated critical habitat for the Oahu elepaio (*Chasiempis sandwichensis* spp. *ibidis*) (Appendix 1). Based on the information provided in the Programmatic Biological Assessment for Routine Military Training and Transformation of the 2nd Brigade 25th Infantry Division (Light), U.S. Army, Oahu, Hawaii (Biological Assessment) we concur with the determination that the Oahu creeper (*Paroreomyza maculata*) and the Hawaiian hoary bat (*Lasiurus cinereus semotus*) will not be adversely affected by the actions, and therefore, these species will not be addressed further in this biological opinion.

The biological opinion was prepared using the following information: 1) Biological Assessment; 2) Preliminary Draft Wildland Fire Management Plan Pohakuloa and Oahu Training Areas (WFMP), March 2002; 3) information from our files; and, 4) informal consultation between the Army and the Service.

Six Army installations are considered in this consultation to include: 1) Dillingham Military Reservation (DMR); 2) Kahuku Training Area (KTA); 3) Kawailoa Training Area (KLOA); 4)

Schofield Barracks East Range (SBER); 5) Schofield Barracks Military Reservation (SBMR); and 6) South Range Acquisition Area (SRAA) (Figure 1). Two additional Army installations on Oahu, Helemano Military Reservation (HMR) and Makua Military Reservation (MMR) are mentioned in this consultation, but are not addressed indepth. HMR consists of a large inactive antenna field (114 hectares (ha); 282 acres (ac)) with some military housing and there are no listed species nor native habitat remaining on this installation. Legacy training at MMR, was previously addressed in a biological opinion (1-2-99-F-01) dated July 23, 1999, that addressed impacts to 27 plant species, Oahu elepaio and Oahu tree snails (*Achatinella mustelina*). A supplement to the MMR Biological Opinion was issued on October 12, 2001, that addressed several new or modified actions to the original project.

Scientific nomenclature for native and non-native plant species is used throughout this biological opinion. For identification or reference of a plant species by its common name see Appendix 2.

CONSULTATION HISTORY

The Service has been working with the Army to assist in the conservation and management of threatened and endangered species on Army lands on Oahu for many years. Early coordination for activities at Oahu installations pertaining directly to this consultation began officially on April 9, 1997, when the Army transmitted the following documents to the Service for review and comment:

- Draft Ecosystem Management Plan for Oahu Training Areas
- Draft Environmental Assessment for the Ecosystem Management Plan Oahu Training Areas
- Draft Endangered Species Management Plan for Oahu Training Areas
- Draft Fire Management Plan for the Island of Oahu
- Draft Outdoor Recreation Plan for U.S. Army Training Areas in Hawaii

The Service provided comments on the above documents on June 17, 1997. These documents became the foundation for this consultation.

On September 16, 1999, representatives from the Service and the Army met to discuss the action area for SBMR.

On October 4, 1999, the Service and Army met to discuss baseline improvement measures for SBMR, west and south ranges.

On April 2, 2002, the Army sent the Service a Draft Biological Assessment for Programmatic Section 7 Consultation on Routine Military Training at Schofield Barracks Military Reservation Fixed Ranges (Waianae Mountains) for review and comment.

June 28, 2002, the Army wrote a letter to the Service concluding that a fire that occurred outside the fire break road at SBMR did not jeopardize any listed species or adversely modify critical habitat

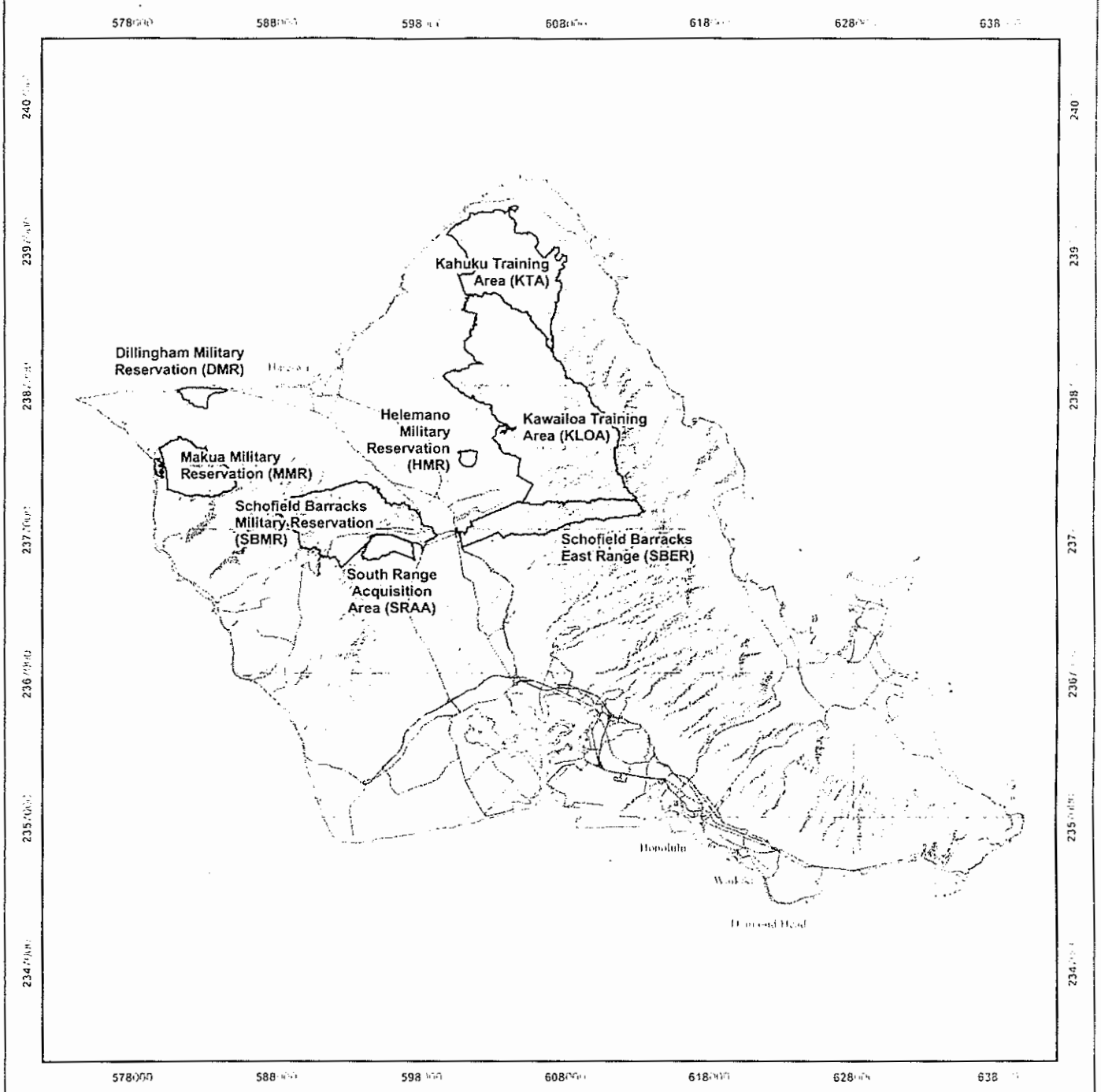

Figure 1
Island of Oahu
Army Installations

Installation

Primary Roads

0 2.5 5 10 Kilometers

0 2.5 5 10 Miles

Prepared by U.S. Fish & Wildlife Service, October 2003

even though 2.5 ha (6.8 ac) of elepaio critical habitat and 4.5 ha (11.1 ac) of proposed Oahu plant critical habitat was burned.

On July 25, 2002, the Service responded with a letter to the Army regarding the SBMR fire that occurred outside the fire break road. In this letter the Service agreed with the Army that the methods used to control the fire (mostly water drops) was not likely to adversely affect listed species. However, the Service informed the Army that consultation cannot occur when the actions have already taken place. Consultation on the effects of the fire after the fact will not provide compliance under the Act.

The Service sent comments to the Army concerning the Draft Biological Assessment for Programmatic Section 7 Consultation on Routine Military Training at Schofield Barracks Military Reservation dated May 6, 2002.

The Army sent a letter to the Service on October 16, 2002, requesting concurrence with the Army's determination that upgrading Drum Road is not likely to affect any federally listed or proposed species, or proposed critical habitat.

The Army sent the Pre-final Biological Assessment on Routine Military Training and Army Transformation of the 2nd Brigade, 25th Infantry Division (Light) to a Stryker Brigade Combat Team, Oahu, dated December 4, 2002, to the Service for review and comment which was received on December 6, 2002.

On December 13, 2002, the Service sent a letter to the Army stating that we did not concur with the Army's determination that upgrading Drum Road was not likely to affect any federally listed species or proposed critical habitat. We requested additional information.

On January 17, 2003, the Service provided the Army with a 26-page comment letter on the Pre-final Biological Assessment on Routine Military Training and Army Transformation of the 2nd Brigade, 25th Infantry Division (Light) to a Stryker Brigade Combat Team.

On January 28, 2003, the Service received a copy of the Preliminary Draft Wildland Fire Management Plan for Pohakuloa and Oahu Training Areas (March 2002).

On January 30, 2003, the Army organized a field visit to Drum Road to drive the length of the proposed project and discuss the future road upgrade and potential effects to listed plant species. Representatives from the Army, U.S. Army Corps of Engineers, Service, and Tetra Tech, Inc. were in attendance.

Representatives from the Army, Service, U.S. Army Corps of Engineers, and Colorado State University (fire consultant) met on February 3 and 4, 2003, to discuss the final action area delineations for SBMR, SRAA, DMR, KTA and SBER.

On February 20-21, 2003, representatives from the Army, Service, Center for the Environmental Management of Military Lands, U.S. Army Corps of Engineers, and Colorado State University met and discussed and attempted to resolve each item in the Service comment letter dated January 17, 2003.

A meeting was held on February 25, 2003, with representation from the Army, Service, Center for the Environmental Management of Military Lands, U.S. Army Corps of Engineers and Colorado State University to finalize the action area for the proposed acquisition parcel SRAA.

The Army sent the Second Draft Biological Assessment for Routine Training and Stryker Brigade Combat Team Transformation, dated March 21, 2003, to the Service for review and comment.

On April 15, 2003, the Service provided a 25-page comment letter to the Army on the Second Draft Biological Assessment for Routine Training and Stryker Brigade Combat Team Transformation (March 21, 2003).

On April 25, 2003, the Army provided the Service with copies of the Final Biological Assessment for Routine Military Training and Transformation for the Island of Oahu and a request for formal initiation of section 7 consultation for proposed actions on six installations on Oahu.

On May 27, 2003, representatives from the Army, Service, and U.S. Army Corps of Engineers met to discuss minimization and conservation measures on SBER, SBMR, SRAA, KTA, KLOA, and DMR.

On May 28, 2003, the Service sent a letter to the Army agreeing to initiate formal consultation for routine and Transformation training on six installations on Oahu. The consultation would address Army training impacts to 37 plants and 11 snail species all listed as endangered, and designated critical habitat for Oahu elepaio. The official date of initiation was April 28, 2003, which is the date the Army's request letter was received.

On June 24, 2003, the Service received a Pre-Final Draft of the Wildland Fire Management Plan for Pohakuloa and Oahu Training Areas (dated June 2003).

On July 15, 2003, a wildfire occurred at KTA due to the use of explosive charges (C-4) to remove trees from a landing zone. The fire re-started on July 17, 2003, and burned approximately 5.5 ha (13.5 ac) before being extinguished. A small occurrence of the endangered plant, *Eugenia koolauensis,* was in the vicinity and Army biologists estimate that the fire burned within inches of several seedlings.

A wildfire occurred on SBMR due to training exercises on July 17, 2003, in an area referred to as Coffee Gulch. Approximately 3.6 ha (9 ac) were burned outside of the impact area.

On July 21, 2003, representatives from the Army and the Service met to discuss additional conservation measures for several vulnerable plant species on KTA and SBMR.

Amanda McAdams, (Fire Planner for the Service, Regional Office), Gayland Enriques, (Deputy Fire Chief/Wildland Fire Program Manager), and biologists from the Service and Army visited SBMR, DMR, MMR, SBER, and KTA to review and discuss fire suppression and infrastructure issues and concerns. Field visits were conducted on September 17-20, 2003.

The Service received a letter, dated August 14, 2003, formally extending the Oahu consultation due date for an additional 30 days. The completion date was changed to October 10, 2003.

On August 19, 2003, a second fire occurred at SBMR started by a 40 mm round that was fired during an inappropriate time pursuant to the Fire Danger Rating System. This fire burned approximately 2.8 ha (7 ac) outside of the impact area and portions of two Oahu elepaio territories were impacted.

On August 20, 2003, Amanda McAdams emailed an 11-page question and comment document to the Army regarding the Draft WFMP for the Oahu and Pohakuloa installations.

On October 22, 2003, representatives from the Army and Service finalized the conservation measures that are presented in this biological opinion.

On October 10, 2003, the Army formally extended the due date for the Oahu biological opinion until October 24, 2003.

DESCRIPTION OF THE PROPOSED ACTION

Introduction

The following project description is a summary of the military training actions on all Army installations on Oahu as presented in the Biological Assessment, various meetings, and field visits to the various installations. This project description includes all ongoing, or Legacy training, plus the future Stryker Brigade Combat Team (SBCT) Transformation that will take place within the next few years. The actions addressed in this consultation include current military activities such as live-fire (real ammunition) and non-live-fire (blank ammunition) training, mounted and dismounted maneuvers, aviation training, deployment and reconnaissance operations. SBCT Transformation will increase the number of troops at the various installations, alter training and ammunition practices and incorporate the Stryker vehicle as part of the new, more mobile Army strike-force.

Legacy Training

The 25th Infantry Division Light is the primary user of the Oahu installation training lands. These installations support infantry brigades, division artillery, aviation brigade, and other divisional combat and service support units. Non-Army units currently using Army training facilities on Oahu, and included in the scope of this Biological Assessment, include Hawaii Army National Guard, U.S.

Marine Corps Units, and other Allied Forces. The Oahu training facilities currently include 26 ranges, 49 training areas, 1 airfield (Wheeler Army Airfield), 5 airborne drop zones, and 13 surveyed field artillery and mortar firing points.

General Description of Current Training Activities

Oahu training resources include an assortment of live-fire and non-live-fire maneuver training facilities, fixed-position live-fire training facilities, infantry and engineer demolition training facilities, and grenade training facilities. On Oahu training lands, live-fire maneuvers occur at SBMR and MMR; non-live-fire maneuver training occurs at the other locations.

Live-fire training includes many types of munitions, including ball, high-explosive, rockets, mines, grenades, all artillery and mortar, short-range training ammunition (low-velocity plastic bullets), explosives, and practice and training-practice ammunition. All live-fire training takes place on training ranges within surface danger zones (the portion of a range that could be impacted by the firing of a particular type of weapon) established for that purpose. No live-fire training takes place outside of established ranges or surface danger zones. The firing of blank ammunition, including munitions up to .50 caliber, is not considered live-fire. All live-fire ranges on Oahu used by legacy and future SBCT units are located on SBMR, MMR, the proposed SRAA, and KTA (proposed use of short-range training ammunition at KTA), and are described in detail in those sections.

Maneuver Training

Maneuver training is a tactical exercise that can include movement by foot, vehicle, or helicopter, offensive operations, defensive operations, withdrawing under enemy pressure (retrograde), and reconnaissance and security. Maneuver training exercises are conducted at all levels from squad (9 soldiers) to brigade (1700 soldiers) and are sometimes supported by firepower. Unit movement during maneuver activities consists of soldiers in formation moving in a predetermined direction to accomplish a mission. If engagement with an enemy is part of the exercise then soldiers seek concealment in the vegetation. When contact with an enemy is simulated, then one section of a unit may provide a base of weapons fire while another section maneuvers towards the enemy. Live-fire normally entails an individual gunner, a crew of a weapon system, or a collective unit firing at predetermined targets from designated firing positions on a range facility. Airborne units may parachute in under tactical scenarios. Combat effects such as smoke and obscurants, noise, and simulated nuclear, biological, and chemical conditions are integrated into training events to train troops for operations in a realistic battlefield environment. This training also entails the set-up of temporary defensive positions to repel an enemy attack. This may entail digging individual fighting positions or trenches using hand tools and larger crew-served weapons using excavators. During these exercises soldiers may sleep in the field either without tents or in a more logistical bivouac situation.

Reconnaissance Training

Typical reconnaissance training operations involve small groups, from squad to platoon strength (9 to 35 soldiers). This type of training may take place in all types of terrain but can be constrained by extremely rugged terrain and thick vegetation. In many respects, reconnaissance training resembles

dismounted maneuver training but does not have the same type of vehicle support. No live-fire is involved, and vehicles are not used. Reconnaissance training occurs on all Oahu installations.

Bivouac

Bivouac consists of setting up camp for rest, resupply/refit, maintenance, or to provide support. Bivouac sites vary depending on unit size and mission. The size of bivouac areas can range from 100 x 100 m (330 x 330 ft) for a squad (9 soldiers) or platoon (35 soldiers) to 300 x 300 m (330 x 330 ft) for a company size (120 soldiers) bivouac. Depending on unit size, bivouac sites can contain a vehicle and weapons maintenance area, vehicle parking area, general supply area, munitions supply area, medical area, helicopter landing zones, and vehicle off-loading area. A bivouac site may consist of a series of tents, temporary structures, and equipment covered with camouflage nets. Bivouac is normally done on level or gently rolling areas that provide vehicle and/or aircraft access. Open fires are not allowed during bivouac, but cooking in special mobile kitchens (enclosed ovens), and use of tent heaters (enclosed) and generators is permitted. Munitions used in bivouac typically consist of grenade and artillery simulators and blank ammunition. Bivouac training occurs on all Oahu installations.

Deployment Training

Deployment training teaches soldiers how to prepare and move military units and supplies as part of a military action. Deployment training principally involves moving troops and equipment from SBMR to other installations. Transportation of units consists of a combination of vehicles, sea transport vessels, and aircraft, depending on the type and location of training. Legacy force personnel currently deploy to Pohakuloa Training Area, Hawaii, from Hickam Air Force Base or Wheeler Army Airfield using C-17 or C-130 aircraft.

Aviation Training

Aviation training consists of aircrew training, maneuver training, and aerial gunnery. Aircrew training pertains to normal aviation flight skills, including takeoff and landings; normal, nap-of-the-earth, contour and low level flights; confined and high altitude area landing/takeoff; and navigation for helicopters. Maneuver training pertains to the ability of aviation units to transport ground maneuver and combat support/combat service support units to support the tactical battlefield. This type of training requires up to 20 helicopters flying in tactical formations carrying ground troops and equipment to battle areas. Aviation training is conducted daily on Oahu ranging from a single aircraft to flights of 10 helicopters. Large aviation task force operations can exceed 35 aircraft, but this event happens only once or twice per year. Flights of aircraft will pick up soldiers in pickup zones and carry them to tactical landing zones. Drop zones are used for parachute drops of troops and equipment. Pickup and landing zones are used as starting and end points for foot maneuvers. In an air assault exercise, troops dismount from the helicopters, the helicopters take off, and the troops disperse into the area adjacent to the landing zone (*i.e.*, into the woodline). The unit then assembles and may attack one or more objectives before being picked up or moving to another location on foot. Equipment and or vehicles may be dropped as part of the exercise. Primary installations for this type of training includes: KTA, KLOA, SBMR, and SBER.

Force-on-Force Training

These operations involve armed clashes between two organized forces, up to brigade-level (1700 soldiers). Activities include dismounted ground maneuvers during the day or night, helicopter operations, operation of wheeled and track vehicles, establishment of field command centers, establishment of operating sites for logistics and aviation units, and preparation of field fortifications. There is a continuous movement of aircraft, vehicles, and troops within the training area for force-on-force operations. The multiple integrated laser engagement system, blank ammunition and artillery, flares, and other pyrotechnic devices may be used extensively to simulate live-fire.

Combined Arms Live-Fire Maneuver Training

A combined arms live-fire training exercise involves usually a infantry company (120 soldiers) but can also involve squads (9 soldiers) to battalions (500 soldiers). This is a large, annual training exercise that involves bivouac, live-fire training and a simulated attack to include trench lines, mine fields, and other obstacles. Aerial support may be involved. Upon seizing their objectives, units then prepare for any counterattack again using live-fire such as howitzers, cannon, and artillery support. This exercise consists of several days and can occur either during the day or night.

Transformation and the Stryker Brigade Combat Team

The proposed action would convert the 2nd Brigade 25th Infantry Division Light (one of two light brigades in Hawaii) to a different configuration that involves a rapidly deployable, medium weight force, which is more self-supported. The primary difference between Legacy and SBCT training would be: 1) the introduction and use of the Stryker armored vehicle; 2) an increase in off-road travel at several installations on Oahu; and, 3) increased live-fire range requirements. Proposed SBCT training would focus more on urban close combat training, but many missions would be very similar to light infantry missions currently practiced on Oahu training lands. Almost all of the SBCT weapon systems are in the current Army inventory, and SBCT training activities in the field are projected to be very similar to Legacy training, except the introduction and use of the Stryker. It is projected that Transformation of the 2nd Brigade will result in a net gain of approximately 810 soldiers and 400 Stryker vehicles and will include 26 construction projects at DMR, KTA, SBER, KTA, SBMR, Wheeler Army Airfield, Hickham Air Force Base including the construction of a small arms qualification range on SRAA.

SBCT Training Activities

Maneuver area requirements are higher for the SBCT. The net effect on the intensity and distribution of maneuver miles is difficult to estimate without historic data to draw upon. However, it is estimated that the impacts related to vehicle maneuvers will be approximately three times greater (all Army lands) under the proposed action compared to current training. A large proportion of the SBCT maneuver requirement will be met by land acquisition adjacent to Pohakuloa Training Area on the Big Island.

A Stryker is a highly deployable, wheeled armored vehicle that combines firepower, battlefield mobility, survivability and versatility with reduced logistics requirements. The exact manner in which Stryker vehicles will be used is not known at this time. Published doctrine indicates that the Stryker

vehicle is primarily a troop transport vehicle that will traverse terrain and obstacles to ensure protected delivery of infantry squads to their dismount points. Because of the limitations of the Stryker, the majority of mounted movement takes place on roads or unrestricted terrain. The number of vehicles used for an exercise will vary with the size of the unit. Company and battalion-level maneuvers will involve 27 and 96 vehicles, respectively. SBCT training would involve up to 27 Strykers at SBMR, up to 27 Strykers at DMR, from 27 to 200 Strykers at KTA, and up to 27 Strykers at KLOA (limited to training along Drum Road). SBCT maneuvers, both mounted and dismounted, will take place in the same areas currently being used by military forces. The areas available for vehicle maneuvers are generally located at lower elevations on slopes of less than 30 percent that are not forested. The areas where the vast majority of vehicle maneuvers happen (and would happen in the future) are delineated in the high-probability vehicle maneuver maps (see Section 3.1.2.1 of the Biological Assessment). These maps give the best available knowledge regarding where vehicles (and much foot travel) occur and will occur in the future.

SBCT forces will conduct dismounted training to include company level combined arms live-fire exercises called Collective Arms Live-fire Exercise. The SBCT dismounted Collective Arms Live-fire Exercises will be similar to the exercises conducted by the Legacy forces using the same types of weapons and similar tactics. SBCT dismounted Collective Arms Live-fire Exercise training would occur at the SBMR Battle Area Complex (primary live-fire training area for the SBCT) and MMR.

The Aviation Brigade will continue to support some SBCT training requirements. Pickup and landing zones will continue to be used for air assault operations for the SBCT, but drop zones will not be used by the SBCT because there are no airborne units within the transformed brigade.

Changes in Current and Proposed Live-Fire Range Use

All SBCT training will be planned and conducted in accordance with established Army range and training land regulations and standard operating procedures. The SBCT will use new and existing live-fire ranges and firing points/position areas. Many changes to training and range usage will be site-specific and addressed in more detail under the section for each installation. Legacy and SBCT units will perform individual weapon and collective arms live-fire training including the use of the Stryker Mobile Gun System (105 mm cannon). SBCT live-fire training is planned for SBMR, SRAA, MMR and KTA (short-range plastic bullets only).

Changes in Non-Live-Fire Maneuver Training Activities Maneuver Training

Annual SBCT mileage per vehicle is estimated to be 1.3 times greater than Legacy vehicles. These increases in off-road impacts would potentially occur in all areas used by vehicles. Currently, Legacy Force vehicles are allowed off-road on Oahu installations (with site-specific restrictions). SBCT vehicles will also travel off established roads and trails in support of the SBCT missions (see Section 3.5 of the Biological Assessment) and will remain close to dismounted units for appropriate missions. The Stryker vehicle is expected to travel over rough surfaces not trafficable by Humvees and other Legacy force wheeled vehicles which will allow for more off-road activity.

Reconnaissance Training with Unmanned Aerial Vehicles

SBCT Reconnaissance training would be carried out in a similar manner as Legacy training except that the SBCT Unmanned Aerial Vehicles would offer air reconnaissance that, in combination with ground reconnaissance, would provide situational awareness and knowledge throughout a larger area of operations. Unmanned Aerial Vehicles training would take place at SBMR, Wheeler Army Airfield, and DMR. Vehicles would be launched from roads or hardened areas. It is anticipated that the Unmanned Aerial Vehicles's total flying hours would amount to 2,400 hours of flight per year (four Unmanned Aerial Vehicles at 600 hours per year), or 600 operations (takeoffs) per year. This would be the maximum allowable amount. The Unmanned Aerial Vehicles would not need to take off from or land at ordinary airfields, but use a self-supported hydraulic launcher. An arrested recovery system would also be used.

Deployment Training

Deployment training would principally involve moving troops and equipment from SBMR to the other training areas. As with Legacy training, transportation would use a combination of vehicles, vessels and aircraft, depending on the type and location of training. Deployment training would be similar to Legacy forces, except SBCT units would be deployed at least twice a year to Pohakuloa Training Area from Hickam Air Force Base or Wheeler Army Air Force using C-17 or C-130 aircraft. The only difference between SBCT strategic deployment and Legacy deployment is the increased numbers of vehicles and troops for a SBCT and an increase in the number of Logistics Support Vessel round trips from 30 to 38 between Oahu and the Big Island. Vehicles will be washed at SBMR and Pohakuloa Training Area wash racks before inter-island deployments.

Other Training Actions under SBCT

Most of the SBCT non-live-fire and non-maneuver training will be similar to Legacy training. All Combined-Arms Live-Fire Training and Force-on-Force training exercises would be carried out in a similar manner as with Legacy training. The only increase in Combined Arms Live-Fire Exercises would be from the introduction of the Reconnaissance, Surveillance and Target Acquisition Squadron, which could conduct up to three Company Combined-Arms Live-fire Exercise per year. There would be no change in Major Force-on-Force training which would still occur at SBMR and KTA.

Dillingham Military Reservation Training Actions

Legacy Training

DMR is located along the northwest shore of Oahu on the Waialua Plain bordered by Farrington Highway and the Pacific Ocean to the north and the Waianae Mountains to the south (see Figure 1). DMR is approximately 269 ha (664 ac) in size and includes a small airstrip used by both civilians and the military. Approximately 147 ha (364 ac) are suitable for maneuver and field training, 43 ha (107 ac) are developed within the cantonment area, and the remaining 82 ha (203 ac) are located on steep slopes of the Waianae Mountains. Non-military uses of the installation include hiking, biking, hunting, and glider plane operation and parachuting.

DMR is used for small unit (platoon and squad) maneuvers and combat support operations including vehicle movement, maneuvers and convoys, foot maneuvers, bivouacking, limited aviation training, and staff training exercises. All operations involving significant support activities, tents, field facilities, and vehicles/equipment take place in the flatter areas cleared of vegetation in P1 and the lower elevations of P2 and P3 (Figure 2). These activities take place within areas that support off-road vehicle maneuvers. However, helicopters do use the taxi-way (in portions of P1, P2, and P3) for training for both day and night tactical flight operations and airmobile (*i.e.*, troop transport) exercises. The average use of each training area ranges from 74 to 123 days per year and from 7,100 to 13,600 troops per year. Ammunition includes blanks, smoke, and simulators for current training at DMR.

The following training restrictions apply at DMR:

- There is no live-fire at DMR.
- Airfield is off-limits to military training unless coordinated through Range Division Hawaii.
- Live ammunition (*i.e.*, live-fire training), aerial pyrotechnics (*e.g.*, star and parachute flares), and tear gas grenades are not authorized.
- No ignition sources (including cigarettes, cooking/warming fires, and blanks) outside of P-1 until the first fire break is complete. No ignition sources outside of the first fire break until the second (future) fire break is complete. No ignition sources outside of the second (future) fire break at any time. This includes smoking and cooking/warming fires as well as all munitions. Future fire break construction is discussed in Section 4.3.1 and a map is presented in Section 4.4 of the Biological Assessment.
- Blank ammunition is authorized at DMR.
- The use of pyrotechnics, simulators (including demolition effects simulators), and blanks requires approval from Range Division Hawaii and will be controlled by the Fire Danger Rating System for DMR.
- Range Division Hawaii will restrict the use of pyrotechnics under the red Fire Danger Rating System category.
- Range Division Hawaii will authorize and apply safety buffer zones for smoke grenades in Training Areas P-1, P-2, and P-3 and ground simulators in Training Areas P-2 and P-3.[1]
- Smoke grenades will only be used in areas devoid of vegetation.

Fire Breaks

Two fire breaks will be built at DMR (see Section 4.4.3 of the Biological Assessment) to provide fire containment. These will provide fuel free areas that give firefighters access and a defensible location from which to fight a fire. They will both be built to standards as outlined in the WFMP. The first will largely be composed of existing roads and will contain all of P-1 and portions of P-2 and P-3. This fire break will be completed in 2005. The second fire break will be closer to the southern edge of the installation and will contain nearly all of the training areas. This break will be constructed in 2006 and will be built to standard. These fire breaks will be constructed regardless of whether SBCT occurs.

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[1] Buffer information is listed U.S. Army Hawaii Regulation 210-6, Appendix F.

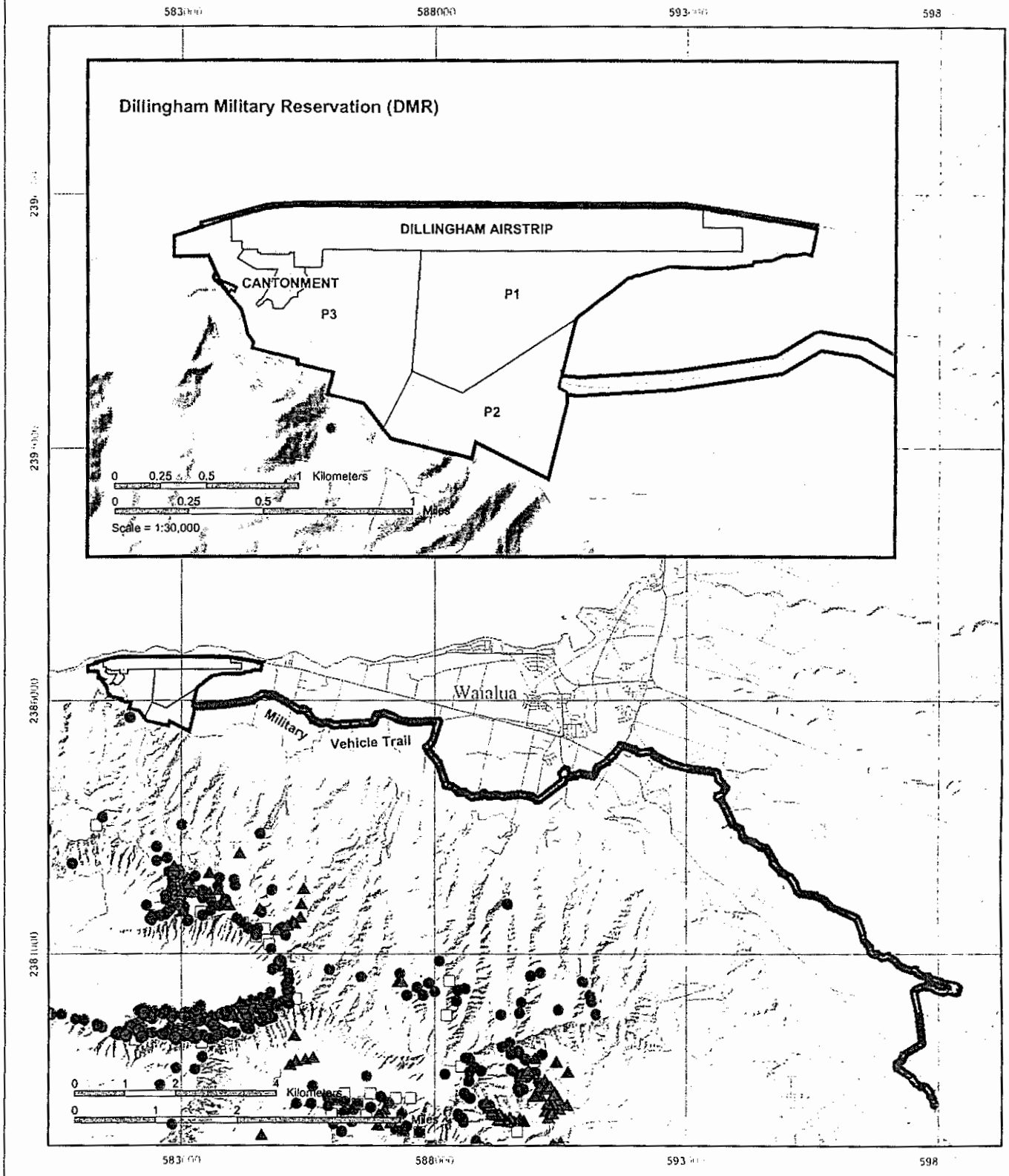

Figure 2

Scale = 1:110,000
UTM Zone 4, Old Hawaiian

Prepared by U.S. Fish & Wildlife Service, October 2003

Construction will remove vegetation and clear debris using bulldozers or other mechanical means to create a drivable surface approximately six meters wide. The vast majority of the area to be used will follow existing roads and/or power line right of ways. The construction of the fire breaks will be covered under a separate coordination or consultation with the Service.

SBCT Transformation at DMR

Several construction projects will be a part of the Transformation at DMR including a military vehicle trail to facilitate movement between SBMR and DMR. The road project will consist of a 7.3 m (24-ft) wide gravel road with 0.9 m (3-ft) wide gravel shoulders on both sides from SBMR to DMR. The road would be one-lane wide and approximately 24 kilometers (km) (15 miles (mi)) long (see Figure 4b in the Biological Assessment). Work includes grading, paving, drainage improvements, culverts at stream crossings, guardrails at drop-offs, and storm drainage structures and lines to preclude excessive storm runoff from flowing over the road and posing a hazard to vehicular traffic.

Construction of three Fixed Tactical Internet antenna support structures with four antennas each is proposed. Four antennas will be installed at each proposed site located on Oahu. Existing antenna support structures and sites will be utilized when possible. The antennas are vertical whips approximately 5 centimeters (cm) (two inches (in)) in diameter with one approximately 1.2 m (4 ft) long and two approximately 3.3 m (10 ft) long. They will be mounted on an antenna mast, utility pole, existing support structure, or building. Some of the antennas may have a red light at the top, according to Federal Aviation Administration guidelines, to warn nearby aircraft. Each site will be fenced and accessed via existing roads in all cases. No security lighting will be installed at the sites.

Non-Live-Fire Maneuver and Other Training Activities

Most training would be similar to that conducted by the current light infantry brigades. SBCT forces will use DMR for small unit maneuvers and combat support operations to include Initial Staging Base operations.[2] Such training would include non-live-fire, mounted maneuver training with vehicles such as the Stryker, Humvee, and cargo trucks, as well as foot training. Field activities, or training exercises, can involve a variety of activities, such as vehicle movement, maneuvers and convoys, foot maneuvers, bivouacking, limited aviation training, and staff training exercises. As with Legacy training, exercises would continue to be at the squad through company level (9 to 120 soldiers), with some opportunities for larger unit training. General SBCT training would likely occur between 180 and 242 days per year. Allowable and restricted uses of pyrotechnics would be the same as under Legacy training. No ignition sources would be permitted outside of the second fire break at any time. This includes smoking and cooking/warming fires as well as all ammunition. With SBCT Transformation, usage of both blanks and smoke grenades would increase by approximately 10 percent in Training Areas P1, P2, and P3. Simulators would not be used in P1 and P2, and usage would increase in P3 by approximately 10 percent under Transformation.

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[2] This training is essentially the same as Brigade Support Area operations, which consist of a variety of support, maintenance, and service functions supported by tents and vehicles.

High-probability vehicle maneuver areas include most of DMR. Delineation of high-potential vehicle maneuver areas is described in Section 3.1.2 of the Biological Assessment. High probability vehicle maneuver areas include the airstrip, 74 ha (183 ac) of area P1, 19 ha (47 ac) of area P2, and 44 ha (109 ac) of area P3, for a total of approximately 205 ha (507 ac) on DMR. No vehicle maneuver would occur south (*i.e.*, outside) of the future fire break proposed at DMR. Until the second fire break is completed, this restriction will apply to the first fire break. Until the first fire break is completed, this will apply to the area outside of P-1.

There are no federally listed species within the DMR action area; however, there are several endangered plant occurrences outside of the installation boundary. The Service concurred that the action area could follow the installation boundary due to the implementation of the WFMP, restrictions on pyrotechnics, and the construction of two fire breaks that would reduce the risk of fire spreading into adjacent habitat that contains endangered plant species.

Helemano Military Reservation

HMR is located in north-central Oahu in the eastern portion of the Wahiawa Plain, west of KLOA and the Koolau Mountains (see Figure 1). Ninety percent of the installation is comprised of a large inactive antenna field and the remainder of HMR consists of family housing, offices and a motor pool. The vegetation is predominantly exotic species with a few intermittently dispersed native species. Therefore, HMR will not be addressed in any detail since Army activities will not result in any adverse impacts to federally listed species.

Kahuku Training Area Training Actions

Legacy Training

KTA is located on northern Oahu on the terminus of the Koolau Mountains (see Figure 1). This installation is approximately 3,808 ha (9,409 ac) in size and is the largest contiguous ground-maneuver training area on Oahu with 1,369 ha (3,384 ac) classified as suitable for mounted and/or dismounted maneuver. KTA contains nine sub-areas (training areas), five open helicopter landing zones, three closed landing zones, and three parachute drop zones also used as landing zones. KTA does not have a defined cantonment area, but does have a Range Control compound and three smaller compounds that are set aside to support Army-related operations.

Primary users of KTA include Army and U.S. Marine Corps units. The areas support up to battalion-level (500 soldiers) exercises. The northern portion of the installation, consisting of rolling grasslands and shrublands with moderate relief, supports all tactical maneuver training scheduled on KTA, including mountain and jungle warfare, and air support training. All operations involving significant support activities, tents, field facilities, and vehicles/equipment take place in the lower elevation and flatter areas cleared of vegetation and accessible by road. These activities take place within areas that support off-road vehicle maneuvers. The entire area is divided by several north-to-south oriented drainages that limit east-west movement between the broader ridge top areas. Historically, use of higher elevation areas including Training Areas A1, A3, C1, C2, D1 and D2 has been limited due to the terrain and dense vegetation (Figure 3). A summary of training types and

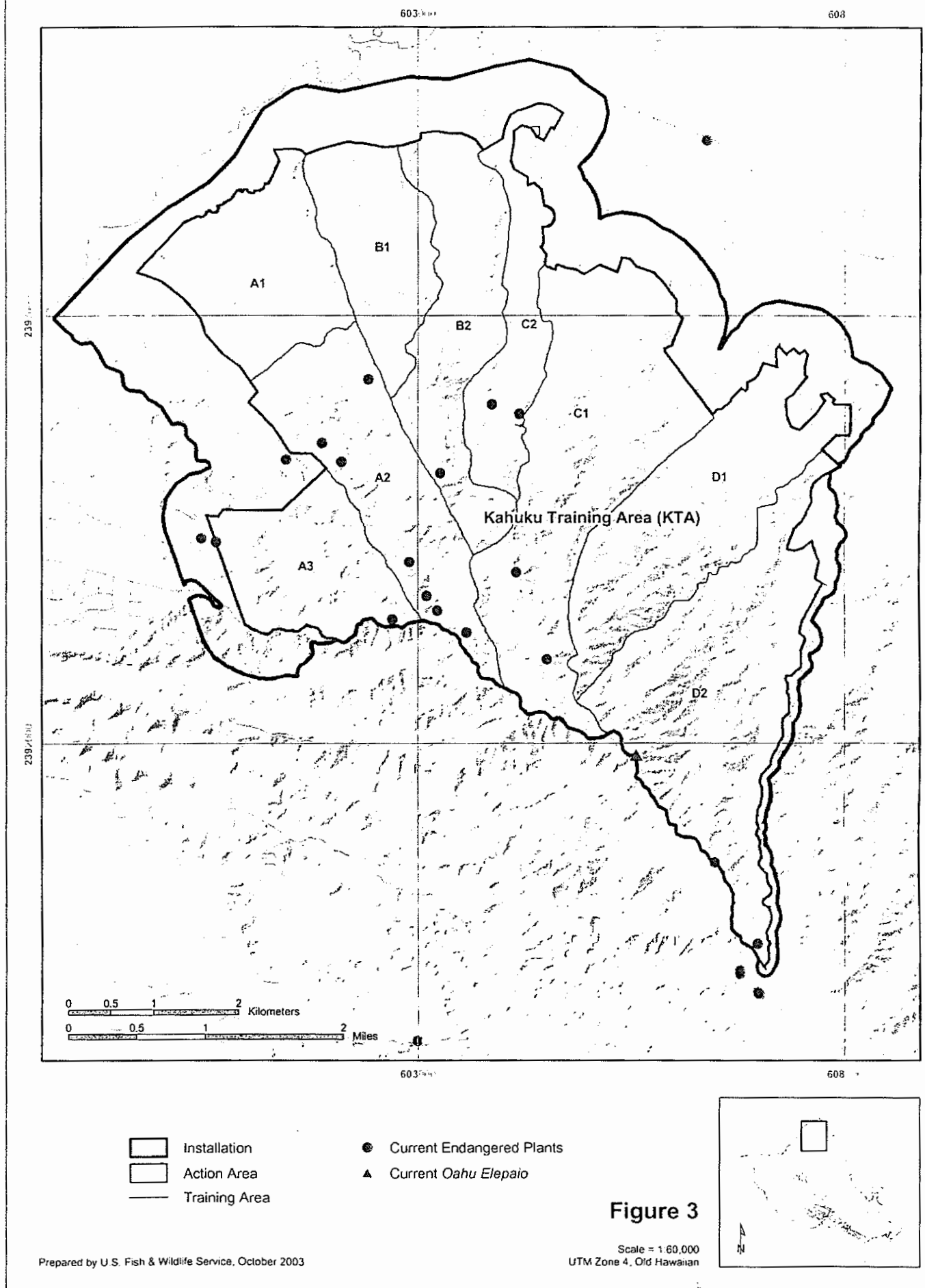


Figure 3

Scale = 1:60,000
UTM Zone 4, Old Hawaiian

Prepared by U.S. Fish & Wildlife Service, October 2003

annual usage (number of days and troops) for each training area at KTA is presented in Table 6.a of the Biological Assessment. The average use of each training area ranges from 26 to 44 days per year and approximately 1,500 to 4,800 troops per year. Ammunition (short range training ammunition, blanks, smoke, and simulators) usage at KTA is presented in Section 6.3.2 of the Biological Assessment.

Small unit maneuvers and combat support training include non-live-fire, mounted maneuver training with Humvees, cargo trucks, trailers, as well as foot training. Field activities, or training exercises can involve vehicle movement, maneuvers and convoys, foot maneuvers, bivouacking, limited aviation training, and staff training exercises. The size of bivouac areas can range from 100 x 100 m (330 x 330 ft) for a squad or platoon (9 to 35 soldiers) to 300 x 300 m (985 x 985 ft) for a company (120 soldiers) size bivouac. Foot maneuvers occur anywhere that safety or administrative restrictions permit including the high probability vehicle maneuver areas. Pyrotechnics use occurs anywhere that dismounted (and/or mounted) training occurs in accordance with rules for pyrotechnics use at KTA.

Vehicle maneuvers are largely limited to the northern portion of KTA. High-probability off-road vehicle maneuver areas include 437 ha (1,080 ac) out of a total area of approximately 5,199 ha (12,846 ac) within Training Areas A1, B1, B2, C1, C2 and D1 (see Table 6.b of the Biological Assessment). A few very small and disjunct areas that met maneuver criteria are remote and inaccessible to vehicles and, therefore, will not be used. Nearly all vehicle travel, and a high proportion of dismounted training occurs within the high probability areas. These areas (*i.e.*, locations of use) are the same for Legacy and SBCT training. Legacy forces operate wheeled vehicles on existing roads and trails, as well as on off-road areas suitable for maneuver. Units currently use Drum Road through KLOA to access KTA on a minimal and infrequent basis (and very few vehicles – mainly Humvees) due to the poor condition of this one-lane dirt road. The primary route for vehicles going to KTA is via Kamehameha Highway. Future use of Drum Road to access KTA is expected to be approximately 77 (36 company Level, 41 battalion level) legacy vehicles 12 times per year once the road is upgraded.

The following training restrictions apply at KTA:

- There is no live-fire training at KTA.
- KA-1 and KA-3 are off limits to military units during weekends and Federal holidays, except for brigade field exercises if coordinated through Range Division Hawaii.
- Live ammunition and aerial pyrotechnics (star clusters/parachute flares) are not authorized.
- Blank ammunition is authorized in all training areas with approval from Range Division Hawaii.
- Use of pyrotechnics, blank ammunition, and other ignition sources will be controlled by the Fire Danger Rating System for KTA.
- The use of pyrotechnics and simulators (including demolition effects simulators) requires approval from Range Division Hawaii.
- Range Division Hawaii may restrict the use of pyrotechnics based on the Fire Danger Rating System.

- Smoke and tear gas grenades, Hexachloroethane/Terephthalic Acid smoke, smoke generators, and ground simulators are allowed in all areas, except A-1 and A-3.
- Range Division Hawaii will authorize and apply safety buffer zones for Hexachloroethane smoke and tear gas grenades.[3] (*e.g.*, tear gas and smoke grenades restricted in an approximate 1000 m (3300 ft) buffer south of the northern perimeter of Training Areas B1 and B2).
- Smoke grenades will only be used in areas devoid of vegetation.

SBCT Training Actions Proposed at KTA

SBCT will include the construction of a state-of-the-art Combined Arms Collective Training Facility at KTA, consisting of a site-adapted 24-building facility to simulate a town. The "town" would contain mock buildings such as ware houses, schools, church, office building, hotel, police station, bank, and residences. Approximately 75 ha (187 ac) of earth movement would be associated with construction of the 227-ha (560-ac) facility which will also include simulated firing points, obstacles, targets, and other infrastructure. This facility will use short-range training ammunition, which is considered live-fire. One to 20 combat vehicles and 1-20 support vehicles would be used per exercise at KTA. Collective training exercises will be conducted 90-180 days per year.

Additional construction projects include a tactical vehicle wash facility with six wash stations with a new off-site water system. The water system would consist of two pump stations, each with motors and controls. The wash stations would utilize a high-pressure wash system and recycle water to minimize wastewater disposal. The water would flow through a water sediment basin, an equalization basin, oil-water separators, and then be deposited into a water supply reservoir. Treatment would include oil and grease removal, grit removal and organic control. A mechanical equipment building would be provided to house the mechanical secondary treatment units and the control panels necessary for the facility. Sediment recovered from the facility would be disposed of offsite. The vehicle wash station will remove dirt and invasive seeds prior to moving these vehicles to another installation.

Drum Road will be used through KLOA to access KTA which will facilitate movement of vehicles/troops to KTA while minimizing the use of Kamehameha Highway. Approximately 15-90 Strykers and 10-90 trucks/Humvees would be using the road approximately 12 times per year for SBCT training. However, the Drum Road upgrade by itself would not change training uses or patterns at KTA (more detail regrading the upgrade of Drum Road is found in the KLOA section).

Construction of two Fixed Tactical Internet antenna support structures with four antennas each is proposed to provide tactical communications infrastructure enabling units to train at any hour of the day or night. Existing antenna support structures and sites would be utilized when possible. The antennas are vertical whips approximately 5 cm (2 in) in diameter. Two antennas approximately 1.2 m (4 ft) long and two approximately 3 m (10 ft) long would be mounted on an antenna mast, utility pole, existing support structure, or building. Some of the antennas may have a red light at the top, in accordance with Federal Aviation Administration guidelines, to warn nearby aircraft. Each site

[3] Buffer information is listed in U.S. Army Hawaii, Regulation 210-6, Appendix F.

would be 6.1 x 7.6 m (20 x 25 ft), including a 4.6 x 6.1 m (15 x 20 ft) concrete pad for the support structure and shed. The mounted antennas would be 12.8 m (42 ft) and 31 m (102 ft) in height. Each site would be fenced and accessed via existing roads in all cases. No security lighting would be installed at the sites.

Live-Fire Ranges

Limited live-fire of special plastic simulations ammunition called short range training ammunition is proposed for the Combined Arms Collective Training Facility. No tracer ammunition would be used. Legacy units and the transformed brigade would conduct at least one major exercise each year that will involve at least two battalion-level (500 soldiers) attacks in the Military Operation in Urban Terrain site. Each brigade would conduct one field training exercise each year consisting of two-four battalion-size operations at the Combined Arms Collective Training Facility. Each battalion would also perform Military Operation in Urban Terrain operations at platoon and company levels (35 to 120 soldiers) at least once a year at KTA. The Marine Corps would train two battalions each year at the Combined Arms Collective Training Facility Military Operations Urban Terrain site. The overall estimate for the proposed KTA Combined Arms Collective Training Facility for 5.56 mm and .50 caliber short range training ammunition is 124,000 rounds per year, mainly within the buildings that make up the complex. The .50 caliber short range training ammunition will not be used at the Military Operation in Urban Terrain facility at KTA. A summary of blank ammunition, short-range training ammunition and pyrotechnics usage for current and proposed training is presented in Table 6.c of the Biological Assessment.

Non-Live-Fire Maneuver and Other Training Activities

Mounted and dismounted maneuver and Combined Arms Collective Training Facility training would be the primary activities carried out at KTA. Off-road vehicle maneuvers are anticipated to be very similar to Legacy training in terms of areas used, although a greater number of maneuver miles will be driven on an annual basis by the SBCT (see Chapter 2 of the Biological Assessment). Type of training in each training area would be the same for Legacy and SBCT training (see Table 6.a of the Biological Assessment). Field training can involve a wide variety of activities, such as vehicle movement, maneuvers, and convoys; foot maneuvers; bivouac; limited aviation training; and staff training exercises. Landing and pickup zones may be used by SBCT forces with support from the Aviation Brigade. Vehicle maneuvers are largely limited to the northern portion of KTA by steep terrain and dense woody vegetation. High-probability off-road vehicle maneuver areas include 437 ha (1,080 ac) out of a total area of approximately 5,199 ha (12,846 ac) in KTA (see Figure 6.c. and Table 6.b of the Biological Assessment). Most of the high probability area is located in the northern half of the installation within Training Areas A1, B1, B2, C1, C2 and D1. A few very small and disjunct areas that met maneuver criteria are remote and inaccessible to vehicles, and therefore would not be used. Almost all vehicle travel and a high proportion of dismounted training would occur within the high probability areas. As with current light infantry training, SBCT units driving Strykers and other wheeled vehicles would operate on existing roads and trails, as well as on off-road areas suitable for maneuver. One to 20 combat (*i.e.*, Stryker) vehicles and 1-20 support vehicles would be used per exercise at KTA. Collective training exercises will be conducted 90-180 days per year. Foot maneuver training is anticipated to be similar to current Legacy training.

Rules for allowable and prohibited live-fire and pyrotechnics (see Section 6.2 of the Biological Assessment) would be unchanged and would apply to all future Legacy and SBCT training, with the exception that short-range training ammunition (plastic bullets), which is considered live-fire, would be used at the urban training facility. As with Legacy training, exercises would continue to be at the squad through company level (9 to 120 soldiers). The use of higher elevation areas including Training Areas A1, A3, C1, C2, D1 and D2 is currently very limited due to the steep terrain and dense vegetation and would continue to be limited for SBCT for the same reasons. Landing zones and drop zones would continue to be used at similar levels as current training. General SBCT training would likely occur between 180 and 242 days per year.

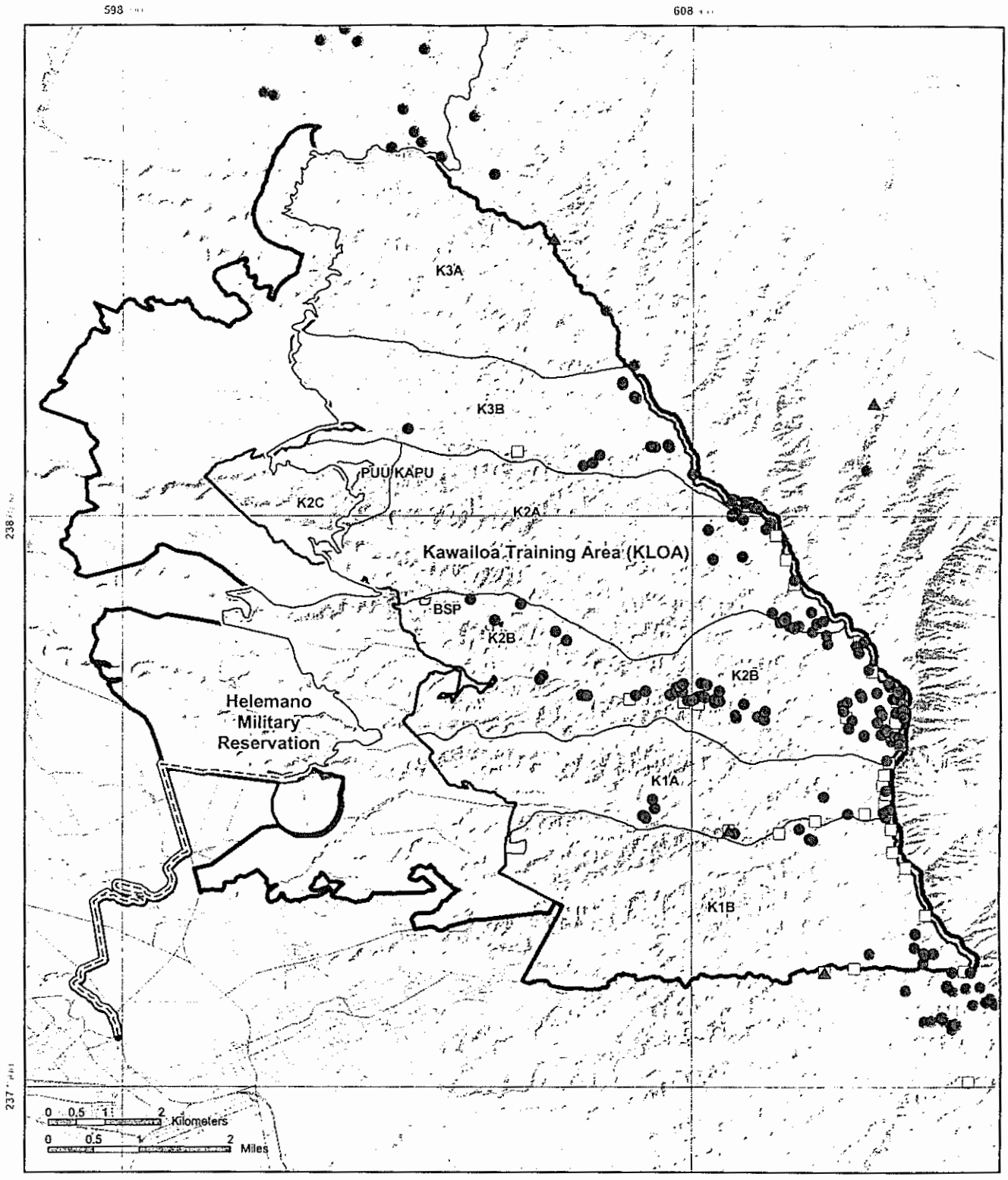
Kawailoa Training Area Training Actions

Legacy Training

KLOA is located in north-central Oahu on the western slope of the Koolau Mountains (see Figure 1). This is the Army's largest training area on Oahu and consists of 9,453 ha (23,348 ac) of land leased from Kamehameha Schools, Bishop Estate and other private landowners. A single unimproved roadway (Drum Road) traverses most of the western boundary (Figure 4), however, most training and land management activities use helicopters to transport people, equipment, and supplies. The installation is used primarily for helicopter aviation training, including long-range patrol, helicopter unit tactical training, and command post displacement up to company level (120 soldiers). Non-military uses permitted at KLOA include hiking, hunting, and camping.

Current helicopter usage averages approximately 78 flights per day. The installation is a desirable location for mountain and jungle warfare training because of its ravines and dense vegetation. Approximately 2,049 ha (5,064 ac) of the installation are considered suitable for maneuver (mounted and dismounted) training activities. The remaining area is considered less desirable for maneuver training activities due to excessively steep slopes and thick vegetation. In areas with slopes greater than 20 percent, troop deployment is typically limited to single file, small unit maneuvers along ridgelines and trails.

There are 7 training areas, 12 open and 7 closed landing zones, 3 landing zones on private lands west of KLOA, and 1 drop zone on KLOA (see Figure 4). No developed facilities exist at KLOA. Historical foot maneuver usage generally occurs in the immediate vicinity of Drum Road, Puu Kapu (Area K2C), Landing Zone Red (Area K2B), Landing Zone Black (Area K2B), and Landing Zone 1652 (Area K1B). Usage outside these areas is discouraged by rugged topography and dense vegetation. A summary of training types and annual usage (number of days and troops) for each training area at KLOA is presented in Table 7.a of the Biological Assessment. The average use of each training area ranges from 100 to 154 days per year and approximately 12,700 to 19,500 troops per year.



Installation
Action Area
Training Area
Drum Road
Helemano Road

Current Endangered Plants
Current *Oahu Elepaio*
Current *Achatinella* spp.

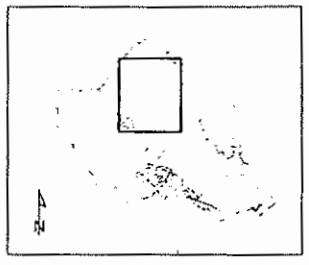


Figure 4

Scale = 1:100,000
UTM Zone 4, Old Hawaiian

Prepared by U.S. Fish & Wildlife Service, October 2003

The following training restrictions apply at KLOA:

- There is no live-fire on KLOA.
- Live ammunition and pyrotechnics (including smoke grenades, simulators, and fog oil) are not authorized.
- Agricultural lands are off-limits.
- All additional provisions of the lease agreement must be followed when requesting and using KLOA, which is leased land.
- Civilians have exclusive rights to KLOA during weekends and holidays. Weekend training may be authorized for brigade level and higher training, with coordination for approval 45 days prior to execution.
- 5.56 mm and 7.62 mm blanks are authorized.
- Cigarette smoking and cooking/warming fires will be authorized by Range Division Hawaii using the Fire Danger Rating System for KLOA.

Drum Road

One unimproved roadway, Drum Road, runs along the western boundary of KLOA providing vehicle access, but all other access is via foot or helicopter. Legacy units (mainly using Humvees) use Drum Road to access the KLOA training areas (by foot) from the west, occasionally support Landing Zone/Drop Zone operations, and as a route to KTA. Current use of Drum Road is very limited due to its poor condition. Foot trails lead from the Drum Road corridor to higher elevation areas accessible only by foot.

The proposed improvements to Drum Road from HMR through KLOA and KTA include paving about 37 km (23 mi) of road with asphaltic concrete, widening the road to 7.3 m (24 ft) to accommodate two lanes, providing 0.9-m (3-ft) compacted gravel shoulders on both sides, realigning dangerous curves to provide better/safer sight distances, regrading to correct steep slopes and provide better drainage structure and lines to preclude excessive amounts of storm run-off, and providing safety measures (*e.g.*, guard rails at drop offs, barriers, warning signs) where needed. In addition, some segments of Drum Road may require bridging or viaducts where the full width of the roadway cannot be accommodated on the existing terrain. Site work would include clearing, grubbing, grading, and stockpiling of material for embankments. Project actions include the construction of proper drainage features and adequate stream crossing culverts or bridging. This project can be considered as an interrelated action.

Drum Road Use

After improvements to the existing Drum Road, it will be the primary route used by Legacy and SBCT for the transport of equipment and soldiers mostly from SBMR to and from KTA and sometimes KLOA to support training as described for each training area. Once construction is completed the road will have the following approximate vehicle usage: Legacy forces will use Drum Road 12 times per year at the company level utilizing 36 trucks and at the battalion level using 41 trucks. SBCT force units will use 47 Strykers and trucks for company level and 217 Strykers and trucks for battalion level.

Training in KLOA

Dismounted training in KLOA is conducted by Legacy units at present and will also be conducted by elements of the SBCT. Typical operations involve small groups, from squad to platoon strength (9 to 35 soldiers). No live-fire is involved, and vehicles are driven on established roads and trails. The training is conducted between 20 and 40 times per year, in daytime and at night. Areas used for training are based largely on topographic and maneuverability constraints. Off-limits and restricted areas, impact areas, habitat and species protection areas, identified cultural resource sites, cantonment areas, and recreation areas are not used for reconnaissance training.

Maneuver also entails the set-up of temporary defensive positions to repel an enemy attack. Defensive positions may consist of soldiers lying in concealed positions and designating fire zones. More complex maneuver defense entails digging individual fighting positions or trenches using hand tools and digging in larger crew-served weapons using excavators. All digging must be approved through Range Control and Environmental Division. During extended maneuver training, soldiers may sleep in the field. To avoid detection and allow for quick displacement, tents are not set up during light infantry maneuvers.

Typical reconnaissance training operations involve small groups, from squad to platoon strength (9 to 35 soldiers). This type of training may take place in all types of terrain but can be constrained by extremely rugged terrain and thick vegetation. No live-fire is involved, and vehicles are not used. The training is conducted between 20 and 40 times per year, in daytime and at night.

Hunters and hikers are also allowed access when the area is not scheduled for training purposes (lease para. 16). Nap-of-the-Earth helicopter flights are not permitted outside of KLOA boundaries due to the presence of cattle ranches on adjacent lands.

SBCT Training Actions Proposed at KLOA

No construction for Transformation is planned on KLOA proper. The military vehicle trail terminates at the western edge of KLOA and troops will continue north using Drum Road (see Figure 7.b and Table 6.b of the Biological Assessment).

Non-Live-Fire Maneuver and Other Training Activities

KLOA would continue to be used at current levels primarily for helicopter aviation training, including long-range patrol, helicopter unit tactical training, and command post displacement. The installation is a desirable location for mountain and jungle warfare training because of its ravines and dense vegetation. Authorized and prohibited uses of pyrotechnics on KLOA would be unchanged from those listed. Because most of the area is considered unsuitable for maneuver training activities due to excessively steep slopes and thick vegetation, it would continue to be used in a very limited fashion. Dismounted training in KLOA would be conducted by Legacy units. Typical training operations would involve small groups, from squad to platoon (9 to 35 soldiers) strength. No live-fire or pyrotechnics would be used, and vehicles would not be driven off established roads and trails. The training would be conducted between 20 and 40 times per year, in daytime and at night. In

areas with slopes greater than 20 percent, troop deployment would typically be limited to single file, small unit maneuvers along ridgelines. Troop transport would be primarily via helicopter, and the same landing zones and drop zones would be used by Legacy units. Highest levels of foot maneuver usage would generally occur in the immediate vicinity of Drum Road, Puu Kapu (Area K2C), Landing Zone Red (Area K2B), Landing Zone Black (Area K2B), and Landing Zone 1652 (Area K1B). Usage of Drum Road would increase with upgrades planned for the route and SBCT training frequency and types of training associated with landing zones and the drop zone would be unchanged.

SBCT use of KLOA would be confined to vehicular use of the military vehicle trail from SBMR to HMR, and subsequently north toward KTA via Drum Road. Approximately 15-90 Strykers and 10-90 trucks/Humvees would be using the road approximately 12 times per year for SBCT training. However, the Drum Road upgrade by itself would not change training uses or patterns at KLOA. Some limited dismounted maneuvers may occur but little training is planned for SBCT forces in KLOA.

Makua Military Reservation Training Actions

Legacy Training

MMR is located in an amphitheater shaped valley south of Kaena Point in northwestern Oahu (see Figure 1). It is approximately 1,696 ha (4,190 ac) in size and is a significant live-fire facility for Legacy training. MMR is considered an important but nonessential part of SBCT training. SBCT forces will use MMR after the completion of the MMR Environmental Impact Statement (EIS) and Record of Decision if the range is available. MMR will greatly facilitate dismounted Combined Arms Live-fire Exercise throughput and flexibility for all divisional units.

The impacts of routine military training on MMR were addressed in a section 7 consultation with the Service in 1999 and a supplement to the original biological opinion that covered additional species found in the action area and was issued in 2001. To offset the effect of Army training and to address the potential loss of listed species from fire (resulting from training), a "stabilization" system was devised by a joint biological working group that determined what actions were necessary to stabilize each taxon. This resulted in an Implementation Plan for Makua (finalized May 2003) that will result in the stabilization of 27 endangered plant taxa and one snail species. For a taxon to be considered stabilized, each taxon must be maintained with sufficient numbers of population units to ensure their long-term viability. Additionally, threats to the managed and reproducing individuals in each population unit must be controlled, and each taxon must be adequately represented in an *ex situ* collection.

SBCT Transformation training will not alter the way that training will be conducted and Stryker vehicles will not be used at MMR, the impacts to species associated with future training will not change from what was analyzed in the original biological opinion and supplement. Therefore, impacts to species at MMR will not be addressed further in this consultation.

Schofield Barracks East Range Training Actions

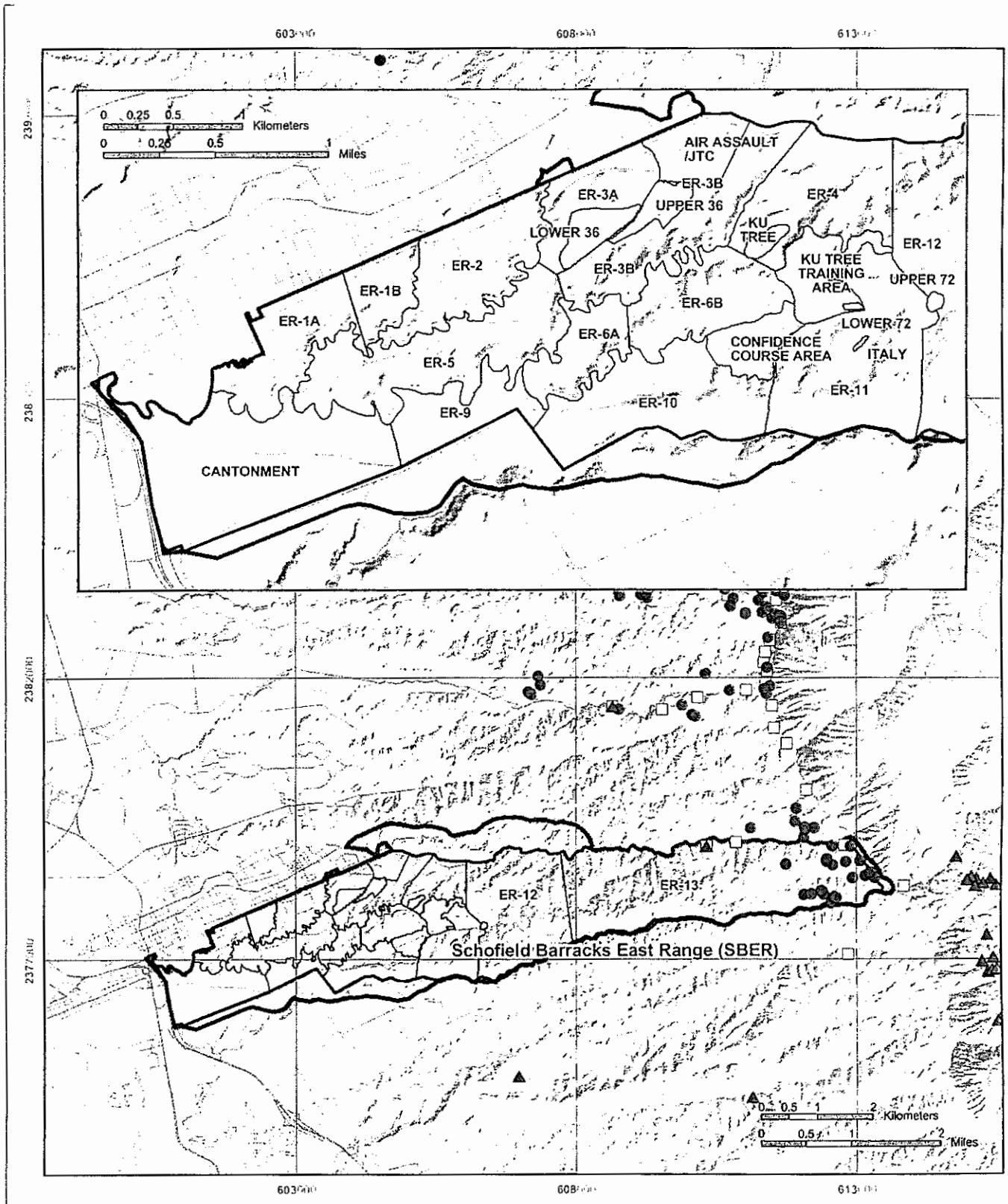
Legacy Training

SBER is located in central Oahu (see Figure 1) and extends east of Kamehameha Highway to the crest of the Koolau Mountains where it borders the Kahana Valley State Park. This installation is approximately 2,086 ha (5,154 ac) in size and quite varied in topography and elevation. The western portion of SBER is mostly gently sloping open areas with mixed cover of grass, shrubs and native trees, separated by steep drainages. The eastern portion is extremely rugged and densely forested with limited road access. For this reason, use of higher elevation areas including Training Areas ER-12 and ER-13 has been limited in the past (Figure 5).

Approximately 776 ha (1,917 ac) in east range is considered suitable for maneuver training. The western maneuver area is valuable for rappelling, jungle survival, and patrolling operations. Several open areas are used for air assault and airborne operations. Training uses include limited battalion and company-level (120 to 500 soldiers) missions including maneuver and bivouac activities. A summary of training types and annual usage (number of days and troops) for each training area at SBER is presented in Table 9.a of the Biological Assessment. The average use of each training area ranges from 78 to 120 days per year and approximately 5,600 to 20,500 troops per year, and would continue to be used in the future at similar levels by Legacy and SBCT forces.

Activity at SBER will include small unit maneuvers and combat support training, mounted maneuver training with Humvees, cargo trucks, trailers, and convoys as well as foot training, bivouacking, and aviation training. Vehicle maneuvers are constrained by topography and vegetation (and other applicable constraints), whereas foot maneuvers occur anywhere that safety and administrative restrictions permit including the high probability vehicle maneuver areas. No live-fire training will occur on this installation. Pyrotechnics use will occur anywhere that dismounted (and/or mounted) training occurs in accordance with rules for pyrotechnics use at SBER. Rappelling training usually occurs on short cliffs near roads and at the rappelling tower facility at SBER. No rappelling is done in training area ER-13. Reconnaissance units may travel along ridgelines in the upper areas of ER-12 and ER-13.

Vehicle maneuvers are limited to the western portion of east range by steep terrain and dense woody vegetation. There are no areas that can support off-road vehicle travel in ER-12 and ER-13. High-probability off-road vehicle maneuver areas include 214 ha (530 ac) out of a total area of approximately 2,727 ha (6,739 ac) in SBER (see Table 9.b of the Biological Assessment). Training areas ER-1A, ER-2, ER-5 and ER-10 have the most high probability area (see Figure 5, insert). A few very small and disjunct areas that met maneuver criteria are remote and inaccessible to vehicles, and therefore are not used. Nearly all vehicle travel, and a high proportion of dismounted training occurs within the high probability areas. These areas (*i.e.,* locations of use) are the same for Legacy and SBCT training. Legacy forces operate wheeled vehicles on existing roads and trails, as well as on off-road areas suitable for maneuver. Existing roads traverse portions of the higher eastern training areas ER-12 and ER-13, and account for some of the usage documented for those training areas. In the year 2000, the average use of SBER was five vehicles for approximately 141 days.



Installation
Action Area
Training Area

Current Endangered Plants
Current *Oahu Elepaio*
Current *Achatinella* spp.

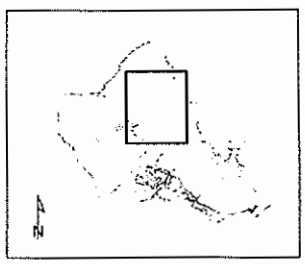


Figure 5

Scale = 1:100,000
UTM Zone 4, Old Hawaiian

Prepared by U.S. Fish & Wildlife Service, October 2003

Once every two years, a major training exercise is held on the range. The exercise runs for two weeks and approximately 200 vehicles are utilized each day.

Aviation training consists of air assault school training, aviator training missions, and air assault operations on a daily basis. Night operations occur approximately eight times per week. In addition to flight training, fixed wing aircraft and helicopters provide support for drop and landing zone activities, respectively.

The following training restrictions apply at SBER:

- Small arms (5.5.6 mm and 7.62 mm) blank ammunition is permitted throughout SBER, with the exception of training areas ER-1A, ER-1B, ER-2, ER-3A, and ER-3B during the hours of 1800-0600 daily. Noise producing simulators or pyrotechnics are not authorized in these areas at any time.
- Fog oil generation is permitted in ER-6B, ER-11, ER-12, and ER-13 only. This training is done on roads.
- Tear gas grenades are not authorized.
- The use of pyrotechnics and simulators (including demolition effects simulators) requires approval from Range Division Hawaii.
- Range Division Hawaii may restrict the use of pyrotechnics based on the Fire Danger Rating System for SBER.
- Pyrotechnics, including smoke grenades, Hexachloroethane/Terephthalic Acid smoke are authorized in all training areas except ER-1A, ER-1B, ER-2, ER-3A, and ER-3B.
- No aerial pyrotechnics (star clusters/parachute flares) are permitted.
- Range Division Hawaii will authorize and apply safety buffer zones for Hexachloroethane smoke.[4]
- Colored smoke grenades are allowed in ER-5, ER-6A, ER-6B, ER-10, ER-11, ER-12, and ER-13.
- Smoke grenades will only be used in areas cleared of debris and grass to reduce the risk of fire.
- All ignition sources will be controlled by the Fire Danger Rating System.

<u>SBCT Training Actions Proposed at SBER</u>

SBCT training will be very similar to current training activities. No live-fire exercises or other activities that significantly increase the risk of fire will occur on SBER. Regulations governing the use of pyrotechnics will remain unchanged. The number of vehicles, days of use, and soldiers will likely increase with SBCT training compared to Legacy training; however, similar activities are anticipated to occur in similar areas. Use of 5.56 mm and 7.62 mm blanks is projected to decrease significantly in Training Areas ER-1A, ER-1B,ER- 2, ER-3A, ER-3B, ER-4, ER-5, ER-6A, ER-6B, ER-11,

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[4] Buffer information is listed in U.S. Army Hawaii, Regulation 210-6, Appendix F.

ER-12, and ER-13. Use of .50 caliber blanks is projected to increase significantly in all Training Areas. Vehicles would be washed before leaving SBER. The proposed vehicle wash rack would minimize spread of undesirable species to other installations.

Military Vehicle Trail (SBMR to HMR)

The proposal is to purchase approximately 6.8 ha (17 ac) of land in a perpetual easement and construct a 4.5 m (15-ft) wide gravel road with a 0.9-m (3-ft) wide gravel road with shoulders on both sides that would provide safe military vehicle access from SBMR to HMR. In conjunction with Drum Road, this project would provide a road network from SBMR to KTA (see Figure 4). This proposed project would be sited from SBMR to the HMR for approximately seven miles. It would be north of Wahiawa and would use as much of the existing agriculture roadways as possible. Work includes grading, paving, drainage improvements, culverts at stream crossings, guardrails, shotcrete, retaining walls, concrete swales, grass swales, signage, and storm drainage structures and lines to preclude excessive amounts of storm runoff from sheet flowing over the road and endangering vehicular traffic on the road. Road grades steeper than 10 percent will be paved with asphalt or concrete. Supporting facilities will include provisions for information systems. The corridor of disturbance associated with the trail construction will vary with terrain and existing road features, but will not extend significantly outward from the trail shoulders, especially where the alignment follows existing roads.

Construction projects with SBCT include a tactical vehicle wash station with six wash stations with a new off-site water system. The construction and use of this wash station is similar to wash stations previously discussed for other installations. It will utilize a high-pressure wash system and recycle water to minimize wastewater disposal including a water sediment basin, an equalization basin, oil-water separators, and a water supply reservoir. A mechanical equipment building will be provided to house the mechanical secondary treatment units and the control panels necessary for the facility. Sediment recovered from the facility will be disposed of offsite. The project will help prevent the spread of non-native and invasive plant seeds to other areas outside of SBER and reduce the amount of soil that may be tracked onto the public highway system.

The construction of a Fixed Tactical Internet antenna on SBER is similar to antenna structures discussed for other installations. On SBER, two antennas approximately 1.2 m (4 ft) long and two approximately 3 m (10 ft) long will be mounted on a new support structure which will make the final height of the antennas both 31 m (102 ft). These antennas may have a red light at the top, in accordance with Federal Aviation Administration guidelines to warn nearby aircraft. Each site will be fenced and accessed via existing roads in all cases. No security lighting will be installed at the sites.

Non-Live-Fire Maneuver and Other Training Activities

Only blank ammunition will be used in a variety of field training exercises. Blank ammunition estimates under Legacy and Transformation for SBER are presented in Table 9.c of the Biological Assessment. The rules for allowable and prohibited live-fire and pyrotechnics use at SBER will

remain unchanged (see Section 9.1.2 of the Biological Assessment). Non-live-fire training will be very similar to current training activities. On average, each training area is used between 78 and 120 days per year, and will continue to be used in the future at similar levels by Legacy and SBCT forces. The western portion of SBER will continue to be used for rappelling, jungle survival, and patrolling operations. Landing and drop zones will continue to be used for air assault/movement and airborne operations. Unit uses will include limited battalion and company-level training missions including maneuver and bivouac activities. Squad and platoon (9 to 35 soldiers) activities will continue in the current dispersed manner. The use of higher elevation areas in the eastern portion of SBER, including Training Areas ER-12 and ER-13, will continue to be limited for foot maneuvers by extremely rugged terrain and dense forest vegetation.

Unit uses include limited company to battalion level (120 to 500 soldiers) missions including maneuver and bivouac activities. The breakdown of maneuver miles by training area is not available for Legacy or SBCT units. High-probability off-road vehicle maneuver areas at SBER include 214 ha (530 ac) out of a total of approximately 2,727 ha (6,739 ac) on the installation (see Figure 9.c of the Biological Assessment). The areas meeting off-road maneuver criteria are located in the western half of SBER on broad, unforested ridges and other suitable areas. Several small areas at higher elevations in the eastern part of the installation are inaccessible to vehicles even though they are shown on the map. As with Legacy training, most vehicle maneuver training is confined to established roads and trails, but some off-road travel could occur where trafficability and vegetation permits, typically in areas with past use. The breakdown of high-probability maneuver areas by training area is presented in Table 9.b of the Biological Assessment. Legacy and SBCT units will wash vehicles using the proposed vehicle wash rack before leaving SBER.

Schofield Barracks Military Reservation Training Actions

Legacy Training

SBMR is located in central Oahu and comprises 3,506 ha (8,663 ac) and it is divided from SBER by Kamehameha Highway (see Figure 1). SBMR is bordered to the north by Mount Kaala Natural Area Reserve, to the west by Waianae Kai Forest Reserve, and to the south by Lualualei Naval Reserve, and private and state lands. SBMR consists of two ranges (West and South), the impact area and a cantonment area. Non-military uses include hiking and hunting.

SBMR is the primary range complex for individual weapons qualification with limited light maneuver training areas. Primary users of SBMR include Army, Marine Corps, Hawaii Army National Guard, and Army Reserve units. The SBMR master plan designates approximately 500 ha (1,235 ac) as suitable maneuver training (South Range) and an additional 610 ha (1,506 ac) to support ranges and indirect fire activities. Approximately 858.3 ha (2,120 ac) is suitable terrain for mounted and dismounted maneuvers. Small unit maneuvers and combat support training include non-live-fire, mounted maneuver training with Humvees, cargo trucks, trailers, and convoys as well as foot training, bivouacking, limited aviation training, and staff training exercises. The size of bivouac areas can range from 100 x 100 m (330 x 330 ft) for a squad or platoon (9 to 35 soldiers) to 300 x 300 m (985 x 985 ft) for a company size bivouac (120 soldiers).

The fixed ranges are grouped into two areas: West Range and South Range (Figure 6). West Range, located north of Trimble Road, includes the impact area and surrounding fire break road. South Range, south of Trimble Road, contains range and maneuver land and serves as the maneuver corridor to the Infantry Battle Area. Within West and South Ranges are various fixed smaller areas where live-fire and non-live-fire training occur. A list of Schofield ranges and authorized ammunition is presented in Tables 10.a-d of the Biological Assessment. With the exception of the Infantry Demolition and Hand Grenade range, all high explosive and tracer ammunition is fired into the impact area in the West Range area. The following rules for allowable and restricted live-fire and pyrotechnics use apply at SBMR South Range Training Area Complex (applies to 10 sub-areas: SR-1, SR-2A, SR-2B, SR-3, SR-5A, SR-5B, SR-5C, SR-5D, SR-6A, SR-6B, see Figure 10a in the Biological Assessment). All other pyrotechnics and live-fire training on SBMR occurs on live-fire ranges. There are nine open landing zones and one landing/drop zone on SBMR.

The following training restrictions apply at SBMR:

- Aerial pyrotechnics (star clusters/parachute flares) and tear gas grenades are not authorized.
- Blanks are authorized at South Range.
- All training at Schofield Barracks Main Post, including South Range is regulated by the Fire Danger Rating System for SBMR. Weapons systems that pose the highest risk of fire will be authorized only under the most benign fire danger category (see Enclosure 7 to Annex A of the WFMP for details). These weapons include tracers, pyrotechnics, and white phosphorous mortar and artillery rounds. Under the highest fire danger category, no weapons systems are allowed with the exception of ball ammunition for direct fire weapons on the Central and McCarthy Flats ranges only. These ranges are heavily manicured to minimize the spread and intensity of any fire and it is extremely unlikely that ball ammunition could cause an ignition. The use of pyrotechnics and simulators (including demolition effects simulators) requires approval from Range Division Hawaii.
- Range Division Hawaii may restrict the use of pyrotechnics through the Fire Danger Rating System.
- Smoke grenades are allowed in all ten sub-areas.
- Smoke grenades will only be used in areas devoid of vegetation.

A summary of training types and annual usage (number of days and troops) for SBMR training facilities and South Range training areas is presented in Table 10.a in the Biological Assessment. The average use of each South Range training area ranges from 34 to 114 days per year and approximately 1,650 to 20,800 troops per year. Ammunition usage at SBMR is presented in Tables 10.b - 10.d in the Biological Assessment.

Artillery firing points are located on SBMR. Mobile howitzers are towed by a Humvee or truck to a designated point. Once at the firing point, the gun crew positions the gun tube to fire on a designated target. These points also support use of mortars.

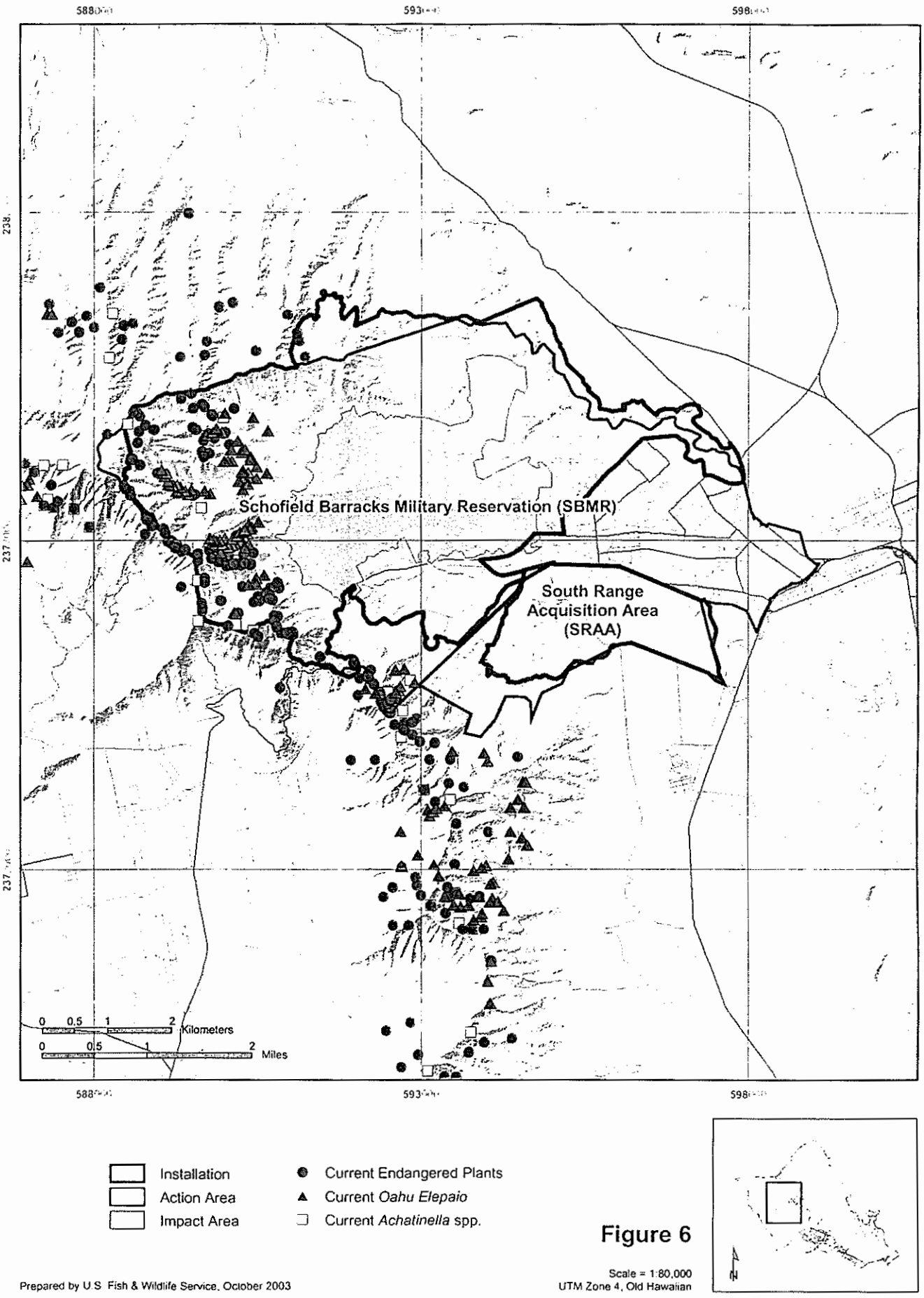

Figure 6

Prepared by U.S. Fish & Wildlife Service, October 2003

Scale = 1:80,000
UTM Zone 4, Old Hawaiian

The Infantry Battle Area provides maneuver training under live-fire support, and includes the following ranges: Infantry Battle Course (KR-5), Live-Fire Trench, Live-Fire Village, Ambush Site 2, Pointman Course 2, and KR-6 Squad Defense Course. Units can fire the following on the Infantry Battle Area: 5.56 mm, 7.62 mm, 9 mm, 40 mm TP grenades, AT-4 anti-tank missiles, 7.62 mm, Claymore mines, demolition effects simulators, Bangalore, 60/81 mm short range training ammunition, Javelin/TOW (Inert), Grenades (CS/HC/SMK), 7.62 mm door gun, aerial gunnery.

Artillery and Mortars

Artillery and mortars are fired from designated firing points. The range of artillery and mortars varies with the amount of propellant charge used. Artillery firing (105 and 155 mm howitzer cannons) is limited to a charge of three to ensure that the weapons will not overshoot the Schofield Barracks ridgeline (*i.e.*, western SBMR boundary). In this way, ammunition (and especially high explosive ammunition) is also more likely to land within the fire break road and the impact area. In addition, units are required to pick up a range card from Range Control that lists the right and left limits and the minimum and maximum range allowed for each firing point and weapon. Maximum allowable charges and distance of artillery firing is listed in Appendix A (U.S. Army 2003a). However, even with these measures in place, ammunition does land outside the impact area.

Small Arms

For small arms ranges that utilize tracers, the ranges are laid out so that tracer burnout occurs before a round leaves the impact area. However, in most cases, since small arms firing is concentrated on targets that are rather close in, the highly disturbed area where most projectiles impact is located immediately around the target area. It is highly unlikely that small arms ammunition would cross the fire break road but if it does, the distance to the fire break road ensures that tracer burnout occurs before then. Tracer burnout distances are listed by ammunition type in Appendix A, Legacy and SBCT Vehicles, and Weapons Systems.

The complete list of weapons and ammunition is shown in Table 10.f in the Biological Assessment. Descriptions of weapons ammunition, and pyrotechnics are provided in Appendix A. Tracer ammunition is the primary cause of fires started within the impact area. This is due to the incendiary nature of the ammunition and the high number of tracers fired relative to other high fire-ignition munitions. Most tracer bullets land near target areas inside the fire break road and all tracer ammunition burns out within the impact area.

Training is planned and executed in accordance with 25th Infantry Division (Light) and U.S. Army Hawaii Regulation 210-6, Installations, Ranges, and Training Areas (Army 2003a). In addition, Standard Operating Procedures for each live-fire range at SBMR are being updated and consolidated into a single Standard Operating Procedure at this time. Existing Standard Operating Procedures outline the safety precautions that soldiers must follow to prevent fires from starting outside the fire break road. The new Standard Operating Procedure and the WFMP will include additional specific fire minimization and suppression procedures that will be followed by range personnel and soldiers. It will also provide additional procedures to protect biological and archaeological resources.

SBCT Transformation

Major changes to live-fire activities include the addition of direct fire gunnery[5] (Mobile Gun System), collective live-fire by the mobile gun system and Stryker vehicle variants. Changes in ammunition usage for all SBMR ranges combined are summarized in Table 10.h of the Biological Assessment. Ammunition usage of the Mobile Gun System is not yet known. Significant changes in ammunition usage include a decrease in 5.56 mm ball and tracer ammunition, increases in other small arms ball and ammunition except for 9 mm ball ammunition, increases in most grenade and mortar ammunition, and increases in 155 mm artillery use.

The following construction projects are planned as part of the proposed action:

1. McCarthy Flats Multi-Purpose Qualification Complex: This complex supports qualification for: Pistol(38 caliber, 9 mm, 45 caliber) Shotgun and rifle (M16, M4, M14 sniper rifle, M21, M24); and Machine gun (M60, M249, M240B, M2). Training at Qualifying Training Range 1 is anticipated to disturb approximately 49 ha (120 ac). The range would be used between 180 and 242 days per year. No combat (*i.e.,* Stryker and Humvee) vehicles would be in service at the range, but between five and ten support vehicles (trucks) would be used per training episode per day.

2. Battle Area Complex: This complex incorporates all weapons intrinsic to the SBCT Infantry Company (except the Javelin) and allows a variety of live-fire exercise scenarios. Training at the Battle Action Course is anticipated to impact approximately 840 ha (2,075 ac). Operations will be conducted by moving/stationary vehicles and/or dismounted personnel against simulation systems. This will include: 2-4 course roads with crossover capability, 22 stationary armor targets, 3 moving armor targets, 167 stationary infantry targets, 27 moving infantry targets, 16 machine gun/observation bunkers, 2 grenade/breaching obstacles, 3 landing zones, 13 mortar simulation devices, 8-16 vehicle firing positions/hull-down defilades and range operations support facilities. Supporting facilities will include site improvements, erosion control, a bivouac area, electrical service, security fencing and gates. The Battle Action Course is anticipated to use combat vehicles between 5 and 21 days per year and support vehicles between 4 and 8 days per year.

3. Urban Assault Course and Training Facility: This project will develop an urban assault course, shoot house, breach facility and the necessary support facilities on an existing military operations in urban terrain assault course. Training at the Urban Assault Course Training Facility is anticipated to impact approximately 6 ha (14 ac). The project footprint would approximate that of the existing military assault course facility on SBMR. The complex would support use of 5.56 mm and 5.56 mm blanks, 40 mm TP grenades, practice grenades, 7.62 mm blanks, smoke grenades, and simulators. The breach facility would be used to train soldiers in the proper techniques to enter buildings through doors, windows,

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[5] Direct fire gunnery traditionally refers to mechanized or tank firing using large caliber guns where the target is in view of the gunner. The Stryker-mounted 105 mm gun would be used at the Battle Area Course.

and walls. The urban assault training facility would train soldiers in other techniques associated with urban combat, including underground training. The live-fire shoothouse would be used to train individuals, squads (9 soldiers), and platoons (35 soldiers), on the proper techniques to enter and clear a building. The facility will be used between 75 and 150 days per year. Support vehicles would be used in training activities between three and five days per year.

4. Range Use: Individual and collective weapons qualification and training will take place on new ranges (*i.e.,* Battle Area Complex, Qualifying Training Range 1 and 2, and combined-arms Military Operations on Urban Terrain training facility) and existing ranges, other facilities, and artillery/mortar firing points. The proposed Battle Area Course will support up to company-level (120 soldiers) Combined Arms Live-Fire Exercise training, with some battalion-level (500 soldiers) exercises possible. Small arms training formerly conducted at McCarthy Flats qualification Ranges 3 and 4, will move to the Qualifying Training Range 2 on the new South Acquisition Area. Because no dud-producing munitions will be used on this range, there are no safety hazards associated with the surface danger zone when the range is not in operation. Therefore, the Qualifying Training Range 2 surface danger zone (*i.e.,* range safety fan) would be accessible for natural resources management and range maintenance approximately 210 days per year. The layout of the planned future fire break with respect to the Qualifying Training Range 2 surface danger zone would allow continuous access (365 days per year) by The Nature Conservancy, Hawaii, to their lands via the planned fire break. There would be no mortar or artillery firing from SRAA. A range usage comparison for one Legacy and one SBCT Brigade is presented in Section 2.6 of the Biological Assessment. Changes in live-fire range use at SBMR are summarized in Table 10.g of the Biological Assessment for individual ranges. Table 10.h of the Biological Assessment summarizes anticipated changes in ammunition usage for all SBMR ranges combined.

Other construction projects include a Range Control Facility, Fixed Tactical Internet antennas, and a virtual fighting training facility. The Range Control facility will be constructed within the cantonment area and will not impact any natural resources. Construction of seven Fixed Tactical Internet antenna support structures with four antennas each between 18 to 31 m (60 to 102 ft) in height. No security lighting will be installed at the antenna sites. The virtual fighting training facility will house war-fighting simulation operations to support small arms marksmanship and dismounted weapons system training. The building would be constructed within the SBMR cantonment area on the south side of Trimble Road.

Non-Live-Fire Maneuver and Other Training Activities

Legacy and SBCT units will use SBMR for tactical infantry training, including land navigation training, and will also use other facilities inside and outside the cantonment area. Such training would include non-live-fire mounted and dismounted maneuver training (*e.g.*, using Strykers, Humvees, cargo trucks, etc.) on South Range sub-areas. The primary use of SBMR will continue to be for weapons qualification, live-fire training, and Military Operations on Urban Terrain training. Training

will continue to include establishing tactical and logistics operations and administrative centers, as well as smaller and more dispersed activities such as bivouac. As with Legacy, training by Army and other units, most training will be at the squad through company (9 to 120 soldiers) level, with some opportunities for larger-scale training. General SBCT training will occur between 180 and 242 days per year. At South Range, all mounted and dismounted maneuver will take place within the boundary of the planned future fire break road. The currently/previously disturbed areas (agricultural fields and access roads) within the parcel will be used for walking (foot maneuvers) and driving administratively between locations. However, units would not conduct Stryker training maneuvers within the proposed acquisition area and will be limited to travel in previously disturbed areas dominated by non-native vegetation at low elevations. Smoking on the Qualifying Training Range 2 will be restricted to designated areas away from vegetation fuels adjacent to forested areas.

South Range Acquisition Area Training Actions

SRAA is located in central Oahu (see Figure 1) and is bordered on the north by SBMR (see Figure 6) to the east by Wheeler Army Air Field, to the south by Del-Monte Fields and The Nature Conservancy Honouliuli Preserve, and to the west by the Waianae Mountains. The SRAA is a proposed new land acquisition and therefore, military training by Legacy forces has not occurred. Non-military use includes guided hikes and environmental education by The Nature Conservancy on the Honouliuli Preserve portion of the parcel.

SBCT Training Actions Proposed at SRAA

The following two projects will be located on the SRAA:

1. South Range Multi-Purpose Qualification Range: This complex supports qualification for shotgun (38 caliber, 9 mm, 45 caliber) and rifle (M16, M4, M14 sniper rifle). This project includes construction of a qualification training range complex to support marksmanship training. No tracer ammunition will be used at the proposed range. Training at Qualifying Training Range 2 is anticipated to disturb approximately 49 ha (120 ac). The proposed range will be used between 180 and 240 days per year. No combat vehicles will be used. Five to 10 support vehicles would be used per training event per day.

2. Brigade Motor Pool: This project includes construction of a brigade consolidated maintenance facility consisting of standard organizational and direct support vehicle maintenance shops. Supporting facilities include: water, sanitary sewer, storm drainage, electric service, exterior lighting, fire protection and alarm systems, telephone, paving, walks, curbs, gutters, parking, roadways, information systems, and site improvements. Construction of these new facilities is required to bring the motor pools up to current Army standards and also to accommodate the future needs of the Army's Transformation mission. The vehicle maintenance shop will support maintenance personnel and parking for the unit's estimated 1,354 vehicles.

Live-Fire Range Use

All live-fire activities will take place at the new qualification training range. Live-fire use will be ball ammunition with small arms. All tracers are prohibited due to fire risk and 5.56 and 9 mm ball

ammunition have a very low potential for starting fires. Table 11.a of the Biological Assessment presents proposed ammunition usage by range for SRAA. The frequency of use for the Qualifying Training Range 2 would be approximately 150 days per year. Since there would be no dud-producing munitions used on this range, approximately 210 days would remain for the Qualifying Training Range 2. As stated previously, The Nature Conservancy of Hawaii would be able to have unlimited and continuous access to the Honouliuli Preserve via the future proposed fire break.

The following training restrictions would apply at SRAA:

- No tracers would be allowed at SRAA; ammunition is restricted to ball only.
- Only direct-fire weapons (rifles, pistol, shotgun) will be fired on the Qualifying Training Range 2.
- No indirect fire weapons (howitzer canons, mortars) will be used.
- No training, including mounted and dismounted maneuvers, will be allowed outside of the future planned fire break road.
- All training will be regulated by the Fire Danger Rating System for SRAA.
- Under the lowest fire danger category all weapons authorized for use at SRAA will be allowed.
- Ball ammunition will be allowed on the Qualifying Training Range 2 under the highest fire danger category because the range will be heavily manicured to minimize the spread and intensity of any fire and ball ammunition has an extremely low ignition probability.
- Smoking will be restricted to designated areas away from vegetation fuels next to the forest.
- Pyrotechnics will be restricted under the middle category, and all ignition sources including smoking and cooking/warming fires, but not including ball ammunition, will be restricted under the highest Fire Danger Rating System.

Non-Live-Fire Maneuver and Other Training Activities

The SRAA primarily supports qualification range usage and the proposed brigade motor pool. No other facilities are currently planned for construction. Non-live-fire training activities in the proposed parcel include mounted and dismounted maneuvers, the use of maneuver corridors, and small unit activities such as bivouac, and combat service support operations in agricultural areas at lower elevations. Areas would be accessed using existing roads and trails, and limited off-road maneuvers may occur.

Summary of Changes in Training Activities as a Result of Transformation at SRAA

Small-arms, live-fire qualification range and non-live-fire activities will be concentrated at lower elevations, with potential for dismounted maneuvers and small unit activities all within the proposed future firebreak. No tracer ammunition will be used at the proposed range. Vehicular access above the developed (formerly agricultural) area is nonexistent.

Other Proposed SBCT Training Action Locations

Wheeler Army Airfield

The 25th Infantry Division Aviation Brigade consists of two aviation battalions, one reconnaissance squadron, one medical evacuation company, and one aviation intermediate maintenance company. The Aviation Brigade is equipped with 108 helicopters, 280 land vehicles, and 1,000 soldiers who work at Wheeler Army Airfield and are housed there and at SBMR.

Upgrade Wheeler Army Airfield for C-130 Operations

The proposed project would repair the existing aircraft parking apron which would strengthen the apron to accommodate C-130 aircraft staging operations to support SBCT training and rapid deployment. Currently, the apron areas are structurally inadequate for loading C-130 aircraft which restricts airfield operations.

Multiple Deployment Facility at Wheeler Army Airfield

The proposal is to construct a Multiple Deployment Facility to support deployments from multiple airfields. This proposed facility will be on a previously disturbed site south of Airdrome Road on an abandoned airstrip at Wheeler Army Airfield. Three existing buildings will be demolished as part of this project. The facility includes a deployment marshaling area, pre-fabricated guardhouses and document control station, wash rack, de-fuel shed, scale houses, joint inspection area, vehicle maintenance shelter, vehicle holding area, alert holding area and contingency warehouse.

Hickam Air Force Base

Hickam Air Force Base is on the south side of Oahu approximately 14.5 km (9 mi) west of downtown Honolulu. It consists of 1,153.4 ha (2,850 ac) of land and facilities, sharing its runways with adjacent Honolulu International Airport. Hickam Air Force Base and Hawaii International Airport constitute a single airport complex operated under a joint-use agreement.

The SBCT Transformation will not result in any changes at Wheeler Army Airfield or Hickam Air Force Base, or result in any adverse affects to federally listed species. These areas are already heavily impacted by human development, dominated by alien plant species, and there are no known federally listed species present.

Wildland Fire Management Plan Overview

The WFMP is a key component of this consultation in order to achieve the overall goal of reducing the risk and impact of wildfires by limiting their frequency, size, and severity while still allowing military training. The WFMP provides comprehensive documentation of the plans, policies, methods, and actions necessary to achieve this objective. The document also describes the current fire situation in Hawaii, and on Army lands specifically, including a summary of fire effects and the available fire history for each installation. It goes into some detail describing fire prevention, preparedness planning, and suppression response.

One of the top priorities is implementation of a Fire Danger Rating System. The WFMP establishes a Fire Danger Rating System for each installation that is tailored to the specific military uses found there and the local weather and fuel conditions. Weather readings are taken every hour by remote automated weather stations placed at the installation. This information is immediately available to Army Range Control, who use the output from the remote automated weather stations to determine the level of fire danger. This, in turn, determines any restrictions placed on military training for that hour, as set by the WFMP. Restrictions are relayed to troops in the field via radio transmission. By restricting highly fire prone activities during periods of high fire danger, the likelihood of a fire start is

reduced. Additionally, fires that are ignited, are more likely to occur during periods of low or moderate fire danger, making them easier to control and extinguish.

The WFMP also lays out locations and standards of fire breaks and fuel breaks. Fire breaks are similar to 4-wheel drive roads and are cleared of all vegetation to mineral soil. Fuel breaks are swaths of cut, burned, grazed or otherwise modified vegetation within which a fire's intensity will be reduced. Their widths are determined by fuels, topography, and prevailing winds. The standards of upkeep are determined by the rapidity with which they become overgrown. Generally speaking, fuel and fire breaks in wetter locations need to be kept up more frequently because vegetation will grow more rapidly than in dry locations. Fire and fuel breaks are strategically located at all of the more fire prone installations.

A wildfire prevention analysis is included for all installations covered by the WFMP. This is a prioritization tool that allows managers to split installations into smaller pieces and then assign each piece a prioritization level for funding and implementation of pre-suppression projects. Standard Operating Procedures for each installation are included in the WFMP to outline responsibilities, fire prevention, Fire Danger Rating System usage, staffing levels, equipment caches, fuel modifications, proper fire suppression actions, and post-fire reports. The Standard Operating Procedures also include fire prevention briefings to be given to range users prior to commencement of training, notification lists in case of fire, operational decision charts for fires, and maps of resources, fuels, and fire breaks.

Fuels management programs are described for each fire break, fuel break, or fuel management area. All available fuel management techniques are considered, but most of the on the ground application is limited to mechanical cutting, herbicide application, and prescribed fire.

Stabilization Overview

As previously discussed, stabilization is a process that was developed several years ago for the 1999 MMR consultation to offset the impacts of military actions to listed species in the MMR action area. The stabilization process will be repeated for endangered plants and snails outlined in this biological opinion (Appendix 1). The process and methodology for species stabilization was four years in development and included a team of experts represented by the Army, Service, State, Berry Botanic Garden, Hawaii Natural Heritage Program, The Nature Conservancy, U.S. Geological Survey and the University of Hawaii. Stabilization will increase the environmental baseline for each species that fits the criteria required to be stabilized.

The Service has determined that a plant species may be considered stable when: 1) each population is naturally reproducing; 2) there are at least three populations each having at least 25 (for long-lived perennials), 50 (for short-lived perennials), or 100 (for annuals) reproducing individuals each; 3) all major threats have been controlled; and 4) each population is fully represented in an *ex situ* collection. These standards were recommended by the Hawaii and Pacific Plant Recovery Coordinating Committee to the Service in July 1994 and adopted in all subsequent plant recovery

plans (including Service 1998a, 1997, 1996 for Oahu species), along with additional standards for considering downlisting and delisting a species.

It is the opinion of the Service that for any species where the number of reproductive individuals per population has dropped below stability, the loss of even a single individual may preclude the potential for the species to recover, if no additional management actions are taken such as reintroduction or augmentation. This is based on the current literature (U.S. Army Garrison 2003), which indicates that it is not possible to determine the relative genetic diversity remaining in each individual or group of individuals within a species. When the species has declined in number below the level of stability, any one individual may contain a high proportion of the genetic diversity of the species due to population founder effect, genetic drift, and stochastic events. Because so little is known about the genetic variation of Hawaiian species and which genes affect such critical aspects as ability to reproduce, the loss of a single individual could result in the extinction of the species no matter what management actions are taken for the remaining individuals if no other measures are taken to increase numbers.

Many of the conservation and stabilization measures outlined below are based on an understanding of what constitutes a population. However, lack of basic biological knowledge of most listed Hawaiian plants makes it extremely difficult to determine which individuals comprise a population. Therefore, the term "population unit" is used in lieu of population, and is defined as the individuals of a species occurring at a discrete site separated by significant topographic barriers or habitat discontinuities from other individuals of that species, or occurring greater than 1,000 m (3,280 ft) apart (U.S. Army Garrison 2003). The final determination of what constitutes a population unit will need to be made on a case-by-case basis by the Oahu Implementation Team, following the general guidelines developed for the Makua IP.

In lieu of having a minimum viable population size tailored to each species, we are defining a stable population unit according to the standards recommended by the Hawaii and Pacific Plant Recovery Coordinating Committee in 1994 and subsequently adopted in all plant recovery plans (Service 1998a). While it is convenient to use such a standard prescription for determining stable population size, biological systems are so complex and individualistic that at least some detailed knowledge of the specific system of concern is necessary for management. Generalities can be dangerous and destabilizing for a management scheme. It is repeated throughout literature that management approaches relying on quantitative rules of thumb and cookbook procedures are to be used with caution (U.S. Army Garrison 2003). Therefore, the Service believes that gross estimates of minimum viable population size based on the specific taxon's life history attributes are desirable and should be addressed by the Oahu Implementation Team. If, in the course of further research on stability and recovery standards, the Service determines our current guidelines for species stability are incorrect, this will be interpreted as a change in the status of the plant species covered in this biological opinion and will be the basis for recommending that the Army reinitiate consultation.

The stabilization actions for individual species outlined in the Biological Assessment and this biological opinion are based on a thorough review of the available literature, as well as the definitions

of species stability based on the recommendations of the Hawaii and Pacific Plant Recovery Coordinating Committee and the Service's recovery plans. Many species-specific strategies will need to be developed by the Oahu Implementation Team.

There are several strategies available for stabilizing population units, including protection of extant population units, augmentation, reintroduction, introduction, and translocation. Of these alternatives, the Service considers only protection of extant population units, augmentation, and reintroduction to be acceptable stabilization strategies for species in this consultation. We do not endorse the translocation of plants because it carries the highest risk of failure. We cannot endorse introduction because the establishment of a species outside its historic range is contrary to Service policy. Thus, for population units that are currently stable (consisting of at least 25 reproducing individuals for long-lived perennials and 50 reproducing individuals for short-lived perennials), stabilization may be limited to protecting and managing such a population and its surrounding habitat. For population units that are not currently stable, augmentation may be necessary to buffer against environmental, demographic, and genetic stochasticity. The decision to augment carries both significant biological benefits and drawbacks and must be made after weighing both risks and benefits on a case-by-case basis by the Oahu Implementation Team. In other cases where not enough population units exist to reach three stable populations, reintroduction may be necessary. Each method varies in terms of time and money required, likelihood of success, and biological integrity. The decision about which method(s) to use will be difficult and should be finalized by the Oahu Implementation Team.

While reintroduction is the most risky management action and the least preferred alternative when compared to *in situ* preservation, it is fundamentally necessary in those cases where adequate numbers of wild populations and individuals no longer remain. As the recovery plans point out, reintroduction for most of these species is required to ensure the continued long-term existence of the species. In addition, the Oahu IP will include several measures to maximize the likelihood of reintroduction success. These measures include clear definitions of success; management of the population and the surrounding habitat after the plants have been planted; and ongoing monitoring, evaluation of success, and adaptive management. The Army's reintroduction efforts to stabilize these species, along with management of existing individuals and populations, is the only way to increase the overall numbers and distribution of these species and create stable populations where none exist at present. This effort will result in both a minimization of overall risk to the species from military training activities and be of net conservation benefit to the species.

The goal of all conservation measures is to stabilize each species that may likely be jeopardized by military training in the Oahu action areas. In order to achieve this, three populations of at least 25 (for long lived perennials) or 50 (for short lived perennials) reproducing individuals must be established. Furthermore, threats to the species and their habitat must be managed to ensure the continued survival of the species. It is important to note that the criteria for stabilizing a species are less stringent than the criteria for delisting (recovering) a species. Although recovery is always the ideal, the Army is only expected to stabilize, not recover, species in order to avoid the likelihood of jeopardy from military activities.

These conservation actions must be continued by the Army until all species that face the likelihood of jeopardy within the action areas have reached stability or until the Army has minimized the effects of its actions on-site sufficiently to avoid all adverse impacts to threatened and endangered species. At such time, the Army may reinitiate consultation with the Service to either redefine the action area and/or reduce the number of species requiring stabilization.

Protocols

The detailed protocols for the species-specific stabilization and habitat management will follow the Makua IP, unless the Oahu Implementation Team justifies a different method as part of the planning process. One issue that must be addressed for species specific to this biological opinion prior to determining success is the gross scale minimum viability analyses to identify rough estimates of population size needed. Important protocols that have been developed include: 1) intermediate and final definitions of success; 2) collection protocols to achieve the highest possible genetic representation that can be sampled within the species' range; 3) outplanting protocols, including determining the adequate number of individuals to outplant to reach success, number of populations, size or life stage distribution of the population, how to achieve the highest number of individuals possible within a population, contamination issues, timing of outplanting, and site selection; and 4) monitoring and adaptive management to incorporate lessons learned. All of these protocols are discussed in detail in the Makua IP (U.S. Army Garrison 2003), and will be adapted to the species on the other Oahu installations by the Oahu Implementation Team. Many of the issues regarding site selection, including habitat quality and quantity (larger for species that occur in a more scattered distribution), will be addressed in the Oahu IP as part of the general habitat management, as appropriate for the given threats in each area.

Urgent Actions

The length of time required for thorough and biologically sound planning to stabilize 31 plant species and Oahu tree snails over such a broad area leads to concerns over the delay in implementation of actions for those species at highest risk of fire from military training. Several urgent actions have been identified for individual species that the Army will implement immediately, while the planning process continues (see Conservation Measures section below). One of the first actions of the Implementation Team will be to identify additional urgent actions that the Army will implement during the planning process. These actions are meant to reduce the risk of impacts from training activities for those populations in the highest risk areas and/or those species at extremely low numbers.

Species in Makua IP

Nine endangered plant species and the snail *Achatinella mustelina* from this biological opinion overlap with species in the Biological Opinion for MMR (Service 1999a, 2001a). Stabilization measures have been identified in the Makua IP (U.S. Army Garrison 2003) for these nine "overlap" plant species: *Alectryon macrococcus* var. *macrococcus*, *Cyanea grimesiana* ssp. *obatae*, *Cyrtandra dentata*, *Delissea subcordata*, *Flueggea neowawraea*, *Phyllostegia kaalaensis*, *Plantago princeps* var. *princeps*, *Schiedea kaalae*, and *Viola chamissoniana* ssp. *chamissoniana*. However, the stabilization needs for these species were developed prior to the identification of action areas for the six other Army installations on Oahu. Six of these species

therefore require additional conservation measures, since one or more of the population units identified for management in the Makua IP occur within one or more of the Oahu action areas not yet identified at the time of the Makua IP and therefore will now receive less credit. These species include *Cyanea grimesiana* ssp. *obatae*, *Cyrtandra dentata*, *Delissea subcordata*, *Flueggea neowawraea*, *Phyllostegia kaalaensis*, and *Schiedea kaalae*. Additional actions for these species, which may include management of additional population units, augmentation, and/or additional reintroductions, will be determined by the Oahu Implementation Team.

CONSERVATION MEASURES

When used in the context of the Act, "conservation measures" represent actions proposed by the Federal action agency that are intended to further the recovery of and/or minimize or compensate for project effects on the species under review. Because conservation measures are pledged in the project description by the action agency, their implementation is required under the terms of the consultation. The following measures will reduce project impacts associated with routine and SBCT training activities by avoiding and minimizing Army actions to listed species. The following represent conservation measures as proposed by the Army as part of the overall action:

Stabilization

Plant taxa are considered to be of special consideration if they meet criterion 1 and/or 2 below:

1. Less than three populations of the taxon exist, consisting of 25 (long-lived perennials), 50 (for short-lived perennials), or 100 (for annuals) reproductive individuals and each population is naturally reproducing;

and/or

2. More than 50 percent of known individuals occur within one or more of the six Oahu action areas, regardless of stability.

In addition, these populations must have all major threats controlled and must be fully represented in an *ex situ* collection.

Oahu IP

The Army will develop and implement an Implementation Plan in accordance with the following criteria:

1. Many of the management actions the Army is implementing are experimental in nature and success cannot be ensured at this point. It is vital that the management actions be closely examined and modified as needed to ensure success and reduction of impacts to listed species. This will be done through an Implementation Plan, to be developed by the Army in

consultation with an Oahu Implementation Team consisting of Army, Service, and State biologists familiar with the species and the conservation areas. The team may advise that sections of the Oahu IP be written and or reviewed by appropriate experts. The Oahu IP must be approved by the Service.

2. The Oahu IP must include at a minimum the following: a) time frame for completing its implementation phase; b) identification of priority species, areas, and actions; c) definitions of success for listed species population management and habitat management; d) methods for collection, site selection and size, propagation, population reintroduction, and habitat management; e) methods for monitoring, data tracking, analysis, and feedback; f) a gross scale estimate of minimum viable population for each species requiring stabilization; and g) a cost estimate for plan implementation. The Oahu IP shall follow the conceptual model and protocols developed for the Makua IP.

3. The Oahu Implementation Team will review the progress of the Implementation Plan annually, and make recommendations to the Army as to needed adaptive management changes. The Service will have final approval regarding changes to the Implementation Plan to ensure they meet the goals of the consultation.

4. The Oahu IP will be completed by December 31, 2005, with measures intended to stabilize plants and snails beginning within six months of the completion date.

5. The Oahu Implementation Team will assist in identifying areas suitable for offsite conservation measures and any necessary management actions within each area, as well as those management actions needed within the action areas. Additional surveys of the action areas and potential off-site areas may lead to finding more suitable areas for habitat management and reintroduction. Surveys are likely to reveal additional population units and/or individuals of several of the threatened and endangered species in this consultation. If such is the case, changes in species status will be considered when appropriate stabilization sites and actions are identified by the Oahu Implementation Team.

6. The species-specific effects discussions in this document include the current status of the species in the action area, the effects of military training on the species, and the general stabilization actions needed for each species, as described in the Biological Assessment and are hereby incorporated as stabilization conservation measures.

7. If final stabilization measures cannot be agreed upon by the Service, State, and Army during the development of the Oahu Implementation Plan, then the biological opinion must be reinitiated in order to determine if a jeopardy threshold has been surpassed.

8. Within two months from the completion date of this biological opinion, Army, State and Service biologists shall meet and review the nine plant species and one snail species that are

included in the completed Makua stabilization plan, and will also be a part of the Oahu IP. The Oahu Implementation Team shall review the current status of these 10 species and determine what, if any, additional conservation actions shall be implemented to reduce the potential of species loss due to military actions on Oahu and MMR. The Army will implement any determined urgent actions within one year from the completion date of the biological opinion in order to minimize the risk of species loss prior to the finalization of the Oahu IP.

SBMR

The Army will implement the following conservation measures at SBMR:

1. The Army will fence the single individual of *Schiedea kaalae* in SBMR since there are only 25 individuals State-wide. Within six months from the completion of this biological opinion, an exclosure shall be constructed around this individual to eliminate impacts from ungulates. In addition, non-native plant species shall be controlled within the fenced area.

2. The Army will develop a fuel reduction plan for the fire break road that encircles the impact area at SBMR. This fuel reduction/removal plan will incorporate measures to reduce the risk of fires from "spotting" across the fire break road. This will include the removal of ironwood and eucalyptus trees within 10 m (33 ft) of the fire break road in order to further reduce fires in occupied elepaio habitat. This proposal will be completed within six months from the completion date of the biological opinion and implemented within the following six months. The fuel reduction plan will be reviewed by the Service and Army fire ecologists and approved by the Service prior to finalization.

3. The Army will control alien rats in the territories of 75 elepaio pairs, roughly half of the 155 elepaio pairs at SBMR. This can be accomplished through any or all of several alternative methods, including: a) increasing access for resource management at SBMR to a minimum of 45 days per year to allow deployment of rat bait stations in a larger number of elepaio territories, more frequent maintenance of bait stations, and more effective ungulate removal; b) construction of three fenced exclosures consisting of 40 ha (100 ac) each to facilitate ungulate control in key portions of SBMR, including rodent bait stations and/or when registration is approved, broadcast of diphacinone to control rats; or c) if three such exclosures cannot be constructed at SBMR and it is not possible to control rats in the prescribed number of elepaio territories at SBMR, then the Army will manage the remaining number (75 less the number managed at SBMR) of elepaio territories at an appropriate off-site location agreed upon by Army and Service biologists, such as Honouliuli Preserve, in order to produce an equivalent number of juveniles that disperse to SBMR. Exclosures would facilitate habitat management and reduce the long-term cost of habitat management by obviating the need for continual removal of feral ungulates. In addition, the fenced areas will add a conservation measure for endangered plant and snail species since their occurrences overlap with elepaio territories. The design and planning of the fenced exclosures will be

addressed and finalized in the Oahu IP by Army, State and Service biologists knowledgeable about the distribution and ecology of elepaio, tree snails, and endangered plants.

4. The Army will review SBMR target locations and confirm that all targets are 150 m (495 ft) from the fire break road. If targets are within the 150-m (495 ft) buffer, they will be moved to reduce the "overshoot" issue and wildfires. When consistent with training objectives, the Army will review the feasibility of reducing the maximum propellant charge from three powder bags to two, so there is less chance a round will land outside the impact area.

5. The Army will increase the number of days per year available for resource management at SBMR to 45. This increased access will enhance ability of the Natural Resource staff to effectively remove ungulates, control weeds, maintain rat bait stations, and conduct monitoring.

SRAA

The Army will implement the following conservation measures at SRAA:

1. The Oahu Implementation Team will review and determine appropriate measures for ungulate control and/or fencing at SRAA.

2. Coordinate ungulate monitoring results at SRAA with The Nature Conservancy of Hawaii's ungulate program.

DMR

The Army will implement the following conservation measures at DMR:

1. The Army will notify the Service immediately if any threatened or endangered avian species are observed at DMR.

2. The Army will establish natural noise barriers (*e.g.*, vegetation) if federally listed wetland bird species are present at Crowbar Ranch Pond in coordination with the Service.

3. The Army will conduct surveys of the Crowbar Ranch Pond near the DMR military vehicle trail to determine the presence of any federally listed wetland bird species, and if present, determine if nesting activities are occurring and if trail noise is resulting in an adverse impact.

KTA

The Army will implement the following conservation measures at KTA:

1. All occurrences of *Eugenia koolauensis* will be fenced to restrict foot traffic and remove ungulate pressure. Fencing of *E. koolauensis* will be considered an urgent action to be addressed and implemented by the Implementation Team within one year from the

completion date of the biological opinion. The size of the fenced exclosures will be determined by the Implementation Team.

2. The Army will assess problems and develop solutions to minimize soil disturbance, vegetation loss, and other habitat degradation associated with motorcycle and off-road vehicle use and trespass in Training Area A1 and other affected areas on KTA. Any solution will require cooperation between the Army (user and neighbor), the state (lessor), and the lessee. Site-specific remediation actions will be addressed by ongoing Integrated Training Area Management efforts and an Erosion and Sediment Control Management Plan.

3. The Oahu Implementation Team will develop a fuel modification plan for the occurrences of *Eugenia koolauensis* at KTA that are most vulnerable to fire. Fuel reduction or modification will be implemented with one year from the completion date of this biological opinion. The Implementation Team will assess the feasibility and implementation of a natural fire break consisting of native plants that would further reduce the potential for a wildfire to impact these plant occurrences. In addition, the Implementation Team may determine additional urgent actions that will be implemented for *E. koolauensis*.

KLOA

The Army will implement the following conservation measures at KLOA:

1. Since 97 percent of all individuals of *Melicope lydgatei* are located along an active trail within KLOA, the Implementation Team will assess urgent actions to minimize impacts to this species to be completed within one year from the completion date of this biological opinion. These actions may include fencing, signage, or genetic research to minimize threats and/or understand more about the ecology and life history of this species.

2. Approximately 100 percent of the occurrences of *Mrysine judii* occur along trails within KLOA. To minimize potential threats from trail use, the Oahu Implementation Team will determine and implement any necessary actions to reduce trampling/crushing from human activity.

3. There are only 69 individuals of *Cyrtandra viridiflora* rangewide of which 58 occur in KLOA. This species will be monitored twice a year to assure that impacts from training along trails will not adversely affect these individuals. If adverse impacts are detected, then the Oahu Implementation Team will immediately address urgent actions to protect this species.

Wildland Fire Management Plan

The Army will develop and implement a WFMP for the six Oahu installations:

1. The WFMP will be completed by December 31, 2003. All conditions of this document will be agreed to, and signed by both the Army and the Service. The WFMP will address the

following actions as outlined in the document including: the establishment and maintenance of fuel breaks, fire breaks, fuel management corridors, dip tanks, suppression measures, and implementation of a Fire Danger Rating System for all installations where military training occurs. Implementation of the aforementioned measures shall have time frames and due dates that will be stipulated in the WFMP. The Army will implement these measures pursuant to the agreed upon dates.

2. The Army will inform the Service via phone or email within 48 hours after a fire occurs outside of an impact area for live-fire installations or occurs anywhere else within non-live-fire installations. A copy of the report (or form) will be sent to the Service.

3. Since prescribed burns are not a part of this consultation, the Army will consult with the Service before each prescribed burn.

4. The WFMP will be an adaptive document which can be modified when new information is obtained or if it is determined by the Service or Army fire specialists that additional measures should be implemented to further reduce the risk of fire. The Army and Service shall have appropriate individuals (biologists and fire personnel) meet every six months to review the implementation of the plan, to discuss documented fires on the installations, and any necessary modifications to the Standard Operating Procedures to ensure that the best measures are being implemented to reduce and minimize fires on all installations. Any modifications to the WFMP shall require the concurrence of the Service and the Army.

5. The Army will assess the feasibility of maintaining a trained fire fighting staff of 10 individuals to assist the Wildland Fire Program Manager on Oahu installations. The onsite presence of this team is intended to further reduce the risk of a catastrophic fire event that could impact native habitat and endangered species. The composition of the team shall be addressed in the final WFMP.

6. It has become apparent that some of the fires in 2003 at SBMR and KTA were due to failure of an individual or individuals to follow proper Standard Operating Procedures. To curtail future mishaps the Army will reassess compliance with the Standard Operating Procedures and establish and develop measures to ensure their enforcement.

7. A Humvee equipped to fight a fire, and two fire trained personnel will be present on the installation during any training exercise at KTA

Invasive Plant Control

The Army will implement the following measures to reduce the introduction and spread of, or where possible, to eradicate invasive plant species:

1. The Army will minimize the threat of alien species introductions which could result from range maintenance, construction and training activities by implementing an invasive plant

monitoring program within and adjacent to landing zones, trails, and roadsides. Newly found weeds will be eradicated using the most effective means for each of the invasive species. Detailed methods for the monitoring and eradication of alien plants will be included as part of the Oahu IP.

2. The Army will prevent secondary weed spread from fire by monitoring and eradicating newly dispersed weeds. Detailed methods for the monitoring and eradication of alien plants will be developed as part of the Oahu IP.

3. The Army will wash vehicles in the wash rack facility prior to returning to Oahu from the Pohakuloa Training Area to minimize the chance of spreading non-native plant species (*e.g.*, fountain grass). The Army will wash vehicles at SBMR and KTA in the wash rack facilities prior to leaving the training areas to remove any seeds and large clumps of soil that may have accumulated on the vehicles and minimize the spread of weeds. Once vehicles are washed they will be traveling on paved roads between the two areas.

4. The Army will develop and implement an educational program regarding cleaning vehicles and field gear to all troops using the Oahu installations (education materials will be reviewed and approved by the Service).

5. Persons and equipment coming from foreign countries must go through U. S. Department of Agriculture and U.S. Customs inspections before coming into the United States.

6. The Army will provide specific training and require soldiers to clean their gear and vehicles when first arriving in Hawaii and prior to moving from installation to installation on Oahu, as well as when moving between Oahu and the island of Hawaii and back.

Invasive Animal Control

The Army will implement the following measures to reduce the introduction and spread of, or where possible, to eradicate invasive animal species:

1. The Army will brief soldiers on alien reptilian species and require that all snake and lizard sightings be reported to the Army Environmental office.

2. The Army has developed and distributed brown tree snake response and alert posters which inform the public about the potential for a brown tree snake introduction with rapid response measures and numbers to call in case of a sighting. The Army will continue these efforts particularly when new troops are training on the Oahu installations.

3. The Army will require that all vehicles will be washed in the wash rack facility at Pohakuloa Training Area prior to returning to the island of Oahu. This measure will minimize animals (*e.g.*, invertebrates) from hitch-hiking to Oahu from the island of Hawaii.

4. The Army is a member of, and will continue its active participation in the Oahu Invasive Species Committee. This is a voluntary partnership of private, governmental, and non-profit organizations and individuals united to prevent new invasive species infestations on the island of Oahu and to eradicate incipient invasive species that already occur.

5. The Army will develop a herpetofauna certification program as part of the implementation process for plant material purchased by the Department of Defense to prevent incidental introductions of herpetofauna to the island of Oahu.

6. The Army will establish the phytosanitation certification program similar to that developed in the Makua IP (U.S. Army Garrison 2001).

7. The Army will coordinate with the Toxicants Working Group in an effort to determine a safe toxicant for controlling populations of newly established animals and invertebrates.

8. The Army will use environmentally safe toxicants for alien species control or eradication associated with military operations or natural resource management and they shall be used pursuant to manufacturers directions and Army Standard Operating Procedures.

9. If a new introduction of an alien animal is found, the source and time of the introduction will be identified, and the area will be searched and treated with an appropriate environmentally safe toxicant to eradicate any other individuals of the target species that may be present. In addition, an area deemed adequate to cover the potential dispersal distance of the new alien animal will be searched and treated as well.

10. The Army will pursue implementation and funding for the licensing and application of a more effective rodenticide including the broad scale distribution of rodenticides to improve rat control in remote areas, especially in areas with threatened and endangered species.

Reduction and Avoidance of Endangered Species from Foot Traffic

The Army will develop and implement the following measures to avoid and minimize impacts from foot traffic to listed species:

1. The Army will educate each set of new soldiers regarding the importance of avoiding listed species to minimize trampling/crushing of native vegetation, especially in the Koolau and Waianae Mountains. Endangered and threatened plant or snail occurrences shall be signed or fenced if the species is located within 25 m (15 ft) of a road or trail and troops shall be informed to stay out of these areas.

2. The Army will establish Land Condition-Trend Analysis (Integrated Training Area Management) plots to monitor impact of foot traffic trampling by infantry soldiers.

3. Permanent fencing of federally listed species occurrences near roads or trails will be addressed by the Implementation Team.

4. The Army will establish signage to identify areas that are off limits due to the presence of federally listed species.

Integrated Training Area Management

The Army will develop and implement the following measures to avoid and minimize impacts from Integrated Training Area Management activities:

1. Establish a project review process headed by Integrated Training Area Management and including U. S. Army Hawaii Department of Public Works, G3/Directorate of Plans, Training, and Mobilization, and Range Control, to optimize watershed protection and rehabilitation (*e.g.*, road construction and maintenance, storm water management, etc.).

2. Establish GIS support headed by Integrated Training Area Management to develop project data layers, analyze data, and display results.

3. The Army will participate in future watershed partnership initiatives to facilitate watershed protection and conservation projects, maximize available resources, and optimize information exchange and learning.

4. All stock plants purchased by Integrated Training Area Management for revegetation shall be certified to be free of invasive species prior to moving the plants to any natural areas for planting.

5. When using grass seed to revegetate an area, Integrated Training Area Management will periodically monitor these areas for invasive weeds, and remove all non-target introductions from the area before establishment.

6. Public trail use will be limited since the public is required to get permission from Division of Forestry and Wildlife and Department of Public Works for access to hike Kealia trail, Kaunala-West trail, Pupukea Summit trails, Pupukea Summit, Puu Kalena and Puu Hapapa (Kolekole) trails. Permission from the appropriate landowners is required if the public is accessing trails through non-Army lands.

7. Recreationalists will be informed of their responsibility to clean all gear prior to entry. The Army will develop and place signage at appropriate places along DMR, KTA, KLOA, SBER, SBMR, and SRAA boundaries and trail heads to notify users of resource management issues, boundaries, and trail issues.

8. The Army will develop maps of the Kealia trail, Kaunala-West trail, the Pupukea summit trails, Pupukea summit, Puu Kalena, and Puu Hapapa (Kolekole) trails for distribution with

access permits, including the level of difficulty, and natural resources issues (*e.g.*, weed distribution concerns, endangered species information, the importance of staying on the trail).

Drum Road Construction and Use

The following measures will be a part of the construction and maintenance of Drum Road to minimize and avoid impacts to native habitats and federally listed species:

1. Water will be sprayed along sections of Drum Road as needed during construction to reduce the potential adverse effects from fugitive dust, particularly in the vicinity of *Tetraplasandra gymnocarpa*.

2. Contractors and their employees will be educated on the need maintain clean vehicles and equipment when coming onto the Drum Road construction site to reduce the spread of non-native plant species. All construction equipment will be cleaned and inspected before being transported to the Drum Road construction sites.

3. Vehicles will be left at the Drum Road construction site over night, confined to the training area, or recleaned before returning to the construction site if used off-site.

4. Every effort will be made to balance earthwork so no outside fill sources will be needed for the Drum Road project. If outside fill is used, sites will be monitored for new alien species every two months and herbicide will be sprayed to combat new plant invasions.

5. Army Natural Resources personnel will periodically inspect Drum Road construction sites for new alien species. Alien species will be documented and removed.

6. Vehicles will be washed in KTA and SBMR before and after use of Drum Road.

7. Roadside monitoring of invasive weeds will be done (every two months during construction and twice a year thereafter) and all non-native weedy species that are found will be removed along Drum Road.

8. Staging areas will be prohibited within sensitive areas. Staging areas will be delineated on the grading plans and reviewed by qualified Army and Service biologists.

9. No fueling or equipment maintenance will take place along Drum Road during construction. Contractor equipment will be checked for leaks prior to operation and repaired as necessary.

10. A pre-construction briefing shall be held prior to groundbreaking and all construction workers and related personnel will be required to attend. At this meeting, the Army biologist will discuss the importance of environmental awareness to include the following topics: keeping all activities within the project footprint; no-littering; smoking confined to roadways

and cigarette butts disposed of properly; no equipment maintenance onsite; and disposal and removal from site of organic waste (such as apple cores).

11. If any accident occurs that releases petrochemical or toxic substances, the Service shall be notified within 24 hours and shall advise on clean-up procedures.

12. Portable restroom facilities shall be present on the job site to prevent personnel from trampling the vegetation.

13. A Project biologist shall be assigned to the Drum Road construction project and will oversee that the aforementioned conditions are adhered to during the construction phase of this project. This individual will be the responsible party regarding compliance of all conservation measures and shall be the "go to" person if any unforseen issues arise during the construction of this road. This individual shall submit a short progress/compliance report every month to the Service as part of their oversight responsibilities. These conditions shall be incorporated into the Project Statement of Work so that all contractors fully understand their responsibility to comply with all Drum Road conservation measures.

STATUS OF THE SPECIES AND ENVIRONMENTAL BASELINE

Status of the Species - *Abutilon sandwicense* (No Common Name)

Species Description *Abutilon sandwicense* is a member of the Malvaceae (mallow family). It is a shrub that grows to 3 m (9 ft) in height. The vegetation is covered with white to yellowish stellate glandular hairs. Leaf blades are pale green, shallowly dentate, and covered with sparse pubescence. Flowers are solitary and pendulous in the leaf axils. The sepals are greenish yellow in color, with the petals being bright green to reddish brown with green venation. The fruit is a capsule. This species is distinguished from others in the genus by its green or reddish-brown tipped petals that exceed the sepals (Wagner *et al.* 1999).

Listing Status *Abutilon sandwicense* was federally listed as endangered on September 20, 1991 (56 FR 47695) and listed by the State of Hawaii at the same time. A recovery plan was prepared for *A. sandwicense* and 65 other plant taxa that occur on the island of Oahu in 1998 (Service 1998a). Critical habitat was designated for this species on June 17, 2003 (68 FR 35950).

Historic and Current Distribution Historically, *Abutilon sandwicense* was known from nearly the entire length of the Waianae Mountains, from Makaleha Valley to Nanakuli Valley (Service 1998a). Currently, between 180 and 246 plants are estimated to be extant as part of 11 occurrences: West Makaleha to Palikea (68 to 83 individuals), Kahanahaiki (1 to 2), Keaau (1), Ekahanui (9), Halona (1), Huliwai (8), Makaha (50 to 100), north Mikilua (2), Nanakuli (30), south Mikilua (4), and Waianae Kai (6) (K. Kawelo, U.S. Army, pers. comm. 2003; J. Lau, HINHP, pers. comm. 2003).

Ecology *Abutilon sandwicense* typically grows on steep slopes or gulches in dry to mesic lowland forest between 149 and 875 m (489 and 2,870 ft) elevation. Associated native species include *Antidesma pulvinatum, Diospyros sandwicensis, Elaeocarpus bifidus, Eugenia reinwardtiana, Hibiscus arnottianus, Metrosideros polymorpha, Myrsine lanaiensis, Nestegis sandwicensis, Pipturus albidus, Pisonia* spp., *Pittosporum* spp., *Pleomele* spp., *Psydrax odorata, Rauvolfia sandwicensis, Reynoldsia sandwicensis,* and *Sapindus oahuensis* (HINHP Database 2001). *Abutilon sandwicense* has been observed flowering in winter and spring. Fruits develop within six weeks. Although seedlings are often initially abundant, few plants appear to survive to maturity for unknown reasons. Little else is known about the phenology, pollinators, seed dispersal agents, longevity, specific environmental requirements, or limiting factors for this species (56 FR 47695).

Threats The major threats to *Abutilon sandwicense* are competition for light, space, and nutrients from non-native plant species; fire; the black twig borer (*Xylosandrus compactus*); the Chinese rose beetle (*Adoretus sinicus*), habitat degradation and/or destruction by feral pigs and goats, and trampling by feral cattle. Human activity along a trail in Honouliuli Preserve also threatens individuals in a nearby occurrence. Non-native plants that may compete with *A. sandwicense* include *Ageratina riparia, Aleurites moluccana, Clidemia hirta, Ficus microcarpa, Grevillea robusta, Hyptis pectinata, Ipomoea* spp., *Kalanchoe pinnata, Leucaena leucocephala, Melia azedarach, Melinis minutiflora, Montanoa hibiscifolia, Oplismenus hirtellus, Panicum maximum, Passiflora suberosa, Pimenta dioica, Psidium cattleianum, Psidium guajava, Rivina humilis, Schinus terebinthifolius, Syzygium cumini,* and *Toona ciliata* (Service 1998a).

Conservation Needs of the Species A State-wide management plan should be developed and implemented for the long-term conservation of all known occurrences of *Abutilon sandwicense.* This plan should also include broader landscape actions that are needed for the recovery of this plant throughout its range. The recovery plan for this species identifies the following important conservation actions. Fenced exclosures need to be constructed around all known populations of *A. sandwicense*, with priority given to the smaller occurrences (*e.g.*, Kahanahaiki, Keaau, Halona, north Mikilua). Feral ungulates should be controlled or removed from these areas and from the broader landscape that is needed to recovery this plant. Non-native plants should be controlled or removed from the vicinity of all known occurrences with priority given to the smaller occurrences. Monitoring should be carried out to preclude the re-establishment of competitive, non-native plant species. Surveys should be conducted to identify new occurrences of *A. sandwicense,* update the status of known occurrences, identify new reintroduction sites, and assess the effects of the black twig borer and/or Chinese rose beetle on this species. If either of these insect pests are detected, it should be determined if their presence is adversely affecting *A. sandwicense.* If so, control measures should be undertaken. A coordinated fire management plan needs to be developed and implemented for those areas where *A. sandwicense* is present (Service 1998a).

Ongoing Conservation Actions Seeds and cuttings of *Abutilon sandwicense* are being held at the Lyon Arboretum and Seed Storage Facility, National Tropical Botanical Garden, and Waimea Arboretum. The Lyon Arboretum has seeds and cuttings in genetic storage from material collected

in the Makaleha Forest Reserve, and seeds for research purposes at the Arboretum and Seed Storage Facility collected from Puu Pane and the Waimea Arboretum, respectively. The National Tropical Botanical Garden has seeds from two collections made in the Waianae Mountains (Kaimuhole Gulch in Kaala Natural Area Reserve and Waianae Kai) as well as seeds from plants grown from the Kaimuhole Gulch seeds. Waimea Arboretum has seed and cuttings from Kaukonahua Gulch and Puu Pane. The Honolulu Botanical Garden also has *A. sandwicense* as plants in its garden (Service 2002). The Nature Conservancy of Hawaii monitors and controls non-native weedy plant species, particularly *Passiflora suberosa,* at one occurrence of *A. sandwicense* in Honouliuli Preserve at Huliwai Gulch. *Abutilon sandwicense* is also being outplanted by Hawaii's Division of Forestry and Wildlife in Pahole Natural Area Reserve (Service 1998a). The Service is currently not aware of any other conservation efforts for this species.

Environmental Baseline

Status of the Species in the Action Area Between 68 and 83 individuals of *Abutilon sandwicense* occur within the SBMR action area. These individuals occur outside of the impact zone in the northern portion of the action area (see Figure 10b in the Biological Assessment) and represent between 28 and 46 percent of the species rangewide. Two to three individuals (less than one percent rangewide) are known from the MMR action area (K. Kawelo, U. S. Army, pers. comm. 2003; J. Lau, HINHP, pers. comm. 2003). No stable population units with 50 or more mature, reproducing *A. sandwicense* are known outside of the action area (U.S. Army 2003a).

Threats in the Action Area Within the SBMR action area, the following threats from Army actions have been identified: introduction and establishment of competitive non-native plant species, fire, and trampling from foot maneuvers (U.S. Army 2003a). Feral pigs occur within the action area and they continue to be a threat to *Abutilon sandwicense.*

Conservation Needs in the Action Area A stabilization plan needs to be developed and implemented for the stabilization and long-term conservation of *Abutilon sandwicense.* This plan should include broader landscape actions that are needed to sustain this plant, including suitable habitat outside and within the action areas. *Abutilon sandwicense* will be stabilized because three stable population units do not currently exist outside of the Army action areas (SBMR and MMR). To be considered stable, *A. sandwicense* must meet the criteria required for stability of a short-lived perennial (Service 1998a).

Stabilization for *A. sandwicense* will include the following actions. Fenced exclosures will be constructed around occurrences of *A. sandwicense* where the ungulate threat has been identified as significant by the Oahu Implementation Team. Feral ungulates and competitive non-native plant species will be removed from or controlled within the fenced exclosures. Non-native plant species should be controlled or removed from the vicinity of all known occurrences of *A. sandwicense*, and ungulates should be controlled or removed from the broader landscape needed to sustain this plant. Surveys and monitoring will be done to determine the presence of the black twig borer and/or Chinese rose beetle, to locate new sites for reintroducing this plant, and to locate new occurrences

(U.S. Army 2003a). The Army will provide protection from fire as outlined in the WFMP (U.S. Army 2003b).

Ongoing Conservation Actions within the Action Area No species-specific conservation actions are currently being implemented for this species at SBMR (U.S. Army 2003a). The Service is currently not aware of any other conservation efforts for this species within the action area.

Status of the Species - *Alectryon macrococcus* (Mahoe)

Species Description *Alectryon macrococcus* is a member of the Sapindaceae (soapberry family). There are two varieties, *macrococcus* and *auwahiensis*, both trees growing up to 11 m (34 ft) tall. Fully mature trees are usually multi-trunked, and the trunks have a sinewy appearance and reddish-brown branches. The leaves are compound, with two to five pairs of leaflets, each of which measures 10 to 28 cm (3.9 to 10.9 in) long. The underside of the leaves of young *A. macrococcus* var. *macrococcus* plants have dense brown hairs. The flowers are borne in panicles up to 30 cm (11.7 in) long. Flowers are either perfect (possessing male and female reproductive parts), or staminate (possessing only male reproductive parts). The roundish fruits are 2.5 to 7 cm (0.9 to 2.7 in) in diameter. On Kauai, the fruits have been observed to be uniformly small on all of the fruiting trees, averaging about 2.5 cm (1.0 in) in diameter (K. Wood, Pelea Foundation, pers. comm. 2000). On the other islands the fruits are larger, averaging about 4 cm (1.6 in) in diameter (J. Lau, HINHP, pers. comm. 2000). The hard rind of the fruit often cracks open when the fruit is ripe to expose the contents. Most of the volume within the hard rind is taken up by the aril, or the fleshy part of the fruit, and a single flattish seed at the end of the fruit takes up the remainder. The aril is red, and has a pleasant taste somewhat like that of *Syzygium malaccense*. *Alectryon macrococcus* var. *auwahiensis* is found only on the island of Maui. *Alectryon macrococcus* is the only member of the genus found in Hawaii, and it is distinguished from other Hawaiian members of the family by being a tree with a hard fruit 2.5 cm (1 in) or more in diameter (Wagner *et al.* 1999).

Listing Status *Alectryon macrococcus* was federally listed as endangered on May 15, 1992 (57 FR 20772) and State-listed as endangered in Hawaii at the same time. A recovery plan was prepared for this species in 1997 (Service 1997). Critical habitat was designated for *A. macrococcus* on Kauai, Molokai, Maui, and Oahu on February 27, March 18, May 14, and June 17, 2003 respectively (68 FR 9116; 68 FR 12982; 68 FR 25934; and 68 FR 35950).

Historic and Current Distribution *Alectryon macrococcus* var. *macrococcus* is known from Kauai, Oahu, Molokai, and West Maui. On Kauai it has been found on the western side of the island from Olokele Canyon to Kalalau Valley. On Oahu it is known primarily from the Waianae Mountains, where it has been recorded throughout the mountain range, on both the windward and leeward sides. There are only two historical records of the taxon in the Koolau Mountains. On Molokai it has been documented only from the western portion of East Molokai. On West Maui it has been found in the valleys and gulches on the eastern, southern, and western sides of the mountains. Currently, *A. macrococcus* var. *macrococcus* is present throughout its historic range except for the

Koolau Mountains of Oahu. The total number of individuals known statewide is about 405 to 425 from approximately 30 occurrences (U.S. Army 2003a; U.S. Army Garrison 2003). The species has always been considered relatively rare on Molokai and West Maui. Over the last three decades, only about 10 plants have been observed on Molokai at Kahuaawi (1 individual), Kaunakakai to Kawela (8), and Kawela and Makolelau (1). Approximately 21 have been observed on West Maui at Haena Nui (15), Honokowai (2), Iao (2), Launiupoko (1) and Waikapu (1) (HINHP Database 2002). *A. macrococcus* is most common on parts of Kauai and in the Waianae Mountains of Oahu. Approximately 79 plants are thought to remain on Kauai at Haeleele (3), Kalalau (11), and Koaie (65). It is estimated that about 300 plants still remain in the Waianae Mountains at West Makaleha to Palikea (68 to 83), Central Kaluaa to Central Waieli (53 to 58), Ekahanui (4), Halona (1), Huliwai (11), Kahanahaiki (2), Kapuna (6), Keaau (2), Makaha (77), Makua (15), Mikilua (2), Napepeiauolelo (1), sorth Mohiakea (2), north Palawai (1), north Waieli (3), Pahole (7), south Kaluaa (17), south Mohiakea (17), and Waianae Kai (6) (U.S. Army Garrison 2003).

Ecology *Alectryon macrococcus* is a relatively slow-growing, long lived tree that grows in xeric to mesic sites and is adapted to periodic drought. A substantial percentage of the trees flower but never bear fruit despite appearing relatively healthy (J. Lau, HINHP, pers. comm. 2000). Although the cause of this is not known, it may be that some trees only bear flowers that are functionally male. There is little information on growth rates of wild plants and their age of maturation. However, two trees in cultivation have been observed to flower for the first time when they were about 15 years old. At that age they were about 6 m (20 ft) tall. They were single-trunked, with the trunks measuring about 14 cm (5.5 in) in diameter. Wild trees undoubtedly live for decades based on observed growth rates and tree sizes (J. Lau, HINHP, pers. comm. 2000). Pollination of the taxon is probably carried out by insects (K. Wood, pers. comm., Pelea Foundation, 2000). It is hypothesized that now extinct large flightless ducks acted as dispersal agents for *A. macrococcus* var. *macrococcus* (Wagner *et al.* 1999). No recruitment has been observed and most remaining individuals are likely to be old, senescent individuals that will die without replacement (Makua IP 2003). Flowering cycles, seed dispersal agents, and specific environmental requirements are unknown (Service 1997). *A. macrococcus* var. *macrococcus* grows on slopes, ridges, or in gulches within mesic lowland forests between elevations of 367 and 941 m (1,204 and 3,086 ft). Associated native plant species include *Alyxia oliviformis*, *Antidesma platyphyllum*, *Canavalia* sp., *Charpentiera* sp., *Claoxylon sandwicense*, *Diospyros hillebrandii*, *Diospyros sandwicensis*, *Diplazium sandwichianum*, *Elaeocarpus bifidus*, *Hibiscus arnottianus*, *Metrosideros polymorpha*, *Myrsine lanaiensis*, *Neraudia* sp., *Nestegis sandwicensis*, *Pipturus albidus*, *Pisonia sandwicensis*, *Pisonia umbellifera*, *Pouteria sandwicensis*, *Psychotria hathewayi*, *Psydrax odorata*, *Streblus pendulinus*, or *Xylosma* sp. (HINHP Database 2001).

Threats The threats to *Alectryon macrococcus* var. *macrococcus* on Oahu are habitat degradation by feral goats and pigs; competition with the non-native plant species; damage from the black twig borer; seed predation by rats, mice, and insects; fire; depressed reproductive vigor; loss of pollinators; and, due to the very small remaining number of individuals and their limited distribution, a

single natural or human-caused environmental disturbance could easily be catastrophic for the species. The non-native plant species *Aleurites moluccana*, *Blechnum appendiculatum*, *Buddleia asiatica*, *Christella parasitica*, *Clidemia hirta*, *Heliocarpos popayanensis*, *Lanatana camara*, *Melinus minutiflora*, *Oplismenus hirtellus*, *Passiflora suberosa*, *Pennisetum clandestinum*, *Psidium cattleianum*, *Psidium guajava*, *Rubus rosifolius*, *Schinus terebinthifolius*, *Syzygium cumini*, and *Toona ciliata* threaten *A. macrococcus* var. *macrococcus* by altering its habitat and competing with it for nutrients, light, and space (Service 1997; 57 FR 20772).

Conservation Needs of the Species A State-wide management plan should be developed and implemented for the long-term conservation of all known occurrences of *Alectryon macrococcus*. This plan should also include broader landscape actions that are needed for the recovery of this plant throughout its range. The recovery plan for this species identifies the following important conservation actions. The types of management actions needed at these occurrences will depend on local site characteristics but should include fencing, weed control, outplanting of local genetic material, and rodent control (perhaps only seasonally during fruiting season). Surveys and monitoring of the known occurrences should be done to determine effects of the black twig borer and rodents. Sites that are relatively free from these influences should be considered as prime candidates for protection. Extreme care should be taken not to introduce the black twig borer into a pest-free area with propagated material of *A. macrococcus* (Service 1997).

Ongoing Conservation Actions The U.S. Navy is working to control alien plants in areas where individuals of *Alectryon macrococcus* var. *macrococcus* are located at Naval Magazine Lualualei. The Navy also allows recreational hunting on its lands to control feral pigs (U.S. Army 2003a). This species is being propagated at the Army Environmental nursery and the Lyon Arboretum on Oahu, the Hawaii Division of Forestry and Wildlife nursery on Kauai, and the National Tropical Botanical Garden on Maui and Kauai. Seeds are in seed storage facilities at the Lyon Arboretum and the National Tropical Botanical Garden (Service 2002). The Service is currently not aware of any other conservation efforts for this species.

Environmental Baseline

Status of the Species in the Action Area An estimated 39 plants from four occurrences are found in the SBMR action area, which represents approximately 10 percent of the remaining wild individuals (HINHP Database 2002; U.S. Army 2003a). Two individuals are located in Palikea Gulch, 17 individuals are located in south Mohiakea Gulch, three are located in north Waieli, and the remaining 17 individuals are found in south Kaluaa (HINHP Database 2002; U.S. Army 2003a). All of the individuals occur above the impact area in West Range and in the non-live-fire zone in South Range. While there are three population units of greater than 25 *A. macrococcus* var. *macrococcus* outside the Army action area (located at Makaha, central Kaluaa to central Waieli, and in Koaie, Kauai), these population units are not considered stable due to the heavy impacts to the species from the black twig borer and the lack of regeneration (U.S. Army Garrison 2003). The population units within SBMR occur within biologically significant areas that either contain or are likely to contain known occurrences of federally listed endangered and candidate species (CEMML 2001).

Threats in the Action Area Threats to *Alectryon macrococcus* var. *macrococcus* in the SBMR action area include competition for light, nutrients, and space from non-native plant introductions; fire due to military activities; munitions explosions outside the impact area; predation and degradation of habitat by feral pigs; and predation by rats and black twig borers.

Conservation Needs in the Action Area This taxon must be stabilized because no stable population units exist outside of the Army action area. To be considered stable, *Alectryon macrococcus* var. *macrococcus* must meet the criteria required for stability of a long-lived perennial (Service 1997). The stabilization plan for this taxon from the Makua IP must be implemented to achieve three stable population units. Stabilization measures include: habitat and population management of five population units, including the three largest; collection of full *ex situ* representation of wild stock statewide; rat control; and research and implementation of black twig borer control methods (U.S. Army Garrison 2003).

Ongoing Conservation Actions in the Action Area Within the SBMR action area, the Army is conducting the following species-specific actions: controlling rats around populations to protect mature fruit; increasing the number of individuals represented *ex situ* by collecting from previously uncollected trees; propagating with cuttings, air layering, and grafting for genetic storage and reintroduction purposes; collecting fruit for seed storage trials at the National Seed Storage Lab; monitoring known occurrences and protecting fruiting trees; identifying locations to cultivate these trees in the long-term so they can be managed for fruit production; surveying for additional occurrences in suitable habitats; and testing insecticide effectiveness against the black twig borer and supporting research of control methods for the black twig borer and the associated fungus (U.S. Army, *in litt.* 2003). The Service is currently not aware of any other conservation efforts for this species in the action area.

Status of the Species - *Alsinidendron trinerve* (No Common Name)

Species Description *Alsinidendron trinerve* is a short-lived perennial in the Caryophyllaceae (pink family). This shrub is 30 to 80 cm (11.8 in to 31.4 in) high, and leaf blades are 6 to12 cm (2.3 in to 4.7 in) long, 3 to 5 cm (1.1 in to 2 in) wide, and are oppositely arranged. Each inflorescence has 12 to 20 flowers. The flowers lack petals, and the calyx lobes are colored green to white, petal-like in appearance, and approximately 6 to 10 mm (2.3 in to 4 in) long. Each fruit capsule is egg-shaped to round, measures 8 to 12 mm (3.1 in to 4.7 in) long, and contains numerous black seeds. This species appears very similar to *A. obovatum* but has a more open inflorescence with peduncles more than 2 cm (0.8 in) long, and sepals with an acute tip (Wagner *et al.* 1999).

Listing Status *Alsinidendron trinerve* was federally listed as endangered on October 29, 1991 (56 FR 55770) and State-listed as endangered in Hawaii at the same time. A recovery plan was prepared for this species in 1998 (Service 1998a). Critical habitat was designated for *A. trinerve* on Oahu on June 17, 2003 (68 FR 35950).

Historic and Current Distribution *Alsinidendron trinerve* is endemic to the Waianae Mountains on Oahu, specifically to the north-central and southern portions. It was collected from the east side of the Mount Kaala area on numerous occasions during the early and mid-1900s (HINHP Database 2001). Currently, extant individuals in the wild are only known from Mount Kaala, with 87 to 89 mature and 162 immature individuals, and from Puu Kalena, with three mature and one immature individual, for a total of 90 to 92 mature individuals and 163 immature individuals (HINHP Database 2001; K. Kawelo, U.S. Army, pers. comm. 2003; J. Lau, HINHP, pers. comm. 2003).

Ecology *Alsinidendron trinerve* typically grows on slopes or steep terrain in montane wet *Metrosideros polymorpha* forest or the wetter portions of mesic *Metrosideros polymorpha/Ilex anomala* forest between 833 and 1,233 m (2,732 and 4,044 ft) elevation. Associated native species include *Boehmeria grandis*, *Broussaisia arguta*, *Coprosma ochracea*, *Diplazium sandwichianum*, *Gunnera* sp., *Hedyotis* sp., *Machaerina* sp., *Nothoperanema rubiginosa*, *Peperomia* sp., *Perrottetia sandwicensis*, *Phyllostegia* sp., *Pipturus albidus*, and *Vaccinium* sp. (HINHP Database 2001; Wagner *et al.* 1999).

A. trinerve produces flowers and fruits throughout the year with the possible exception of fall, and is a self-pollinating species (Service 1998a; 56 FR 55770). As the fruit matures, the calyx lobes stay alive and become purple and fleshy. This false berry is very likely to attract fruit-eating birds that may disperse the seeds. Little else is known about its flowering cycle, pollination vectors, seed dispersal agents, longevity, specific environmental requirements, and limiting factors (Service 1998a).

Threats The major threat to *Alsinidendron trinerve* is degradation and loss of habitat due to non-native plants and feral ungulates. Non-native plants such as *Buddleia asiatica*, *Clidemia hirta*, *Kalanchoe pinnata*, and *Rubus argutus* compete for light, space, and water. Feral pigs and goats degrade habitat by rooting, browsing and transporting seeds of invasive non-native plants. Threats to *A. trinerve* also include inadvertent trampling by humans along trails, military training activities, and extinction from stochastic events (such as landslides, hurricanes, or flooding) due to the small number of individuals and few occurrences (Service 1998a).

Conservation Needs of the Species A State-wide management plan should be developed and implemented for the long-term conservation of all known occurrences of *Alsinidendron trinerve.* This plan should also include broader landscape actions that are needed for the recovery of this plant throughout its range. The recovery plan for *A. trinerve* identifies two major conservation needs: control and removal of feral pigs from all occupied sites, and control of competing non-native plants (Service 1998a). Pig exclosure fences for most of the remaining individuals of *A. trinerve* are not feasible due to the steepness of the slopes that they occupy. Alternatively, strategic fencing of larger areas combined with removal of feral pigs should be implemented. Non-native plant species that compete with *A. trinerve* should also be removed or controlled. Removal of non-native plants should be combined with revegetation using appropriate native plant species.

Ongoing Conservation Actions Forty to 45 individuals of *Alsinidendron trinerve* were outplanted in a fenced and managed area in the Mt. Kaala Natural Area Reserve in September 1996.

However these plants are not doing well, probably due to oversaturation and low pH in the soil. There were more than 300 seedlings growing at the Pahole Rare Plant Facility in 1997 (Service 1998a). Currently, there are four seedlings growing at the Army's nursery at SBMR. Seeds of this species are being stored at the Lyon Arboretum, the National Tropical Botanical Garden and the Waimea Arboretum (Service 2002). The Service is currently not aware of any other conservation efforts for this species.

Environmental Baseline

Status of the Species in the Action Area Two occurrences of *Alsinidendron trinerve* are located in the SBMR action area (see Figure 10b in the Biological Assessement) and represent 83 percent of the extant individuals of this species. Individuals located on the northwest side of the summit of Mount Kaala (15 to 17 individuals) are outside of the action area. Individuals inside the action area at Mount Kaala number approximately 70 mature and 162 immature plants. All the individuals at Puu Kalena (three mature and one immature) are within the western edge of the action area (K. Kawelo, U.S. Army, pers. comm. 2003; J. Lau, HINHP, pers. comm. 2003). These occurrences are found within areas designated by the Army as biologically significant. These areas contain a relatively low density of rare plants and animals but are within intact, native habitat (CEMML 2001). There are no stable population units of greater than 50 mature and reproducing individuals of *A. trinerve* outside of the SBMR action area (U.S. Army 2003a).

Threats in the Action Area The major threats to *Alsinidendron trinerve* within the action area include fires that result from military training activities, habitat degradation due to feral ungulates, and invasion by non-native plants, especially in areas that are disturbed by fire or feral ungulates. Stray munitions also threaten this species by directly impacting plants. The spread of non-native plants, munitions, and fire are threats directly associated with Army training actions.

Conservation Needs in the Action Area A stabilization plan will be developed and implemented for the stabilization and long-term conservation of *Alsinidendron trinerve*. This plan should include broader landscape actions that are needed to sustain this plant. *A. trinerve* will be stabilized because three stable population units do not exist outside of the SBMR action area, and because more than 50 percent of the remaining individuals occur within the action area. To be considered stable, *A. trinerve* must meet the criteria required for stability of a short-lived perennial (Service 1998a). Stabilization for *A. trinerve* will include the following actions: management of all known occurrences to control ungulates and non-native plants, collection of all individuals for genetic storage and propagation, and reintroduction of *A. trinerve* at additional sites (U.S. Army 2003a).

Ongoing Conservation Actions in the Action Area The Army is continuing to collect from these plants to ensure complete *ex situ* representation from all known mature wild individuals and monitoring known occurrences (U.S. Army 2003a). The Service is currently not aware of any other conservation efforts for this species within the action area.

Status of the Species - *Chamaesyce rockii* (Akoko)

Species Description *Chamaesyce rockii* is in the Euphorbiaceae (spurge family). It is a short-lived perennial shrub or small tree typically 0.5 to 2 m (1.6 to 6.6 ft) tall, but in protected sites it may reach 4 m (13 ft) in height. The opposite leaves are narrowly oblong or elliptic, leathery, 6 to 17 cm (2.4 to 6.7 in) long and 1.5 to 4.0 cm (0.6 to 1.6 in) wide. The flowers form a head arranged in an open or sometimes condensed cymose inflorescence. The fruit are brilliant red or pink and 14 to 25 mm (0.6 to 1.0 in) long, and the seeds are brown to grayish brown. This species differs from others in the genus in that it has large, red, capsular fruit (Wagner *et al.* 1999).

Listing Status *Chamaesyce rockii* was federally listed as endangered on October 10, 1996 (61 FR 53089) and State-listed as endangered in Hawaii at the same time. A recovery plan was prepared for this species in 1998 (Service 1998a). Critical habitat was designated for *C. rockii* on Oahu on June 17, 2003 (68 FR 35950).

Historic and Current Distribution *Chamaesyce rockii* was known historically from scattered occurrences along the Koolau Mountains on the island of Oahu. Currently there are 12 occurrences with a total of between 755 and 867 individuals along the Koolau Mountains at Aiea Ridge trail (two to three individuals), Halawa summit trail (20), Helemano-Opaeula (300), Kaluanui (200 to 300), Kawaiiki and Opaeula (54), north Kaukonahua Gulch (1), north Kaukonahua-Kahana summit Ridge (1), Puu Kainapuaa (100), south Kaukonahua (25), summit Ridge between Aiea Ridge trail and Waimano trail (1 to 2), Waikakalau (40 to 50), and Waimano (11) (HINHP Database 2001; K. Kawelo, U.S. Army, pers. comm. 2003; J. Lau, HINHP, pers. comm. 2003).

Ecology *Chamaesyce rockii* typically grows on gulch slopes, gulch bottoms, and ridge crests in wet *Metrosideros polymorpha-Dicranopteris linearis* forest and shrubland. The habitat is between 208 and 915 m (682 and 3,000 ft) in elevation and primarily along cloud-swept summit ridges and occasionally along streams (HINHP Database 2001). Associated plant species include *Antidesma platyphyllum*, *Bidens* sp., *Broussaisia arguta*, *Cibotium* sp., *Coprosma longifolia*, *Diplopterygium pinnatum*, *Dubautia laxa*, *Hedyotis terminalis*, *Machaerina* sp., *Melicope* spp., *Myrsine juddii*, *Psychotria* spp., and *Wikstroemia* sp. (HINHP Database 2001). *C. rockii* has been observed fruiting in February, and little else is known about its flowering cycles, pollination vectors, seed dispersal agents, longevity, specific environmental requirements, and limiting factors (Service 1998a). The population sizes and the range of *C. rockii* have been declining (U.S. Army 2003a).

Threats The primary threats to *Chamaesyce rockii* are habitat degradation and destruction by feral pigs; trail clearing; potential impacts from military activities; and competition with non-native plant species such as *Clidemia hirta*, *Leptospermum scoparium*, *Paspalum conjugatum*, *Psidium cattleianum*, and *Pterolepis glomerata* (HINHP Database 2001; Service 1998a; 61 FR 53089).

Conservation Needs of the Species A State-wide management plan should be developed and implemented for the long-term conservation of all known occurrences of *Chamaesyce rockii*. This plan should also include broader landscape actions that are needed for the recovery of this plant throughout its range. The recovery plan for this species identifies the following important conservation actions. Fences should be constructed around the known occurrences of *C. rockii* to exclude pigs, and pigs should be controlled over a larger area to alleviate their impacts on the native ecosystems and to assist in the natural regeneration of *C. rockii*. Non-native vegetation should be removed from the vicinity of known plants. Occurrences that have only a few remaining individuals should be given priority for management actions (Service 1998a).

Ongoing Conservation Actions This species is in genetic storage at the Lyon Arboretum (Service 2002). The Service is currently not aware of any other conservation efforts for this species.

Environmental Baseline

Status of the Species in the Action Areas Within KLOA, there are five occurrences of *Chamaesyce rockii* with a total of approximately 456 individuals (between 52 and 60 percent of the total remaining individuals). These plants are found at Puu Kainapuaa, Kawaiiki and Opaeula, Helemano-Opaeula, north Kaukonahua-Kahana summit ridge and north Kaukonahua Gulch (K. Kawelo, U.S. Army, pers. com. 2003; J. Lau, HINHP, pers. com. 2003, U.S. Army 2003a). At SBER, there is one occurrence with 25 individuals (approximately three percent of the total remaining individuals) located in the Koolau Mountains at south Kaukonahua (U.S. Army 2003a). These occurrences are found within biologically significant areas that are known to support or might support federally listed endangered plants, plants that are candidates for listing, or rare natural communities (CEMML 2001). There is one occurrence outside of the action area considered to be stable, with more than 50 mature and reproducing plants. It is located in the Kaluanui vicinity and contains between 200 and 300 individuals (K. Kawelo, U.S. Army, pers. com. 2003; J. Lau, HINHP, pers. com. 2003; Service 1998a; U.S. Army 2003a).

Threats in the Action Areas Within the KLOA and the SBER action areas, *Chamaesyce rockii* is threatened by non-native plants, ungulates, fire, and trampling from foot traffic. The spread of non-native plants and trampling are threats that are directly associated with Army training actions, as is fire, but at a very low level.

Conservation Needs in the Action Areas A stabilization plan will be developed and implemented for the stabilization and long-term conservation of *Chamaesyce rockii*. This plan should include broader landscape actions that are needed to sustain this plant. *C. rockii* needs to be stabilized, as currently only one stable population unit exists outside of any of the Army action areas (KLOA and SBER) and more than 50 percent of the known remaining individuals occur within Army action areas. To be considered stable, *C. rockii* must meet the criteria required for stability of a short-lived perennial (Service 1998a).

Stabilization for *C. rockii* will include the following actions. Management will be conducted in KLOA and SBER in the Koolau Mountains where most individuals of this taxon are known to occur. The Army will construct fences to protect all known occurrences from rooting by feral pigs and from trampling by foot traffic, where these threats are identified as significant by the Oahu Implementation Team. Of highest priority for these efforts are immature plants and occurrences that have only a few remaining individuals. The Army will also control competing invasive plant species within and near the exclosures, including *Psidium cattleianum* and *Clidemia hirta*; as well as monitor for new introductions of alien plant species. The Army will increase the number of individuals represented in *ex situ* propagation by collecting from plants not currently represented in *ex situ* propagation facilities (U.S. Army 2003a).

Ongoing Conservation Actions in the Action Areas *Chamaesyce rockii* is currently under propagation in the Army's nursery. The Army Natural Resource staff has collected propagules for germination trials. The Helemano fence will protect many of the *C. rockii* individuals from ungulates in KLOA when it is completed (CEMML 2001; U.S. Army 2003a). The Service is currently not aware of any other conservation efforts for this species in the action areas.

Status of the Species - *Cyanea acuminata* (Haha)

Species Description *Cyanea acuminata* is a short-lived perennial and a member of the Campanulaceae (bellflower family). It is an unbranched shrub 0.3 to 2 m (1 to 6.6 ft) tall with inversely lance-shaped to narrowly egg-shaped or elliptic leaves 11.0 to 32.0 cm (4.3 to 12.6 in) long and 3.0 to 9.0 cm (1.2 to 3.5 in) wide. The flowers are 3.0 to 3.5 cm (1.2 to 1.4 in) long, white, and occasionally have a purplish tinge. The globe-shaped berries are yellow to yellowish orange. *C. acuminata* is distinguished from others in this endemic Hawaiian genus by the color of the petals and fruit and length of the calyx lobes, flowering stalk, and leaf stalks (Wagner *et al.*1999).

Listing Status *Cyanea acuminata* was federally listed as endangered on October 10, 1996 (61 FR 53089) and State-listed as endangered in Hawaii at the same time. A recovery plan was prepared for this species in 1998 (Service 1998a). Critical habitat was designated for *C. acuminata* on Oahu on June 17, 2003 (68 FR 35950).

Historic and Current Distribution Historically, *Cyanea acuminata* was known from 31 scattered occurrences in the Koolau Mountains of Oahu. Currently, between 172 and 208 plants are known from 18 occurrences in both the Koolau and Waianae Mountains at East Makaleha (2 individuals), Halemano (6), Kaala (18), Kaalaea (30), Kahana near Puu Kaaumakua (3-4), Kahuku Cabin (1), Kaipapau (40 to 50), Kaluanui and Maakua (12), Kawaiiki (1), Konahuanui (20 to 40), Makaua (3), Pia (4), Poamoho (12-17), Pukele (1), Puu Keahiakahoe (3), Puu O Kona (1), south Kaukonahua (5), and Waahila (10) (HINHP Database 2001). The number of occurrences and the range of *C. acuminata* are declining (U.S. Army 2003a).

Ecology *Cyanea acuminata* typically grows on slopes, ridges, or stream banks between 216 and 1,208 m (708 and 3,962 ft) in elevation. The plants are found in *Metrosideros polymorpha-Dicranopteris linearis*, *Acacia koa-M. polymorpha* wet or mesic forest or shrubland, or *Diospyros sandwicensis-M. polymorpha* lowland mesic forest with one or more of the following associated native species: *Antidesma* sp., *Broussaisia argutas*, *Chamaesyce* sp., *Charpentiera* sp., *Cyrtandra* spp., *Diplazium sandwichianum*, *Dryopteris sandwicensis*, *Dubautia laxa*, *Freycinetia arborea*, *Hibiscus* sp., *Hedyotis* sp., *Ilex anomala*, *Labordia* sp., *Machaerina* sp., *Melicope* spp., *Perrottetia sandwicensis*, *Phyllostegia* sp., *Pipturus albidus*, *Pisonia* sp., *Psychotria* sp., *Sadleria* sp., *Syzygium sandwicensis*, *Touchardia latifolia*, and *Wikstroemia* sp. (HINHP Database 2001; Wagner *et al.* 1999). *Cyanea acuminata* has been observed fruiting in February and November. Little else is known about its flowering cycles, pollination vectors, seed dispersal agents, longevity, specific environmental requirements, and limiting factors (Service 1998a).

Threats The major threats to *Cyanea acuminata* are habitat degradation and destruction by feral pigs and goats; potential impacts from military activities; predation by slugs; predation by rats; and competition with the non-native plant species such as *Ageratina adenophora*; *Aleurites moluccana*, *Clidemia hirta*, *Cordyline fruticosa*, *Dioscorea* sp., *Erigeron karvinskianus*, *Musa* sp., *Passiflora suberosa*, *Psidium cattleianum*, *Rubus argutus*, and *Schinus terebinthifolius*. In addition, *C. acuminata* is threatened by the risk of extinction from naturally occurring stochastic events (such as landslides, hurricanes, or flooding) and from reduced reproductive vigor, both due to the small number of remaining individuals (HINHP Database 2001; Service 1998a; 61 FR 53089).

Conservation Needs of the Species A State-wide management plan should be developed and implemented for the long-term conservation of all known occurrences of *Cyanea acuminata.* This plan should also include broader landscape actions that are needed for the recovery of this plant throughout its range. The recovery plan for this species identifies the following important conservation actions. Fences should be constructed around the known populations of *C. acuminata* to exclude feral pigs. Feral pigs should be controlled or removed from these areas to alleviate their impact on native ecosystems and promote germination of *C. acuminata* over a greater landscape. Where fences are not feasible due to topography, other means of ungulate control should be extensively employed. Occurrences that have only a few remaining individuals should be give priority for remove non-native plants and fence construction. Rats should controlled in the vicinity of known occurrences and over the broader landscape needed to sustain this plant. This should include the use of the approved rodenticides and, when approved, aerial dispersal of rodenticide.

Ongoing Conservation Actions This species is in genetic storage at the Lyon Arboretum and the National Tropical Botanical Garden (Service 2002). The Service is currently not aware of any other conservation efforts for this species.

Environmental Baseline

Status of the Species in the Action Areas There are four known occurrences of *Cyanea acuminata*

totaling 20 to 25 individuals in KLOA action area (located at Kahuku Cabin, Kawaiiki, Poamoho, and Helemano) (K. Kawelo, U.S. Army, pers. com. 2003; J. Lau, HINHP, pers. com. 2003). These individuals represent about 12 percent of all remaining individuals of *C. acuminata*. There is one known occurrence of 25 individuals of *C. acuminata* in the SBER action area located at south Kaukonahua (HINHP Database 2002; U.S. Army 2003a). These individuals represent about 15 percent of the total remaining individuals of this species. There is one known occurrence of 18 individuals of *C. acuminata* in SBMR action area, located at Kaala (U.S. Army 2003a). These individuals represent about 10 percent of the total remaining individuals of this species. In total, 63 to 68 individuals from six occurrences, representing approximately 37 percent of the known individuals of the species, are found in action areas. Currently, there are no stable population units of greater than 50 mature and reproducing plants outside of the Army action areas (U.S. Army 2003a). All of these occurrences are within biologically significant areas that contain or are likely to contain federally listed endangered or candidate species within intact native vegetation (CEMML 2001).

Threats in the Action Areas The threats to *Cyanea acuminata* include non-native plants, fire, and trampling by foot traffic in KLOA, SBER, and SBMR. Overall, occurrences of *Cyanea acuminata* in the KLOA, SBER, and SBMR action areas are vulnerable to non-native plant introductions and to trampling from foot traffic, both of which are directly associated with Army training actions. While the threat of fire is considered to be low, it is also directly associated with Army training actions. In addition, *C. acuminata* is threatened by feral ungulates (pigs in SBER and KLOA and goats and pigs in SBMR), slugs and rats.

Conservation Needs in the Action Areas A stabilization plan will be developed and implemented for the stabilization and long-term conservation of *Cyanea acuminata*. This plan should include broader landscape actions that are needed to sustain this plant. Currently, there are no stable population units of *C. acuminata* within or outside of the Army action areas (KLOA, SBER and SBMR). More than 50 percent of the known remaining individuals occur within these action areas. To be considered stable, *C. acuminata* must meet the criteria required for stability of a short-lived perennial (Service 1998a).

Stabilization for *C. acuminata* will include the following actions. Fences will be constructed around all occurrences of *C. acuminata* to exclude feral pigs and prevent trampling from foot traffic, where these threats are identified as significant by the Oahu Implementation Team. Management actions will be prioritized to first address immature plants or occurrences with a few individuals. Where exclosures are not feasible due to topography, other means of ungulate control will be employed. Non-native plant species within or near fenced areas should be controlled or removed, including *Rubus argutus* and *Psidium cattleianum*. Rats are a significant threat to *C. acuminata* and will be controlled near all known occurrences and over the broader landscape. The Army will continue to develop and refine its WFMP to provide protection from fire. Surveys will be conducted within and outside the action areas (U.S. Army 2003a).

Ongoing Conservation Actions in the Action Areas The Service is currently not aware of any conservation efforts for this species.

Status of the Species - *Cyanea crispa* (Haha)

Species Description *Cyanea crispa* is a short-lived perennial in the Campanulaceae (bellflower family). It is an unbranched shrub with leaves that are 30.0 to 75.0 cm (12 to 30 in) long and 9.0 to 16.0 cm (3.5 to 6.5 in) wide, which are clustered at the ends of succulent stems that are 0.3 to 1.3 m (1.0 to 4.3 ft) long. The flowers are 4.0 to 6.0 cm (1.6 to 2.4 in) long with a magenta color and dark longitudinal stripes. The globe-shaped berries are about 1.0 cm (2.54 in) long. *C. crispa* is distinguished from other species in this endemic Hawaiian genus by its leaf shape, distinct calyx lobes, length of the flowers, and stalks of flower clusters (Wagner *et al.*1999).

Listing Status *Cyanea crispa* was federally listed as endangered on March 28, 1994 (59 FR 14482) and State-listed as endangered in Hawaii at the same time. A recovery plan was prepared for this species in 1998 (Service 1998a). Critical habitat was designated for *C. crispa* on Oahu on June 17, 2003 (68 FR 35950).

Historic and Current Distribution Historically, *Cyanea crispa* was known from scattered locations throughout the upper elevations of the Koolau Mountains of Oahu from Kaipapau Valley to Waialae Iki Ridge. This species is now known from 11 occurrences with a total of 65 individuals at Aihualama (1 individual), Kaipapau (3), Kapakahi (1), Kawaipapa (1), Maakua (2), Makua (10), Maunawili (1), Pia (20), Pukele (6), upper Kawaiiki (5), and Wailupe (15) (HINHP Database 2001). The known occurrences of *C. crispa* are in decline, and those that remain occur in small clusters that are widely dispersed (Service 1998a).

Ecology *Cyanea crispa* is found in a variety of habitats ranging from steep slopes in open mesic forests to gentle slopes or moist gullies in closed wet forests and along stream banks at elevations between 56 and 959 m (184 and 3,146 ft). Associated native plant species include *Antidesma platyphylla*, *Boehmeria grandis*, *Broussaisia argutus*, *Christella cyatheoides*, *Cibotium chamissoi*, *Cyrtandra* spp., *Diospyros* sp., *Dubautia* sp., *Metrosideros polymorpha*, *Perrottetia sandwicensis*, *Pipturus albidus*, *Pisonia umbellifera*, *Psychotria* sp., or *Touchardia latifolia* (HINHP Database 2001; Service 1998a). *C. crispa* was observed flower in April and fruiting in June and September. Little else is known about its flowering cycle, pollination vectors, seed dispersal agents, longevity, specific environmental requirements, and limiting factors (Service 1998a; 59 FR 14482).

Threats The major threats to *Cyanea crispa* are habitat alteration and predation by feral pigs; competition with non-native plant species; predation by rats; and extinction due to naturally occurring stochastic events and/or reduced reproductive vigor, both resulting from the small number of remaining individuals, their limited gene pool, and their restricted distribution. The non-native plant species *Arthrostemma ciliatum*, *Clidemia hirta*, *Psidium cattleianum*, *Psidium guajava*,

Pterolepis glomerata, *Rubus rosifolius*, *Schinus terebinthifolius*, *Setaria palmifolia*, and *Zingiber zerumbet* threaten *C. crispa* by altering its habitat and competing with it for nutrients, light, and space. The types of stochastic events most likely to affect *C. crispa* are landslides, hurricanes, or flooding (Service 1998a; 59 FR 14482).

Conservation Needs of the Species A State-wide management plan should be developed and implemented for the long-term conservation of all known occurrences of *Cyanea crispa*. This plan should also include broader landscape actions that are needed for the recovery of this plant throughout its range. The recovery plan for this species identifies the following important conservation actions. Fences should be constructed around the known occurrences of *C. crispa* to exclude feral pigs. Control or removal of pigs from these areas and the broader landscape will alleviate impacts to native ecosystems and will promote nature regeneration. Non-native plant species should be removed from the fenced areas and from the general vicinity of all known occurrences of *C. crispa*. Rats are a serious threat to most occurrences of *C. crispa* and should be controlled in the vicinity of each known occurrence and over the broader landscape. This should include use of currently-approved rodenticide bait blocks and, when approved, aerial dispersal of rodenticide (Service 1998a). Occurrences of *C. crispa* with only a few remaining individuals should be given priority for implementation of conservation actions.

Ongoing Conservation Actions *Cyanea crispa* is being propagated at the Lyon Arboretum, the Army Environmental nursery and the National Tropical Botanical Garden. In addition, seeds are being stored at the Lyon Arboretum seed storage facility (Service 2002). The Hawaii Division of Forestry and Wildlife has been controlling pigs in Hidden Valley, however site visits have revealed abundant pig sign with many individuals of *C. crispa* defoliated or dead (Service 1998a). The Service is currently not aware of any other conservation efforts for this species.

Environmental Baseline

Status of the Species in the Action Area *Cyanea crispa* is known from one occurrence of five individuals in upper Kawaiiki in the KLOA action area. They are located approximately 63 m (207 ft) from the Koolau summit trail. These individuals represent eight percent of the all known individuals of this species. There are no stable population units of greater than 50 mature and reproducing plants outside of the KLOA action area. The occurrence within KLOA occurs within a biologically significant area that contains other federally listed endangered species and/or rare natural communities (CEMML 2001).

Threats in the Action Area Threats to *Cyanea crispa* in KLOA include competition with non-native plants, predation by feral pigs, fire, trampling from foot traffic. The spread of non-native plants and trampling are threats that are directly associated with Army training actions.

Conservation Needs in the Action Area A stabilization plan will be developed and implemented for the stabilization and long-term conservation of *Cyanea crispa*. This plan should include broader landscape actions that are needed to sustain this plant. This species will be stabilized because three

stable population units do not exist outside of the KLOA action area. To be considered stable, *C. crispa* must meet the criteria required for stability of a short-lived perennial (Service 1998a). Stabilization for *C. crispa* will include the following actions. Fences will be constructed to protect occurrences from rooting and predation by feral pigs and from trampling by foot traffic, where these threats are identified as significant by the Oahu Implementation Team. Where exclosures are not feasible due to topography, other means of ungulate control will be employed. Non-native plants will be controlled within fenced areas and in the general vicinity all occurrences of *C. crispa*. Rats will be controlled in the vicinity of all occurrences of *C. crispa* and should be controlled over the broader landscape needed to sustain this plant species. The number of individuals represented in *ex situ* propagation will be increased by collecting from plants not currently represented in these collections. These efforts should be prioritized based on the number of individuals remaining in each occurrence of *C. crispa*.

Ongoing Conservation Actions in the Action Area The Service is currently not aware of any conservation efforts for this species in the action area.

Status of the Species - *Cyanea grimesiana ssp. obatae* (Haha)

Species Description *Cyanea grimesiana* ssp. *obatae* is a short-lived perennial in the Campanulaceae (or the bellflower family). It is single-stemmed or sparingly branched shrub, growing from 1 to 3.2 m (3.3 to 10.5 ft) tall. The leaves are wide, deeply lobed, 27 to 58 cm (10.6 to 22.8 in) long, 14 to 32 cm (5.5 to 12.6 in) wide, pinnately divided, and clustered towards the tips of the stems. Stalks of 6 to 12 purple or green to yellow-white flowers, 5.5 to 8.0 cm (2.2 to 3.1 in) long, originate amongst the leaves. The orange berries are 1.8 to 3.0 cm (0.7 to1.2 in) long and 0.8 to1.5 cm (0.3 to 0.6) wide. *C. grimesiana* ssp. *obatae* can be distinguished from the two other subspecies of *C. grimesiana* by its short, narrow calyx lobes that are not fused and do not overlap (Wagner *et al.* 1999).

Listing Status *Cyanea grimesiana* ssp. *obatae* was federally listed as endangered on June 27, 1994 (59 FR 32932) and State-listed as endangered in Hawaii at the same time. A recovery plan was prepared for this species in 1998 (Service 1998a). Critical habitat was designated for *C. grimesiana* ssp. *obatae* on Oahu on June 17, 2003 (68 FR 35950).

Historic and Current Distribution Historically, *Cyanea grimesiana* ssp. *obatae* was known from Puu Hapapa to Kaaikukai in the southern Waianae Mountains. Currently, five occurrences with a total of 42 individuals are known from Palikea (1 individual), north branch of south Ekahanui (5), south Kaluaa (2), Palikea-Palawai (28), and Pahole (6) (HINHP Database 2001; K. Kawelo, U.S. Army, pers. comm. 2003; Wagner *et al.* 1999; J. Lau, HINHP, pers. comm. 2003).

Ecology *Cyanea grimesiana* ssp. *obatae* typically grows on steep, moist, shaded slopes in diverse mesic to wet lowland forests between 404 and 1,075 m (1,325 and 3,528 ft) elevation. They often grow on steep vertical embankments in rock or a mix of rock and soil (U.S. Army 2003a).

Associated native species include *Acacia koa*, *Antidesma platyphyllum*, *Chamaesyce* sp., *Charpentiera obovata*, *Cibotium chamissoi*, *Claoxylon sandwicense*, *Coprosma* sp., *Cyanea membranacea*, *Cyrtandra waianaeensis*, *Diplazium sandwichianum*, *Dryopteris unidentata*, *Dubautia* sp., *Freycinetia arborea*, *Hedyotis acuminata*, *Hedyotis terminalis*, *Metrosideros polymorpha*, *Myrsine lessertiana*, *Nothocestrum* sp., *Perrottetia sandwicensis*, *Pipturus albidus*, *Pisonia umbellifera*, *Pouteria sandwicensis*, *Psychotria hathewayi*, *Rumex* sp., *Selaginella arbuscula*, and *Streblus pendulinus* (HINHP Database 2001; Wagner *et al.* 1999).

C. grimesiana ssp. *obatae* produces flowers and fruits year round, depending on rainfall. The long tubular flowers and orange berries of this taxon, suggest pollination and seed dispersal by birds may be common. However, they are capable of self-pollination and isolated plants have been found with viable seeds. Most known occurrences of *C. grimesiana* ssp. *obatae* are recently discovered. Most of those occurrences that have been tracked for the last 15 to 20 years have either died out or greatly declined in numbers of individuals. Little else is known about its flowering cycles, pollination vectors, seed dispersal agents, longevity, specific environmental requirements, and limiting factors (59 FR 32932). *C. grimesiana* ssp. *obatae* presumably lives for less than 10 years like other *Cyanea* of similar size.

Threats The major threats to *Cyanea grimesiana* ssp. *obatae* are habitat degradation by feral pigs and goats; competition from non-native plant species; predation of seeds, fruits and seedlings by introduced slugs and rats; fires; and extinction caused by naturally occurring events and/or reduced reproductive vigor due to the small number of extant individuals. Non-native plants that may compete for light, soil, and nutrients include *Ageratina riparia*, *Aleurites moluccana*, *Blechnum appendiculatum*, *Buddleia asiatica*, *Clidemia hirta*, *Christella parasitica*, *Lantana camara*, *Morella faya*, *Paspalum conjugatum*, *Passiflora suberosa*, *Psidium cattleianum*, *Rubus rosifolius*, *Schinus terebinthifolius*, *Setaria palmifolia*, and *Toona ciliata*. The types of stochastic events most likely to affect *C. koolauensis* are landslides, hurricanes, or flooding. In addition, the long-billed, nectar-feeding native Hawaiian birds that were the presumed pollinators of *C. grimesiana* ssp. *obatae* have been almost totally extirpated from the Waianae Mountains. Although the taxon is capable of self-pollination, the loss of its normal pollinators has likely resulted in decreased genetic variability within the subspecies (HINHP Database 2001; Service 1998a; 59 FR 32932).

Conservation Needs of the Species A State-wide management plan should be developed and implemented for the long-term conservation of all known occurrences of *Cyanea grimesiana* ssp. *obatae*. This plan should also include broader landscape actions that are needed for the recovery of this plant throughout its range. The recovery plan for this species identifies the following important conservation actions. The occurrences of *C. grimesiana* ssp. *obatae* at Kaluaa and north Palawai should be fenced and managed. Control or removal of pigs from these areas will alleviate impacts on the native ecosystem and permit nature germination of *C. grimesiana* ssp. *obatae* over a broader landscape. The three occurrences of *C. grimesiana* ssp. *obatae* on Oahu are seriously threatened by rat predation. Rats should be controlled in the vicinity of each known occurrence and

over the broader landscape. This should include use of currently-approved rodenticide bait blocks and, when approved, should include aerial dispersal of rodenticide (Service 1998a).

Ongoing Conservation Actions The Army and State Natural Area Reserve System have fenced the single individual of *Cyanea grimesiana* ssp. *obatae* in Palikea Gulch. The Nature Conservancy of Hawaii has fenced a population of eight plants in Ekahanui Gulch and is controlling alien weeds and monitoring this population. This occurrence has now decreased to five individuals. The Hawaii Division of Forestry and Wildlife is growing *C. grimesiana* ssp. *obatae* at the Pahole Rare Plant Facility for planting in The Nature Conservancy's Honouliuli Preserve (Service 1998a). This species is also being successfully propagated and seeds are being stored at both the National Tropical Botanical Garden and the Lyon Arboretum (Service 2002). The Service is currently not aware of any other conservation efforts for this species.

Environmental Baseline

Status of the Species in the Action Area Within the SBMR action area, one individual of *Cyanea grimesiana* ssp. *obatae* is known from Palikea Gulch in the lower part of the Kaala Natural Area Reserve (HINHP Database 2002; U.S. Army 2003a). This individual represents about two percent of all known individuals of *C. grimesiana* ssp. *obatae.* There are also six individuals within the MMR action area, representing 14 percent of the known individuals. There are no known stable population units of greater than 50 mature and reproducing individuals outside of any of the Army action areas (U.S. Army 2003a). The single individual within SBMR occurs within a biologically significant area with stands of intact, relatively common native vegetation (CEMML 2001).

Threats in the Action Area Threats to *Cyanea grimesiana* ssp. *obatae* in SBMR include competition from non-native plants, trampling from foot traffic, and stray munitions. Habitat degradation by feral pigs and goats, predation of seeds, fruits and seedlings by introduced slugs and rats; and extinction caused by naturally occurring events are also significant threats to the species. Non-native plants, munitions, and fire are threats that can be directly linked to Army training actions.

Conservation Needs in the Action Area *Cyanea grimesiana* ssp. *obatae* must be stabilized because no stable populations exist outside of the Army action area. To be considered stable, *C. grimesiana* ssp. *obatae* must meet the criteria required for stability of a short-lived perennial (Service 1998a). The stabilization plan for this taxon from the Makua IP must be implemented to achieve three stable population units. Stabilization measures include habitat and population management of four existing population units; collection of full *ex situ* representation of wild stock statewide; reintroduction into at least three sites; rat control; and research and implementation of slug control methods (U.S. Army Garrison 2003).

Ongoing Conservation Actions in the Action Area The Army, with the State, fenced the single individual of *Cyanea grimesiana* ssp. *obatae* in Palikea Gulch within Mt. Kaala Natural Area Reserve. The Army is conducting surveys for additional occurrences in suitable habitat. Invasive plant and rat management around the individual is ongoing (U.S. Army 2003a). The Service is currently not aware of any other conservation efforts for this species in the action area.

Status of the Species - *Cyanea humboldtiana* (Haha)

Species Description *Cyanea humboldtiana* is a member of the Campanulaceae (bellflower family). It is a short-lived perennial shrub with unbranched woody stems 1 to 2 m (3.2 to 6.6 ft) tall and inversely egg-shaped to broadly elliptic leaves, 18 to 45 cm (7.1 to 17.7 in) long and 7 to 16 cm (3 to 6 in) wide. The leaf edges are hardened and have shallow, ascending rounded teeth. The dark magenta or white flowers are 6 to 7.5 cm (2.4 to 3.0 in) long and form axillary racemes. The fruit is an elliptic shaped pale orange-yellow berry 1.0 to 1.4 cm (0.4 to 0.6 in) long. *C. humboldtiana* is distinguished from other members of this endemic Hawaiian genus by its long and downward bending flowering stalk (Wagner *et al.* 1999).

Listing Status *Cyanea humboldtiana* was federally listed as endangered on October 10, 1996 (61 FR 53089) and State-listed as endangered in Hawaii at the same time. A recovery plan was prepared for this species in 1998 (Service 1998a). Critical habitat was designated for *C. humboldtiana* on Oahu on June 17, 2003 (68 FR 35950).

Historic and Current Distribution *Cyanea humboldtiana* was known historically from 17 occurrences in the central and southern parts of the Koolau Mountains of Oahu. Currently, between 184 and 334 plants are known from seven occurrences at Kaluanui (1), Konahuanui (25), Maakua (6), Puu Keahiakahoe (100 to 200), Wailupe and Pia (50 to 100), Opaeula Midreach (1), and Poamoho trail (1) (HINHP Database 2001; K. Kawelo, U.S. Army, pers. comm. 2003; J. Lau, HINHP, pers. comm. 2003). They are declining in number and populations are small and widely dispersed with restricted distribution (Service 1998a).

Ecology *Cyanea humboldtiana* is usually found in wet *Metrosideros polymorpha-Dicranopteris linearis* lowland forest and shrub between 261 and 959 m (856 and 3,146 ft). Associated native plant species include *Acacia koa*, *Bobea elatior*, *Broussaisia arguta*, *Cibotium chamissoi*, *Dubautia laxa*, *Hedyotis terminalis*, *Ilex anomala*, *Machaerina angustifolia*, *Melicope* sp., *Phyllostegia* sp., *Psychotria mariniana*, *Sadleria* sp., *Scaevola mollis*, *Syzygium sandwicensis*, *Wikstroemia* sp., and ferns (HINHP Database 2001). *Cyanea humboldtiana* has been observed in flower from September through January. Little else is known about its flowering cycles, pollination vectors, seed dispersal agents, longevity, specific environmental requirements, and limiting factors (Service 1998a).

Threats The major threats to *Cyanea humboldtiana* are habitat degradation and destruction by feral pigs, predation by rats, competition with the non-native plant species, and a risk of extinction from naturally occurring stochastic events and/or reduced reproductive vigor due to the small number of remaining occurrences. The non-native plants *Axonopus fissifolius*, *Clidemia hirta*, *Erigeron karvinskianus*, *Psidium cattleianum*, and *Pterolepis glomerata* threaten *C. humboldtiana* by altering its habitat and competing with it for nutrients, light, and space. The types of stochastic events most likely to affect *C. koolauensis* are landslides, hurricanes, or flooding. The Konahuanui summit occurrence is also threatened by trampling by hikers (HINHP Database 2001; Service 1998a; 61 FR 53089).

Conservation Needs of the Species A State-wide management plan should be developed and implemented for the long-term conservation of all known occurrences of *Cyanea humboldtiana.* This plan should also include broader landscape actions that are needed for the recovery of this plant throughout its range. The recovery plan for this species identifies the following important conservation actions. Exclosures should be constructed around the known occurrences to reduce impacts from feral pigs. Subsequent control or removal of pigs from these areas will alleviate their impact on native ecosystems. Specific efforts should be made to control non-native plants and protect occurrences, with priority given to occurrences that have only a few remaining individuals. Occurrences of this species on Oahu may be seriously threatened by rat predation. A rat control plan should be developed and implemented which will include the use of the currently-approved rodenticide bait blocks and ultimately a more broad-scale method such as aerial dispersal of rodenticide (Service 1998a).

Ongoing Conservation Actions No specific conservation measures have been undertaken for *Cyanea humboldtiana* statewide. There are no representatives of this species *ex situ.* However, this species may benefit from habitat level management for other KLOA species (U.S. Army 2003a).

Environmental Baseline

Status of the Species in the Action Area Two individuals of *Cyanea humboldtiana* from two occurrences are known from Opaeula midreach and Poamoho trail between 590 and 730 m (1940 and 2400 ft) elevation in the KLOA action area (HINHP 2002; U.S. Army 2003a). The Opaeula midreach occurrence is 230 m (755 ft) from a trail while the Poamoho occurrence is located less than a meter (less than 3 ft) from the trail. The two occurrences within KLOA action area are found in biologically significant areas that contain or are likely to contain occurrences of other federally listed endangered or candidate species (CEMML 2001). These two individuals comprise less than one percent of the total number of known individuals. Outside of the KLOA action area, there are two stable population units with greater than 50 mature and reproducing individuals; one at Puu Keahia Kahoe (100 to200 individuals) and one at Wailupe and Pia (50 to 100 individuals) (K. Kawelo, U.S. Army, pers. comm. 2003; J. Lau, HINHP, pers. comm. 2003; Service 1998a).

Threats in the Action Area The threats to *Cyanea humboldtiana* include competition from non-native plants, degradation of habitat by feral pigs, predation by rats, fire, and trampling from foot traffic. Threats from non-native plants and trampling are directly related to Army training actions in the KLOA action area.

Conservation Needs in the Action Area The Army is not expected to stabilize *Cyanea humboldtiana* across its range because less than one percent of the known individuals occur in any of the Army's action areas. The Oahu Implementation Team will consider additional species-specific conservation measures that would benefit *C. humboldtiana* and could be combined with management actions for other species covered in this Biological Opinion. These conservation measures could include collecting seeds for genetic storage, *ex situ* propagation, and control of non-native plants.

Ongoing Conservation Actions in the Action Area There are no species specific conservation actions occurring within the action area (U.S. Army 2003a).

Status of the Species - *Cyanea koolauensis* (Haha)

Species Description *Cyanea koolauensis* is a member of the Campanulaceae (bellflower family). It is a short-lived perennial shrub 1 to 1.5 m (3.5 to 5 ft) tall with unbranched woody stems and linear to narrowly elliptic leaves 16 to 37 cm (6.3. to 14.6 in) long and 1.5 to 4.0 cm (0.6 to 1.6 in) wide with a whitish underside. The leaf edges are hardened with shallow, ascending rounded teeth. The magenta flowers are 5 to 9 cm (2.0 to 3.5 in) long and form axillary racemes. The fruit is a yellow, orange or purple globose berry, and the smooth and shiny seeds are brown to black. *C. koolauensis* is distinguished from other species in this endemic Hawaiian genus by the leaf shape and width; the whitish green lower leaf surface; and the lengths of the leaf stalks, calyx lobes, and hypanthium (base of flower) (Wagner *et al.* 1999).

Listing Status *Cyanea koolauensis* was federally listed as endangered on October 10, 1996 (61 FR 53089) and State-listed as endangered in Hawaii at the same time. A recovery plan was prepared for this species in 1998 (Service 1998a). Critical habitat was designated for *C. koolauensis* on Oahu on June 17, 2003 (68 FR 35950).

Historic and Current Distribution *Cyanea koolauensis* was known historically from 27 occurrences scattered throughout the Koolau Mountains on Oahu. Currently, 18 occurrences totaling 101 to 104 individuals are known from the Aiea Ridge trail (2 individuals), Halawa (3), Kalahao (3 to 5), Kalihi-Nuuanu Ridge (1), Lulumahu (6), Manana trail (1), Niu and Wailupe (6), Waialae Nui Ridge (2), Waimalu (2), Kawainui-Kaipapau-Kawailoa (35), upper Helemano (7), lower Helemano-Opaeula (4), Poamoho (4), Kawaiiki-Kawainui (4), Kawailoa trail (10), north Kaukonahua (1), south Kaukonahua (9), and Malaeakahana-Waimea summit (1 to 2) in the Koolau Mountains (HINHP Database 2001). Occurrences of *C. koolauensis* are declining, and the current locations are small and widely dispersed (HINHP Database 2001; Service 1998a; J. Lau, pers. comm. 2003; K. Kawelo, pers. comm. 2003).

Ecology *Cyanea koolauensis* is usually found on slopes, stream banks, and ridge crests in wet *Metrosideros polymorpha-Dicranopteris linearis* wet forest at elevations between 163 and 959 m (535 and 3,146 ft). Associated native plant species include *Acacia koa*, *Antidesma platyphyllum*, *Bidens* sp., *Bobea elatior*, *Broussaisia arguta*, *Cibotium* sp., *Diplopterygium pinnatum*, *Dubautia* sp., *Hedyotis* sp., *Machaerina* sp., *Melicope* sp., *Pittosporum* sp., *Pritchardia martii*, *Psychotria mariniana*, *Sadleria* sp., *Scaevola* sp., *Syzygium sandwicensis*, or *Wikstroemia* sp. (HINHP Database 2001; Wagner *et al.* 1999). *Cyanea koolauensis* has been observed in flower and fruit from May through August. Little else is known about its flowering cycles, pollination vectors, seed dispersal agents, longevity, specific environmental requirements, and limiting factors (Service 1998a).

Threats The major threats to *Cyanea koolauensis* are habitat degradation and destruction by feral pigs; potential impacts from military activities; trail clearing; potential predation by rats; competition with non-native plant species; trampling from foot traffic; and a risk of extinction from naturally occurring stochastic events and/or reduced reproductive vigor due to the small number of remaining individuals. The non-native plant species *Clidemia hirta*, *Heliocarpus popayanensis*, *Psidium cattleianum*, and *Pterolepis glomerata* threaten *C. koolauensis* by altering its habitat and competing with it for nutrients, light, and space. The types of stochastic events most likely to affect *C. koolauensis* are landslides, hurricanes, or flooding (HINHP Database 2001; Service 1998a; 61 FR 53089).

Conservation Needs of the Species A State-wide management plan should be developed and implemented for the long-term conservation of all known occurrences of *Cyanea koolauensis*. This plan should also include broader landscape actions that are needed for the recovery of this plant throughout its range. The recovery plan for this species identifies the following important conservation actions. Fences should be constructed around all known occurrences of *C. koolauensis* to reduce impacts from feral pigs and trampling. In areas where fencing is not feasible, control or removal of pigs should be implemented to benefit the native ecosystem that is needed to sustain this plant. Non-native plants should be removed from the vicinity of all known occurrences of *C. koolauensis*. *Ex situ* propagation should be initiated using seeds from individuals spread across the current range of the species. The threat of rat predation should be assessed and, if it is considered significant, rats should be controlled in the vicinity of all known occurrences of *C. koolauensis* and across the broader landscape using bait boxes and aerial dispersal of rodenticide, when approved (Service 1998a). Priority for these and other conservation actions should be give to occurrences that have only a few remaining individuals.

Ongoing Conservation Actions No specific conservation measures have been undertaken for *Cyanea koolauensis* statewide by other agencies. There are no representatives of this species *ex situ* (U.S. Army 2003a). The Service is currently not aware of any other conservation efforts for this species.

Environmental Baseline

Status of the Species in the Action Areas A total of 75 to 76 individuals of *Cyanea koolauensis* occur on Army lands. One to two individuals are found on the Waimea-Malaeakahana Summit Ridge at about 605 m (1,980 ft) elevation in the KTA action area (HINHP Database 2002; U.S. Army 2003a). They represent about one percent of the total known individuals of this species. There are seven occurrences totaling 65 individuals in the KLOA action area. They are found at Kawainui-Kaipapau-Kawailoa (35), upper Helemano (7), lower Helemano-Opaeula (4), Poamoho (4), Kawaiiki-Kawainui (4), Kawailoa trail (10), and north Kaukonahua (1) (J. Lau, HINHP, pers. comm. 2003; K. Kawelo, pers. comm. 2003). The KLOA occurrences represent about 65 percent of the total known individuals of this species. Nine individuals from one occurrence are found at south Kaukonahua in the SBER action area (HINHP Database 2002; K. Kawelo, pers. comm. 2003; J. Lau, HINHP, pers. comm. 2003; U.S. Army 2003a), representing about nine percent of

the total known individuals of this species. All of these occurrences within biologically significant areas are likely to contain other federally listed endangered or candidate species (CEMML 2001). There are no stable population units of greater than 50 *C. koolauensis* individuals outside of any of the Army action areas (HINHP Database 2001; Service 1998a; U.S. Army 2003a; K. Kawelo, U.S. Army, pers. comm. 2003; J. Lau, HINHP, pers. comm. 2003).

Threats in the Action Areas In KTA, *Cyanea koolauensis* is threatened by ungulates, non-native plants, and trampling by dismounted military training. In KLOA, *C. koolauensis* is threatened by ungulates, fire, and trampling by dismounted military training. In SBER, threats are ungulates, non-native plants, fire, trampling from dismounted military training, and potential predation by rats (U.S. Army 2003a). For *C. koolauensis* impacts from non-native plants, from trampling by foot traffic, and in some locations, from fire, are entirely or partly related to Army activities in the KLOA, KTA, and SBER action areas.

Conservation Needs in the Action Areas A stabilization plan will be developed and implemented for the stabilization and long-term conservation of *Cyanea koolauensis*. This plan should include broader landscape actions that are needed to sustain this plant, including suitable habitat outside and within the action areas. *C. koolauensis* will be stabilized because three stable population units do not currently exist outside of the Army action areas (KTA, KLOA, and SBER). To be considered stable, *C. koolauensis* must meet the criteria required for stability of a short-lived perennial (Service 1998a).

Stabilization for *C. koolauensis* will include the following actions. The Army will conduct surveys within and outside the action areas. The Army will construct fences to protect all known occurrences from feral pigs and from trampling by foot traffic, where these threats are identified as significant by the Oahu Implementation Team. Where fencing is not feasible due to topography, pigs will be controlled or removed from the areas where *C. koolauensis* is known to occur. The threat of fire associated with Army training activities will be managed so that uncontrolled fires are unlikely to occur, and training that has the potential to start a fire should be address in the WFMP. Non-native plants such as *Clidemia hirta* and *Psidium cattleianum* will be controlled or removed form the vicinity of all known occurrences of *C. koolauensis*. Full genetic representation of *C. koolauensis* will be collected for *ex situ* propagation. The threat of rat predation on *C. koolauensis* will be assessed and, if found to be significant, rats will be controlled in the vicinity of all known occurrences of *C. koolauensis* and across the broader landscape needed to sustain this species. Immature plants and occurrences with a small number of individuals will be given priority treatment (U.S. Army 2003a).

Ongoing Conservation Actions in the Action Areas The Army monitors *Cyanea koolauensis* occurrences for threats and some benefit from ungulate and invasive plant removal in the area (U.S. Army 2003a). The Service is currently not aware of any other conservation efforts for this species in the action areas.

Status of the Species - *Cyanea st.-johnii* (Haha)

Species Description *Cyanea st.-johnii is* a member of the Campanulaceae (bellflower family). It is a short-lived perennial shrub with an unbranched woody stem 30 to 60 cm (12 to 24 in) long. Its leaves are lance-shaped to inversely lance-shaped, 6 to 13 cm (2.4 to 5.1 in) long and 1.5 to 2.0 cm (0.6 to 0.8 in) wide. The leaf edges are thickened, smoothly toothed and curl under. The white flowers form groups of five to 20 flowers on stalks 0.5 to 1.5 cm (0.2 to 0.6 in) tall. The fruit is probably a berry, but detailed information on fruiting is unknown. This species is distinguished from others in this endemic Hawaiian genus by the length of the leaves, the distinctly curled leaf margins, and the petal color (Wagner *et al.* 1999).

Listing Status *Cyanea st.-johnii* was federally listed as endangered on October 10, 1996 (61 FR 53089) and State-listed as endangered in Hawaii at the same time. A recovery plan was prepared for this species in 1998 (Service 1998a). Critical habitat was designated for *C. st.-johnii* on Oahu on June 17, 2003 (68 FR 35950).

Historic and Current Distribution *Cyanea st.-johnii* was known historically from 11 occurrences in the central and southern Koolau Mountains of Oahu. Currently, 58 to 63 plants are known from seven occurrences, including Helemano (3 individuals), north Halawa summit ridge (15), Poamoho-Punaluu summit ridge (1), Waiawa-Waiahole summit crest (4), Wailupe summit (15), Waimalu-Waihee summit Ridge (10), and Waimano (10 to 15) (HINHP Database 2001). The number of occurrences and the number of individuals of *C. st.-johnii* are declining and those that remain are small and widely dispersed with restricted distribution (U.S. Army 2003a).

Ecology *Cyanea st.-johnii* typically grows on wet, windswept slopes and ridges between 415 and 959 m (1,361 and 3,146 ft) elevation in *Metrosideros polymorpha* mixed lowland forest and shrubland or *Metrosideros polymorpha-Dicranopteris linearis* lowland forest and shrubland. Associated native plant species include *Alyxia oliviformis*, *Antidesma* sp., *Bidens macrocarpa*, *Broussaisia arguta*, *Chamaesyce clusiifolia*), *Cibotium* sp., *Dubautia laxa*, *Freycinetia arborea*, *Hedyotis* sp., *Labordia* sp., *Machaerina angustifolia*, *Melicope* sp., *Psychotria* sp., *Sadleria pallida*, *Scaevola mollis*, or *Syzygium sandwicensis* (HINHP Database 2001). *C. st.-johnii* has been observed in flower in July through September. Little else is known about its flowering cycles, pollination vectors, seed dispersal agents, longevity, specific environmental requirements, and limiting factors (Service 1998a).

Threats The major threats to *Cyanea st.-johnii* are habitat degradation and destruction by feral pigs, potential predation by rats, predation by slugs and snails, competition with non-native plant species, and a risk of extinction from naturally occurring events and/or reduced reproductive vigor due to the small number of remaining occurrences and individuals. The non-native plant species *Andropogon virginicus*, *Axonopus fissifolius*, *Clidemia hirta*, and *Sacciolepis indica* threaten *C. st.-johnii* by altering its habitat and competing with it for nutrients, light, and space. The types of stochastic events most likely to affect *C. st.-johnii* are landslides, hurricanes, or flooding. The plants

between the summit of Aiea and Halawa trails are also threatened by trampling from foot traffic (HINHP Database 2001; Service 1998a; 61 FR 53089).

Conservation Needs of the Species A State-wide management plan should be developed and implemented for the long-term conservation of all known occurrences of *Cyanea st.-johnii.* This plan should also include broader landscape actions that are needed for the recovery of this plant throughout its range. The recovery plan for this species identifies the following important conservation actions. Fences should be constructed around all known occurrences of *C. st.-johnii* to reduce impacts from feral pigs and trampling. Control or removal of pigs from the broader landscape area should also be undertaken to alleviate impacts on the native ecosystem needed to sustain this species. *Ex situ* propagation of *C. st.-johnii* should be initiated using material collected from individuals throughout the range of the species. Rats may be a serious threat to this species, as they are for other species of *Cyanea*. Rats should be controlled in the vicinity of all known occurrences of *C. st.-johnii* using approved rodenticides. Work on aerial dispersal of rodenticides should be supported (Service 1998a).

Ongoing Conservation actions No specific conservation measures have been undertaken for *Cyanea st. johnii* statewide by other agencies (Army 2003a).

Environmental Baseline

Status of the Species in the Action Area Two occurrences of four individuals of *Cyanea st.-johnii* are located within the KLOA action area near the headwaters of the Helamano Stream (3) and at Poamoho-Punaluu summit ridge (1). The individuals at Helemano are approximately 280 m (919 ft) from a main trail where as the individuals at Poamoho-Punaluu summit ridge are located approximately 23 m (75 ft) from the Koolau summit trail (HINHP Database 2002; U.S. Army 2003a). These occurrences represent approximately six percent of the total remaining individuals of this species (K. Kawelo, U.S. Army, pers. comm. 2003; J. Lau, HINHP, pers. comm. 2003; Service 1998a). There are no known occurrences of greater than 50 mature and reproducing individuals of *C. st.-johnii* outside the action area. The two occurrences of *C. st.-johnii* within KLOA are found within a biologically significant area with intact native vegetation and occurrences of other federally listed endangered species (CEMML 2001).

Threats in the Action Area The threats to *Cyanea st.-johnii* include ungulates; competition from non-native plants; predation by rats; fire; and trampling from foot traffic. The threats from non-native plants and trampling by foot traffic are, in part, related to Army activities in the KLOA action area.

Conservation Needs in the Action Area A stabilization plan will be developed and implemented for the stabilization and long-term conservation of *Cyanea st.-johnii.* This plan should include broader landscape actions that are needed to sustain this plant. *C. st.-johnii* will be stabilized because three stable population units do not exist outside of the KLOA action area. To be considered stable, *C. st-johnii* must meet the criteria required for stability of a short-lived perennial (Service 1998a).

Stabilization for *C. st.-johnii* will include the following actions. Fences will be constructed around all known occurrences to protect them from feral pigs and trampling by foot traffic where these threats are identified as significant by the Oahu Implementation Team. Where fencing is not feasible due to topography, pigs will be controlled or removed from the broader landscape needed to sustain this plant. Non-native plants, particularly *Clidemia hirta*, *Axonopus fissifolius*, and *Sacciolepis indica*, will be controlled in the vicinity of all known occurrences of *C. st.-johnii*. *Ex situ* propagation of material collected from all known occurrences of *C. st.-johnii* will be undertaken. Rats will be controlled in the vicinity of all known occurrences of *C. st.-johnii* and across the broader landscape that is needed to maintain this plant in an ecological robust state.

Ongoing Conservation actions in the action area The Service is currently not aware of any conservation efforts for this species in the action area.

Status of the Species - *Cyrtandra dentata* (Haiwale)

Species Description *Cyrtandra dentata* is a member of the Gesneriaceae (African violet family). It is a short-lived perennial shrub 1.5 to 5 m (5 to 16 ft) tall with sparsely branched stems. The leaves have a papery texture, are oppositely arranged, very broadly elliptical to suborbicular or broadly ovate to ovate, 9 to 33 cm (3.5 to 13.0 in) long, and 6 to 17 cm (2.4 to 6.7 in) wide. The 8 to 23 cm (3 to 9 in) tall inflorescences are open cymes that originate from the leaf axils. The fruit is 1 to 2 cm (0.4 to 0.8 in) long, and contains many minute seeds. This species is distinguished from others in the genus by the number and arrangement of the flowers, the length of the bracts and flower stalks, and the shape of the leaves (Wagner *et al.* 1999).

Listing Status *Cyrtandra dentata* was federally listed as endangered on October 10, 1996 (61 FR 53089) and State-listed as endangered in Hawaii at the same time. A recovery plan was prepared for this species in 1998 (Service 1998a). Critical habitat was designated for *C. dentata* on Oahu on June 17, 2003 (68 FR 35950).

Historic and Current Distribution *Cyrtandra dentata* was historically known from six occurrences in the Waianae Mountains and three occurrences in the Koolau Mountains of Oahu. Currently, this species is found at Kawaiki Gulch (50), Opaeula Stream (26), Kahanahaiki (97), and Pahole to west Makaleha (300). The four known occurrences total 473 individuals (HINHP Database 2001; K. Kawelo, U.S. Army, pers. comm. 2003; J. Lau, HINHP, pers. comm. 2003). *C. dentata* populations are declining, and those that remain are small and widely dispersed (Service 1998a).

Ecology *Cyrtandra dentata* typically grows in gulches, slopes, stream banks, or ravines in mesic forest in the Waianae Mountains and in wet forest in the Koolau Mountains. It is found between 255 and 953 m (836 and 3,126 ft) elevation with associated native plant species such as *Acacia koa*, *Metrosideros polymorpha*, *Pipturus albidus*, *Pisonia sandwicensis*, *Pisonia umbellifera*, *Pouteria sandwicensis*, *Syzygium sandwicensis*, or *Urera glabra* (HINHP Database 2001; Wagner *et al.* 1999). *C. dentata* has been observed in flower and fruit in May and November.

The reproductive biology of most Hawaiian members of this genus, including *C. dentata*, have not been studied. However, a study of the reproductive biology of *C. grandiflora* on Oahu showed that it is self-compatible and that both self-pollination and cross-pollination requires an unknown insect pollinator. It was also found that there is a strong tendency for a flower's pollen to be shed before the flower's stigma becomes receptive to pollen, thereby decreasing the likelihood of self-pollination. The dispersal agents of *C. dentata* are unknown, although its white berries suggest dispersal by fruit-eating birds. The longevity of individuals of this species is unknown, but since the plant is a shrub, its longevity is presumed to be less than 10 years. There is very little information on population trends for this species. It is possible that the species' numbers are rising in places that have been fenced to exclude pigs over the last decade, such as Pahole Gulch in the Pahole Natural Area Reserve and Kahanahaiki Gulch in MMR. Little else is known about its flowering cycles, pollination vectors, seed dispersal agents, longevity, specific environmental requirements, and limiting factors (Service 1998a).

Threats The major threats to *Cyrtandra dentata* include feral pigs and goats; competition with the non-native plant species, potential predation by rats and slugs, potentially fire, military activities, and a risk of extinction from naturally occurring stochastic events and/or reduced reproductive vigor due to the small number of extant occurrences and individuals. The non-native plant species *Aleurites moluccana*, *Blechnum appendiculatum*, *Christella parasitica*, *Clidemia hirta*, *Psidium cattleianum*, *Psidium guajava*, and *Schinus terebinthifolius* threaten *C. dentata* by altering its habitat and competing with it for nutrients, light, and space. The types of stochastic events most likely to affect *C. dentata* are landslides, hurricanes, or flooding (HINHP Database 2001; Service 1998a; 61 FR 53089).

Conservation Needs of the Species A State-wide management plan should be developed and implemented for the long-term conservation of all known occurrences of *Cyrtandra dentata.* This plan should also include broader landscape actions that are needed for the recovery of this plant throughout its range. The recovery plan for this species identifies the following important conservation actions. All known occurrences of *C. dentata* should be fenced and non-native plants should be removed from the vicinity of each occurrence. The threat from rats should be evaluated at all known occurrences of *C. dentata*. If rats are a significant threat, rats should be controlled in the vicinity of all threatened occurrences using established and approved rodenticides. Rats should also be controlled across a broader landscape by using aerial dispersal of rodenticides, when this method is approved (Service 1998a).

Ongoing Conservation Actions Occurrences in Pahole drainage were fenced and feral pigs were removed by the Hawaii Division of Forestry and Wildlife in 1997. Control of the invasive plants *Psidium cattleianum*, *Schinus terebinthifolius*, and *Clidemia hirta* is being conducted in these and surrounding areas. *Cyrtandra dentata* is being propagated at the Lyon Arboretum (U.S. Army 2003a).

Environmental Baseline

Status of the Species in the Action Area There are two occurrences of *Cyrtandra dentata* with a

total of 76 individuals in Kawaiiki gulch (50) and along Opaeula stream (26) between 384 and 530 m (1,260 and 1,740 ft) elevation within the KLOA (HINHP Database 2002; U.S. Army 2003a; K. Kawelo, U.S. Army, pers. comm. 2003; J. Lau, HINHP, pers. comm. 2003). These individuals represent about 16 percent of the total remaining individuals of this species. An additional 397 individuals are found in Kahanahaiki and from Pahole to west Makaleha within the MMR action area. Therefore, the entire species is currently found only in action areas. The two occurrences within KLOA occur within biologically significant areas that contain or are likely to contain occurrences of other federally listed endangered or candidate species (CEMML 2001). There are no stable population units of greater than 50 *C. dentata* individuals outside of any of the Army action areas (U.S. Army 2003a; HINHP Database 2001; Service 1998a).

Threats in the Action Area The threats to *Cyrtandra dentata* in KLOA include competition from non-native plants, fire, trampling from foot traffic, and potential predation by rats and slugs (U.S. Army 2003a). Threats from non-native plants and trampling by foot traffic are, in part, the result of Army training activities in the KLOA action area.

Conservation Needs in the Action Area A stabilization plan will be developed and implemented for the stabilization and long-term conservation of *Cyrtandra dentata*. This plan should include broader landscape actions that are needed to sustain this plant. This species will be stabilized because three stable population units do not exist outside of the KLOA action area. To be considered stable, *C. dentata* must meet the criteria required for stability of a short-lived perennial (Service 1998a). Since this species was addressed in the Makua Biological Opinion, the stabilization actions as outlined in the Makua IP will be implemented to stabilize this taxon. These stabilization measures will include: surveys for additional occurrences, and if not found, reintroduction of *C. dentata* into at least six management units outside of any action area as designated for the Makua IP; collection and propagation of this taxon for genetic storage and reintroduction into the wild; monitoring and management of known population units as identified in the Makua IP; development and implementation of slug control at reintroduction sites and elsewhere where deemed necessary; and rat control around the reintroduced individuals and other population units, if necessary (U.S. Army Garrison 2003).

Ongoing Conservation Actions in the Action Area The Army has fenced all the known individuals of this species at Kahanahaiki in MMR. This resulted in an observable increase in all size-classes (seedlings, juveniles, and mature plants) at the site. Weeding is occurring within the Kahanahaiki management unit, with emphasis on *Clidemia hirta* and monitoring for additional threats or changes in the population. The Kawaiiki occurrence may benefit from construction of an exclosure for the reintroduction of *Stenogyne sherfii* in KLOA. No other management actions have occurred for *C. dentata* in KLOA (U. S. Army 2003a).

Status of the Species - *Cyrtandra subumbellata* (Haiwale)

Species Description *Cyrtandra subumbellata* is a member of the Gesneriaceae (African violet family). It is a short-lived perennial shrub 2 to 3 m (6.6 to 10 ft) tall. The leaves are papery in

texture, oppositely arranged, circular to egg-shaped, 12 to 39 cm (4.7 to 15.4 in) long, and 3 to 19 cm (1.2 to 7.5 in) wide. The white flowers are 18 to 20 mm (0.7 to 0.8 in) long and form dense umbelliform cymes of 5 to 15 flowers. The white berries are 1.0 to 1.5 cm (0.4 to 0.6 in) long and ovoid shaped. It is distinguished from other species in the genus by its leaf shape and texture; the number of flowers per cluster; and the length of bracts, flower stem, calyx lobes, floral tube, and styles (Wagner *et al.* 1999).

Listing Status *Cyrtandra subumbellata* was federally listed as endangered on October 10, 1996 (61 FR 53089) and State-listed as endangered in Hawaii at the same time. A recovery plan was prepared for this species in 1998 (Service 1998a). Critical habitat was designated for *C. subumbellata* on Oahu on June 17, 2003 (68 FR 35950).

Historic and Current Distribution Historically, *Cyrtandra subumbellata* was known from the Koolau Mountains of Oahu. Currently, *C. subumbellata* is known from three occurrences in the north and central Koolau Mountains (U.S. Army 2003a) with a total of approximately 108 individuals: two individuals from Kahana on Waikane trail, six individuals from the south Kaukonahua drainage, and more than 100 individuals from the Punaluu Rim (U.S. Army 2003a; HINHP Database 2002; K. Kawelo, U.S. Army, pers. comm. 2003; J. Lau, HINHP, pers. comm. 2003).

Ecology *Cyrtandra subumbellata* typically grows on moist, forested slopes or gulch bottoms dominated by *Metrosideros polymorpha* wet forest or mixed *M. polymorpha-Dicranopteris linearis-Acacia koa* wet forests between 345 and 790 m (1,132 and 2,591 ft) in elevation. Associated native plant species include *Boehmeria grandis*, *Broussaisia arguta*, *Dryopteris* sp., and *Machaerina* sp. (HINHP Database 2001; Service 1998a; Wagner *et al.* 1999). *Cyrtandra subumbellata* has been observed in fruit in September. Little else is known about its flowering cycles, pollination vectors, seed dispersal agents, longevity, specific environmental requirements, and limiting factors (Service 1998a).

Threats The primary threats to *Cyrtandra subumbellata* are competition with non-native plant species such as *Clidemia hirta*, impacts from military activities, predation by rats, fire, and risk of extinction from naturally occurring events and/or reduced reproductive vigor due to the small number of extant occurrences and individuals (HINHP Database 2001; Service 1998a; 61 FR 53089).

Conservation Needs of the Species A State-wide management plan should be developed and implemented for the long-term conservation of all known occurrences of *Cyrtandra subumbellata.* This plan should also include broader landscape actions that are needed for the recovery of this plant throughout its range. The recovery plan for this species identifies the following important conservation actions. Non-native plant species should be controlled or removed in the vicinity of all known occurrences of *C. subumbellata*. The threats from fire need to be addressed, especially on State land at Kaukonahua and private land at Puu Ohulehule. The threat from rats should be evaluated at all known occurrences of *C. dentata*. Rats should be controlled in the vicinity of all threatened occurrences using established and approved rodenticides. Rats should also be controlled

across a broader landscape by using aerial dispersal of rodenticides, when this method is approved (Service 1998a).

Ongoing Conservation Actions *Cyrtandra subumbellata* is being propagated at the Lyon Arboretum and seeds are in storage at the National Tropical Botanical Garden (Service 2002; U.S. Army 2003a). The Service is currently not aware of any other conservation efforts for this species.

Environmental Baseline

Status of the Species in the Action Area The six individuals from the south Kaukonahua drainage are in the southeast corner of SBER action area from between 561 and 567 m (1840 and 1860 ft) elevation (HINHP Database 2002; U.S. Army 2003a). They are located approximately 716 m (2,349 ft) from the summit trail in rugged terrain. These individuals represent about six percent of the total remaining individuals of this species. The occurrences at SBER are found within biologically significant areas that contain or are likely to contain occurrences of other federally listed endangered or candidate species (CEMML 2001). The occurrence from Punaluu Rim is the only stable population unit outside of any action areas, with greater than 50 mature and reproducing plants. The remaining occurrences are small and widely dispersed (Service 1998a).

Threats in the Action Area The threats to *Cyrtandra subumbellata* in SBER include competition from non-native plants, rats, fire, trampling from foot traffic (U.S. Army 2003a).

Conservation Needs in the Action Area A stabilization plan will be developed and implemented for the stabilization and long-term conservation of *Cyrtandra subumbellata*. This plan should include broader landscape actions that are needed to sustain this plant. *C. subumbellata* will be stabilized because three stable population units do not currently exist outside of SBER action area. To be considered stable, *C. subumbellata* must meet the criteria required for stability of a short-lived perennial (Service 1998a).

Stabilization for *C. subumbellata* will include the following actions. Non-native plants such as *Clidemia hirta* will be removed or controlled in the vicinity of all known occurrences of *C. subumbellata.* Fences will be constructed to protect this plant from trampling by foot traffic at all of the occurrences where these threats are identified as significant by the Oahu Implementation Team. A fire management plan will be developed to protect all occurrences where fire is considered to be a significant threat by the Oahu Implementation Team. Priority conservation actions will be applied to occurrences with immature plants (U.S. Army 2003a).

Ongoing Conservation Actions in the Action Area The Service is currently not aware of any conservation efforts for this species in the action areas.

Status of the Species - *Cyrtandra viridiflora* (Haiwale)

Species Description *Cyrtandra viridiflora* is a member of the Gesneriaceae (African violet family). It is a short-lived perennial shrub 0.5 to 2 m (1.6 to 6.6 ft) tall. The stems are branched and leaves

are sparse. Leaves are opposite, heart-shaped, 6 to 15 cm (2.4 to 5.9 in) long and 3.5 to 7.5 cm (1.4 to 3.0 in) wide. One to five green flowers form open cymes that originate from the leaf axils. The fruit is a white berry 1.3 cm (5.0 in) long. Information on the seeds is lacking. This species is distinguished from others in the genus by the leaves, which are thick, fleshy, heart- shaped, and densely hairy on both surfaces (Wagner *et al.* 1999).

Listing Status *Cyrtandra viridiflora* was federally listed as endangered on October 10, 1996 (61 FR 53089) and State-listed as endangered in Hawaii at the same time. A recovery plan was prepared for this species in 1998 (Service 1998a). Critical habitat was designated for *C. viridiflora* on Oahu on June 17, 2003 (68 FR 35950).

Historic and Current Distribution Historically, *Cyrtandra viridiflora* was known from scattered occurrences in the Koolau Mountains on the island of Oahu. There are approximately nine occurrences of *C. viridiflora* with a total of 69 individuals found at: Kahuku Cabin (5 individuals), Kawainui and Koloa (8), Opaeula and Helemano (45), Helemano (1), Kaukonahua-Waikakaloa (1), Kaalalea (6), Kaluanui-Maakua Ridge (1), Maakua-Kaipapau Ridge (1), and Puu Kaaumakua (1) (HINHP Database 2001). The occurrences are restricted to the northern Koolau Mountains and range from Kawainui and Koloa to Kaalalea (HINHP Database 2001, K. Kawelo, U.S. Army, pers. comm. 2003; J. Lau, HINHP, pers. comm. 2003). *Cyrtandra viridiflora* populations are declining, and those that remain are small and widely dispersed (U.S. Army 2003a).

Ecology *Cyrtandra viridiflora* is usually found on wind-blown ridge tops in cloud-covered wet forest or shrubland at elevations between 443 and 867 m (1,453 and 2,844 ft). Associated native plant species include *Broussaisia arguta*, *Cheirodendron platyphyllum*, *Dicranopteris linearis*, *Diplopterygium pinnatum*, *Dubautia* sp., *Freycinetia arborea*, *Hedyotis* sp., *Ilex anomala*, *Machaerina* sp., *Melicope* sp., *Metrosideros polymorpha*, *Metrosideros rugosa*, *Psychotria* sp., *Syzygium sandwicensis*, or *Trematolobelia macrostachys* (HINHP Database 2001; Wagner *et al.* 1999). *C. viridiflora* has been observed in flower and fruit from May through November. Little else is known about its flowering cycles, pollination vectors, seed dispersal agents, longevity, specific environmental requirements, and limiting factors (Service 1998a).

Threats The major threats to *Cyrtandra viridiflora* are habitat degradation or destruction by feral pigs, impacts from military activities, predation by rats and slugs, competition with the non-native plant species, and risk of extinction from naturally occurring stochastic events and/or reduced reproductive vigor due to the small number of remaining occurrences and individuals. The non-native plant species that threaten *C. viridflora* include such species as *Clidemia hirta* and *Psidium cattleianum*, which alter its habitat and competing with it for nutrients, light, and space. The types of stochastic events most likely to affect *C. viridflora* are landslides, hurricanes, or flooding (HINHP Database 2001; Service 1998a; 61 FR 53089).

Conservation Needs of the Species A State-wide management plan should be developed and implemented for the long-term conservation of all known occurrences of *Cyrtandra viridiflora.* This plan should also include broader landscape actions that are needed for the recovery of this plant

throughout its range. The recovery plan for this species identifies the following important conservation actions. Where feasible, fences should be constructed around the known occurrences of *C. viridiflora* to reduce impacts from feral pigs. In locations where fencing is not feasible due to topography or potential damage to sensitive summit habitats, pigs should be controlled or removed from the broader landscape to alleviate impacts on native ecosystem and promote survival of naturally germinating seedlings of *C. viridiflora*. Non-native plants should be controlled or removed in the vicinity of all known occurrences of *C. viridiflora*. Rats are a serious threat to *C. viridiflora*, and they should be controlled in the vicinity of all known plant occurrences, using currently approved rodenticides, and across the broader landscape using aerial dispersal of approved rodenticides (Service 1998a).

Ongoing Conservation Actions *Cyrtandra viridiflora* is in genetic storage at the Lyon Arboretum (Service 2002). The Service is currently not aware of any other conservation efforts for this species.

Environmental Baseline

Status of the Species in the Action Areas There are 60 individuals of *Cyrtandra viridiflora* from five occurrences within KLOA and SBER on Oahu. At KLOA, there are 59 individuals from four occurrences at Kahuku cabin (5), Kawainui and Koloa (8), Opaeula and Helemano (45), and Helemano (1) (HINHP Database 2002; U. S. Army 2003a; K. Kawelo, U.S. Army, pers. com. 2003; J. Lau, HINHP, pers. com. 2003). These individuals represent approximately 85 percent of the known individuals of this species. A significant number of individuals occur directly alongside the Koolau summit trail. At SBER, a single individual of *C. viridiflora* is known from the vicinity of south Kaukonahua-Waikakaloa in the southeast corner of the subinstallation (HINHP Database 2002; U.S. Army 2003a). This individual represents approximately one percent of the total remaining individuals of this species. It is located in a remote location in rugged terrain. There are no stable population units of greater than 50 mature and reproducing individuals of *C. viridiflora* outside the Army action areas (U.S. Army 2003a). The occurrences at KLOA or SBER are within biologically significant areas that either contain or are likely to contain occurrences of other federally listed endangered and/or candidate species (CEMML 2001).

Threats in the Action Areas *Cyrtandra viridiflora* is threatened by non-native plants, feral ungulates, rats, fire, and trampling from foot traffic in both SBER and KLOA.

Conservation Needs in the Action Areas A stabilization plan will be developed and implemented for the stabilization and long-term conservation of *Cyrtandra viridiflora*. This plan should include broader landscape actions that are needed to sustain this plant. *Cyrtandra viridflora* will be stabilized because three stable population units do not currently exist outside of the Army action areas (KLOA and SBER) and because greater than 50 percent of the known remaining individuals occur within Army action areas. To be considered stable, *C. viridflora* must meet the criteria required for stability of a short-lived perennial (Service 1998a). Stabilization for *C. viridiflora* will include the following actions. Fences will be constructed to enclose and protect *C. viridiflora* populations from feral pigs and from trampling by foot traffic, where these threats are identified as significant by the Oahu Implementation Team. Where fencing is not feasible due to topography, pigs

will be controlled or removed from the broader landscape required by *C. viridiflora* for natural germination, growth, and survival of seedlings. The threat from fire will be managed to minimize the potential loss of occurrences of *C. viridiflora* by implementation of the WFMP. Non-native plant species, such as *Clidemia hirta* and *Psidium cattleianum*, and rats should be controlled or removed from the vicinity of all known occurrences of *C. viridiflora*. The control of rats should employ approved bait box methods and should support work that will lead to the approval of aerial dispersal of rodenticides (U.S. Army 2003a).

Ongoing Conservation Actions in the Action Areas The Army has made collections from the plants in the action areas and deposited them the Lyon Arboretum. This species benefits dramatically from the Opaeula Watershed Protection Project fence, which surrounds nearly all the known individuals of this species in KLOA (CEMML 2001; U.S. Army 2003a).

Status of the Species - *Delissea subcordata* (No Common Name)

Species Description *Delissea subcordata* is a short-lived perennial in the Campanulaceae (bellflower family). It is a shrub which ranges in height from 1 to 3 m (3.5 to 10 ft). Leaf blades measure 12 to 30 cm (4.7 to 11.7 in) in length with toothed or cut leaf margins. Inflorescences consist of 6 to 18 flowers, which are borne close to the stem among the leaves. The corollas are white to green, curved, and measure 45 to 60 mm (1.8 to 2.4 in) long. The purple berries range in length from 12 to16 mm (0.5 to 0.6 in). This endemic Hawaiian species is distinguished from others in this genus by the shape and size of the leaves, the length of the calyx lobes and corolla, and the glabrous anthers (Wagner *et al.* 1999).

Listing Status *Delissea subcordata* was federally listed as endangered on October 10, 1996 (61 FR 53089) and State-listed as endangered in Hawaii at the same time. A recovery plan was prepared for this species in 1998 (Service 1998a). Critical habitat was designated for this species on Oahu on June 17, 2003 (68 FR 35950).

Historic and Current Distribution Although now very rare, *Delissea subcordata* has fared better than most of the other species in the genus which are thought to be extinct. Historically, *D. subcordata* was known from scattered occurrences in the Waianae and Koolau Mountains of Oahu. In the Waianae Mountains, *D. subcordata* is still found throughout much of its historic range but the number of individuals has decreased. For example, 29 individuals were documented in Pahole Gulch in the late 1970s; however, only six plants have been observed in this area recently. Also, plants are absent from a number of locations throughout the Waianae range where they were extant in the 1970s and 1980s. A colony of *D. subcordata* in north Ekahanui Gulch contained nine mature or nearly mature plants in 2000. It appears that this population may have been descended from a single adult plant, since this was the only extant occurrence within several square miles (U.S. Army 2003a). The most current information for *D. subcordata* indicates that there are 52 wild plants remaining in 10 occurrences: Kaawa Gulch (2 individuals), Kaluaa (1), Huliwai (7), Ekahanui (14), Palawai (1), south Mohiakea Gulch (1), East Palikea Gulch (6), Kahanahaiki (1), Keawapilau

(11), Kawaiu (2), and Pahole (6) (K. Kawelo, U.S. Army, pers. comm. 2003; J. Lau, HINHP, pers. comm. 2003; U.S. Army 2003a).

Ecology *Delissea subcordata* typically grows on north-facing gulch slopes, and sometimes in gulch bottoms in mixed mesic forests dominated by *Diospyros sandwicensis*, *Metrosideros polymorpha*, and/or *Acacia koa* between 162 and 1,025 m (531 and 3,362 ft) elevation. Associated native plant species include *Alyxia oliviformis*, *Antidesma* sp., *Bobea* sp., *Chamaesyce multiformis*, *Charpentiera obovata*, *Claoxylon sandwicense*, *Diospyros hillebrandii*, *Hedyotis acuminata*, *Myrsine lanaiensis*, *Nestegis sandwicensis*, *Pisonia* sp., *Pouteria sandwicensis*, *Psychotria hathewayi*, *Psydrax odorata*, or *Streblus pendulinus* (HINHP Database 2001; Service 1998a).

Flowering and fruiting has been documented at various times of the year, with most flowering recorded from February through June, and fruiting from June through August. As with other *Delissea* species with their long tubular flowers, this species is thought to have been pollinated by nectar-feeding birds. The purple berries of *D. subcordata* are indicative of seed dispersal by fruit-eating birds. *Delissea subcordata* is capable of self-pollination, as evidenced by the production of viable seeds by isolated plants. The longevity of the plants is unknown; individuals presumably lives for less than 10 years like other taxa of its size in the genus *Delissea* and in the closely-related genus *Cyanea*. Other *Delissea* species or relatives of *Delissea* that may occur near *D. subcordata* in the Waianae Mountains are: *D. sinuata*, *Cyanea grimesiana* ssp. *grimesiana*, *C. grimesiana* ssp. *obatae*, *C. superba* ssp. *superba*, *C. angustifolia*, *C. membranacea*, *C. calycina*, *C. longiflora*, and four species of *Clermontia*, *C. persicifolia*, *C. kakeana*, *C. oblongifolia*, and *C. fauriei*. *Delissea* species and its relatives may be found growing together, yet to date there is no good evidence of hybridization occurring between species of *Delissea* or between a *Delissea* and a *Delissea* relative. Consequently, concerns are minimal with respect to the possibility of inadvertently allowing unnatural hybridization to occur through the outplanting of *D. subcordata* (U.S. Army 2003a).

Threats The primary threats to *Delissea subcordata* include loss of habitat and degradation of the remaining habitat by non-native plants and animals. The non-native plants such as *Blechnum appendiculatum*, *Clidemia hirta*, *Grevillea robusta*, *Lantana camara*, *Melinus minutiflora*, *Oplismenus hirtellus*, *Passiflora suberosa*, *Pimenta dioica*, *Psidium cattleianum*, *Schinus terebinthifolius*, *Syzygium cumini*, and *Toona ciliata* threaten the species by altering its habitat and competing with it for nutrients, light, and space. Feral pigs can impact this species by consuming the plant or its fruits and by rooting in the soil, which may up root plants and degrade habitat by opening it up for invasion by non-native plants. Feral goats are destructive browsers and can consume the plant, trample on it, or generally degrade the habitat. Rats also pose a threat to this species due to consumption of plant parts and fruits. Non-native slugs and snails also threaten the species by feeding on its leaves, stems, and seedlings (HINHP Database 2001; Service 1998a; U.S. Army 2003a; 61 FR 53089). The long-billed, nectar-feeding native Hawaiian birds that are thought to have pollinated *Delissea subcordata* have been almost extirpated from the Waianae Mountains. Although the species is capable of self-pollination, the loss of its normal pollinating vectors is likely to

result in decreased genetic variability within occurrences over successive generations. The small number of individuals of *D. subcordata* that remain could potentially lead to inbreeding depression (HINHP Database 2001; Service 1998a; U.S. Army 2003a; 61 FR 53089). Construction has also played a role in the decline of this species. In the 1980s road construction in the Kuaokala Forest Reserve resulted in the loss of a colony of *Delissea subcordata* plants. Other colonies of plants were last seen in the 1980s near a major road between Pahole Natural Area Reserve and the Kuaokala area (HINHP Database 2001; Service 1998a; U.S. Army 2003a; 61 FR 53089).

Conservation Needs of the Species A State-wide management plan should be developed and implemented for the long-term conservation of all known occurrences of *Delissea subcordata.* This plan should also include broader landscape actions that are needed for the recovery of this plant throughout its range. Based on the recovery plan for this species the following conservation needs have been identified. One of the most important conservation actions for this species is the control or removal of ungulates from all occupied sites and from the broader landscape to eliminate the constant threat posed by feral goats and pigs. The most effective method to accomplish this task is to construct and maintain fenced exclosures around the known occurrences of this plant (Service 1998a). Occurrences that have only a few remaining individuals should be fenced immediately. If inbreeding depression in these occurrences is indicated, experiments on the ramifications of mixing the species' various stocks should be conducted (U.S. Army 2003a). Specific efforts should be made to remove non-native plants from the vicinity of all known occurrences and from the broader landscape, especially for occurrences that have only a few remaining individuals. In addition, rats should also be controlled in the vicinity of all known occurrence and across the broader landscape to enhance the long-term viability of these occurrences (Service 1998a).

Ongoing Conservation Actions. Four individuals were outplanted in a fenced exclosure in Kaluaa Gulch in Honouliuli Preserve in November 1994. Three survive, with two producing flowers and fruit; however, no recruitment has been observed. Invasive plant control and seed collection is ongoing for these occurrences. Since the publication of the recovery plan in 1998, the Army augmented the occurrences at Kahanahaiki with 29 plants and reintroduced 20 plants at Three Points in west Makaleha, and 43 plants in Palawai Gulch in the Honouliuli Preserve. The Kahanahaiki occurrences are fenced, invasive plants are being controlled, and fruits are being collected. This species is being cultivated by Lyon Arboretum and the Army's baseyard. The National Tropical Botanical Garden, Waimea Arboretum, and Lyon Arboretum have seeds in storage or a living collection of this plant. The Army has built small fence around the northern portion of the Ekahanui population. A larger fence is planned to protect all the occurrences. The Palawai occurrences will also be fenced, and seeds have been collected from the Kapuna, Keawapilau, and Pahole occurrences by Department of Land and Natural Resources (K. Kawelo, U.S. Army, pers. comm. 2003; Service 1998a; Service 2002; U.S. Army, *in litt.* 2003). The Service is currently not aware of any other conservation efforts for this species.

Environmental Baseline

Status of the Species in the Action Area All remaining occurrences of *Delissea subcordata* occur only in the Waianae Mountains. Approximately 13 percent (7 individuals) of the known wild

individuals of this species are found within SBMR action area at south Mohiakea Gulch (1) and east Palikea Gulch (6). Thirty-eight percent (20 individuals) of the total known individuals of this species are found within the MMR action area (J. Lau, HINHP, pers. comm. 2003; K. Kawelo, U.S. Army, pers. comm. 2003; U.S. Army 2003a). Currently, there are no population units outside of the action areas considered to be stable, with more than 50 mature and reproducing plants (U.S. Army 2003a).

Threats in the Action Area The major threats to *Delissea subcordata* within the action area include potential fire from military actions, competition with non-native plant species, and detrimental impacts from feral ungulates and rats. There is also the potential for a direct impact from munitions due to a stray round landing outside of the impact area (U.S. Army 2003a).

Conservation Needs in the Action Area This taxon must be stabilized because no stable populations exist outside of the Army action area. To be considered stable, *Delissea subcordata* must meet the criteria required for stability of a short-lived perennial (Service 1998a). The stabilization plan for this taxon from the Makua IP must be implemented to achieve three stable population units. Stabilization measures include: reintroduction of *D. subcordata* into at least one management unit outside of any action area, as designated for the Makua IP, collection and propagation of this taxon for genetic storage and reintroduction into the wild, monitoring and management of known population units as identified in the Makua IP, surveys for additional population units in suitable habitat, development and implementation of slug control at reintroduction sites and elsewhere where deemed necessary, rat control around the reintroduced individuals and other population units, if necessary, development of fire management plans for population units outside of MMR and SBMR action areas, and implementation of the WFMP (U.S. Army Garrison 2003, U.S. Army 2003b).

Ongoing Conservation Actions in Action Area A two-acre ungulate-proof fence was constructed around the occurrences in south Mohiakea Gulch and invasive plant control is ongoing. Seeds have been collected from the south Mohiakea Gulch occurrences but not the Palikea occurrences (U.S. Army, *in litt.* 2003). The Service is currently not aware of any other conservation efforts for this species in the action areas.

Status of the Species - *Diellia falcata* (No Common Name)

Species Description *Diellia falcata* is a short-lived perennial fern in the Polypodiaceae (polypody family). It grows from a rhizome 1 to 5 cm (0.4 to 2 in) long and 0.5 to 2 cm (0.2 to 0.8 in) in diameter, which is covered with small black or maroon scales. This species is distinguished from others in the genus by the color and texture of its leaf stalk, the venation pattern of its fronds, the color of its scales, its rounded and reduced lower pinnae (leaflets), and its separate sori (spore clusters) arranged on marginal projections. *Diellia* is endemic to Hawaii and includes six species all that may have originated from a single common ancestor (Palmer 2003).

Listing Status *Diellia falcata* was federally listed as endangered on October 29, 1991 (56 FR 55770) and State-listed as endangered in Hawaii at the same time. A recovery plan was prepared

for this species in 1998 (Service 1998b). Critical habitat was designated for this species on Oahu on June 17, 2003 (68 FR 35950).

Historic and Current Distribution Historically, *Diellia falcata* was known from almost the entire length of the Waianae Mountains, from Manini Gulch to Palehua Iki, as well as from the Koolau Mountains of Oahu, from Kaipapau Valley to Aiea Gulch. Currently, *D. falcata* is locally common in the Waianae Range, but it is probably extirpated from the Koolau Range. There are 21 known occurrences of *D. falcata* on Oahu, totaling between 2,050 and 2,290 individuals. These occurrences include East Makaleha (4 individuals), Waianae Kai (more than 100), Makaha (24), Kamaileunu Ridge (3), Waieli Gulch (50), Ekahanui Gulch (84 to 94), Huliwai Gulch (200 to 300 plants), south Kaluaa Gulch (1), Nanakuli/Lualualei Ridge (10), Palawai Gulch (more than 1,000), Napepeiauolelo Gulch (200 to 300), Pualii Gulch (30 to 40), Mohiakea Gulch (5), Puu Kumakalii region (6), Puu Kalena (50), Palikea Gulch (10), Kahanahaiki Valley (200), Pahole Gulch (20 to 30), Kapuna Gulch (40), Ohikilolo (12), and Manini Gulch (1)). *Diellia falcata* is the only member of this genus that seems to be maintaining viable populations (U.S. Army 2003a; Palmer 2003; Service 1998b; Wagner 1952).

Ecology *Diellia falcata* is a terrestrial fern which typically grows in deep shade or open understory on moderate to moderately steep slopes and gulch bottoms in diverse mesic or dryland forest, often in loamy soil, between 224 and 953 m (735 and 3,126 ft) elevation. Associated native species include *Acacia koa*, *Alyxia oliviformis*, *Antidesma* sp., *Asplenium kaulfussii*, *Carex meyenii*, *Charpentiera* sp., *Claoxylon sandwicense*, *Coprosma foliosa*, *Diospyros hillebrandii*, *Diplazium sandwichianum*, *Doodia kunthiana*, *Dryopteris unidentata*, *Elaeocarpus bifidus*, *Freycinetia arborea*, *Hedyotis terminalis*, *Hibiscus* sp., *Melicope* sp., *Metrosideros polymorpha*, *Myrsine lanaiensis*, *Nephrolepis exaltata*, *Nestegis sandwicensis*, *Nothocestrum* sp., *Pipturus* sp., *Pisonia sandwicensis*, *Pouteria sandwicensis*, *Psychotria* sp., *Psydrax odorata*, *Sapindus oahuensis*, *Selaginella arbuscula*, *Sophora chrysophylla*, or *Xylosma* sp. (HINHP Database 2001). *Diellia falcata* has been observed with fronds bearing sori (spores) year-round, and it will hybridize with *D. unisora*. Little else is known about its reproduction, longevity, specific environmental requirements, and limiting factors (Service 1998b).

Threats The major threats to *Diellia falcata* include loss of habitat and degradation of the remaining habitat by non-native plant and animals. Non-native plants that compete with the fern for light, space, and nutrients include *Aleurites moluccana*, *Ageratina riparia*, *Blechnum appendiculatum*, *Christella parasitica*, *Clidemia hirta*, *Grevillea robusta*, *Heliocarpus popayanensis*, *Kalanchoe pinnata*, *Lantana camara*, *Melinus minutiflora*, *Paspalum conjugatum*, *Passiflora ligularis*, *Passiflora suberosa*, *Pimenta dioica*, *Psidium cattleianum*, *Psidium guajava*, *Rubus argutus*, *Schefflera actinophylla*, *Schinus terebinthifolius*, *Syzygium cumini*, and *Toona ciliata*. Feral pigs consume all parts of the fern or root up soil, which degrades the habitat. Feral goats are destructive browsers and can consume the entire plant in conjunction with trampling and general habitat destruction. The two-spotted leafhopper (*Sophonia rufofascia*) is also a potential threat (HINHP Database 2001; Service 1998b; 56 FR 55770).

Conservation Needs of the Species A State-wide management plan should be developed and implemented for the long-term conservation of all known occurrences of *Diellia falcata.* This plan should also include broader landscape actions that are needed for the recovery of this plant throughout its range. The recovery plan for this species identifies major conservation actions. Where feasible, all known occurrences should be fenced, especially those that have only a few remaining individuals. Non-native plants should be removed from the vicinity of all known occurrences. A coordinated fire protection plan needs to be developed and implemented for endangered plants on State Natural Area Reserves (Pahole), private (Honouliuli Preserve), and on Federal (MMR) lands. The two-spotted leafhopper is a potential threat to *Diellia falcata*, and should be investigated. Taxonomic research is needed to determine the relationship and genetic distinctiveness of *D. falcata* and *D. unisora,* and which occurrences are hybridizing. To prevent extinction of this species, *ex situ* propagation should be initiated. Propagation material should be collected immediately from all extant occurrences (Service 1998b).

Ongoing Conservation Actions The Army has constructed a fence around the individuals in Kahanahaiki. Fencing and weeding of feral pigs in the Pahole drainage was completed by Hawaii's Division of Forestry and Wildlife in July 1997. Weeding of non-native plant species in the surrounding areas continues. Individuals of this species in Palawai Gulch have been protected from ungulates by a fenced exclosure by The Nature Conservancy of Hawaii (Service 1998b). Spores and or tissues from this species are currently stored at the National Tropical Botanical Garden and Lyon Arboretum (Service 2002).

Environmental Baseline

Status of the Species in the Action Area Four percent (71 individuals) of the known individuals of *Diellia falcata* are found within the SBMR action area (U.S. Army 2003a). This fern is found in most of the Waianae Mountains drainages in SBMR, both north and south of Kolekole Pass. There are four occurrences in SBMR action area: Mohiakea Gulch (5 individuals), the Puu Kumakalii region (6), Puu Kalena (50), and Palikea Gulch (10). More than three stable population units of greater than 50 mature and reproducing *Diellia falcata* exist outside of the SBMR action area. Thirteen percent (273 to 283 individuals) of the total known individuals of this species are found within the MMR action area (HINHP Database 2001; J. Lau, HINHP, pers. comm. 2003; Service 1998b; U.S. Army 2003a). More than three stable population units of greater than 50 mature, reproducing individuals are found outside the action area (U.S. Army 2003a).

Threats in the Action Area The major threats to *Diellia falcata* within the action area include fire from military actions, competition with non-native plant species and detrimental impacts from feral ungulates and the two spotted leafhopper. There is also the potential for a direct impact from munitions due to a stray round landing outside of the impact area.

Conservation Needs in the Action Area *Diellia falcata* does not require stabilization because 50 percent of the known individuals do not occur in the Army action areas, and there are at least three stable population units of greater than 50 mature, reproducing individuals outside of the Army action areas. The Oahu Implementation Team will consider species-specific management actions such as

collection for genetic storage. This species may benefit from habitat level management for other endangered species in MMR and SBMR.

Ongoing Conservation Actions in Action Area The Army is currently not conducting specific actions for this species within the action area (U.S. Army 2003a).

Status of the Species - *Eugenia koolauensis* (Nioi)

Species Description *Eugenia koolauensis* is a long-lived perennial in the Myrtaceae (myrtle family). This species is a small tree or shrub between 2 to 7 m (7 to 23 ft) tall with branch tips covered with dense brown hairs. The solitary or paired white flowers originate from the leaf axils. The petals are egg-shaped or elliptic in shape, and 4 to 8 mm (0.2 to 0.3 in) long. The yellow to red berries are ovoid-shaped and 0.8 to 2.0 cm (0.3 to 0.8 in) long. *Eugenia koolauensis* is one of two species in the genus that are native to Hawaii. It differs from the other species in having leaves that are densely hairy on the lower surface and leaf margins that curve under the leaves. *Eugenia koolauensis* is known to intergrade with *E. reinwardtiana* in the northern Koolau Mountains and probably derived from this close relative (Wagner *et al.* 1999).

Listing Status *Eugenia koolauensis* was federally listed as endangered on March 28, 1994 (59 FR 14482) and State-listed as endangered in Hawaii at the same time. A recovery plan was prepared for this species in 1998 (Service 1998a). Critical habitat was designated for this species on Oahu on June 17, 2003 (68 FR 35950) and Molokai on March 18, 2003 (68 FR 12982).

Historic and Current Distribution *Eugenia koolauensis* was historically known from Molokai and from Oahu at Kaipapau Valley, Hanaimoa and Kahawainui Gulches, and a gully southeast of Kahuku. *Eugenia koolauensis* may have been extirpated from Molokai as a result of the pineapple industry. Currently, there are 172 known individuals remaining; most occur in the northern Koolau Mountains and one disjunct occurrence is in the vicinity of Papali Loop trail. Locations of occurrences include: Drum Road (1 individual), Hanaimoa (3), Palikea Gulch (2), Pahipahialua (30), Oio (50), Kaunala (59), Aimuu (1), and Kaleleiki (25) (HINHP Database 2001; K. Kawelo, pers comm, 2003; J. Lau, pers. com. 2003; Service 1996, 1998a, 1999b). *Eugenia koolauensis* occurrences are small, in decline, and are widely dispersed. There are seedlings and juveniles found at some occurrences (HINHP Database 2001; Service 1998a; U. S. Army 2003a).

Ecology *Eugenia koolauensis* is found in dry gulches and on gentle to steep slopes or ridges in mesic or dry forests dominated by *Metrosideros polymorpha* or *Diospyros* sp. from 57 to 437 m (187 to 1,433 ft) in elevation. Other associated native plant species include *Alyxia oliviformis*, *Bobea elatior*, *Carex meyenii*, *Dicranopteris linearis*, *Leptecophylla tameiameiae*, *Myrsine lessertiana*, *Nestegis sandwicensis*, *Pittosporum glabrum*, *Pleomele halapepe*, *Pouteria sandwicensis*, *Psydrax odorata*, or *Rauvolfia sandwicensis* (HINHP Database 2001; Service 1998a). Plants have been observed in flower from February to December. Little else is known about its flowering cycles, pollination vectors, seed dispersal agents, longevity, specific environmental requirements, and limiting factors (Service1998a). The one disjunct occurrence of *E.*

koolauensis in the southeastern Koolau Mountains may have unique environmental adaptations (U.S. Army 2003a).

Threats The major threats to *Eugenia koolauensis* include loss of habitat and degradation of the remaining habitat by non-native plants and feral pigs. The non-native plants such as *Acacia confusa*, *Aleurites moluccana*, *Araucaria columnaris*, *Ardisia elliptica*, *Casuarina equisetifolia*, *Clidemia hirta*, *Cordyline fruticosa*, *Eucalyptus* sp., *Grevillea robusta*, *Hyptis pectinata*, *Lantana camara*, *Melia azedarach*, *Oplismenus hirtellus*, *Panicum maximum*, *Passiflora laurifolia*, *Passiflora suberosa*, *Psidium cattleianum*, *Schinus terebinthifolius*, *Syzygium cumini*, and *Toona ciliata* compete with *E. koolauensis* for nutrients, light, and space. Feral pigs can impact plants of this species by consuming fruits and other plant parts, or by rooting and trampling, which degrades the habitat (HINHP Database 2001; 59 FR 14482). Trampling from foot traffic is also a threat, and one occurrence is threatened by disturbance from an illegal motorbike track. *E. koolauensis* occurrences are declining, and those that remain are small, widely dispersed, and have a limited gene pool, which puts the species at risk of extinction from naturally occurring events and/or lack of reproductive vigor (HINHP Database 2001; 59 FR 14482).

Conservation Needs of the Species A State-wide management plan should be developed and implemented for the long-term conservation of all known occurrences of *Eugenia koolauensis*. This plan should also include broader landscape actions that are needed for the recovery of this plant throughout its range. The recovery plan for this species identifies important conservation actions. Fenced exclosures should be constructed around the known occurrences of *E. koolauensis* to reduce impacts from feral pigs. Pigs should be controlled or removed from these areas and in the broader landscape to alleviate their impact on native ecosystems. Specific efforts should be made to immediately fence and protect occurrences that have only a few remaining individuals, if feasible. All occurrences should be weeded, especially those with only a few remaining individuals, if feasible (Service 1998a).

Ongoing Conservation Actions The Waimea Arboretum has seeds of *Eugenia koolauensis*. It has been successfully propagated at Waimea Arboretum and there is a single plant located at the Honolulu Botanical Garden (Service 1998a; Service 2002). The Service is currently not aware of any other conservation efforts for this species.

Environmental Baseline

Status of the Species in the Action Area Ninety-six percent (165 individuals) of the known individuals of *Eugenia koolauensis* are found at five occurrences within the KTA action area (U.S. Army 2003a). These occurrences are at Pahipahialua (30 individuals), Oio (50), Kaunala (59), Aimuu (1), and Kaleleiki (25). There are no stable population units with greater than 25 *E. koolauensis* outside the KTA action area (HINHP Database 2001; K. Kawelo, pers comm, 2003; J. Lau, pers. com. 2003; Service 1996, 1998a, 1999b; U. S. Army 2003a).

Threats in the Action Area The major threats to *Eugenia koolauensis* in the action area include fire, trampling from foot maneuvers, competition with non-native plant species, disturbance from motor bikes, and habitat degradation by feral pigs (U.S. Army 2003a).

Conservation Needs in the Action Area A stabilization plan will be developed and implemented for the stabilization and long-term conservation of *Eugenia koolauensis*. This plan should include broader landscape actions that are needed to sustain this plant. *E. koolauensis* requires stabilization because three stable population units of greater than 25 mature, reproducing individuals each do not exist outside of KTA, and because greater than 50 percent of the known remaining individuals occur within KTA action area. Stabilization for *E. koolauensis* will include the following actions. The one disjunct occurrence is in the southeastern Koolau Mountains must be a high priority for protection because of the potential for environmental adaptations unique to that occurrence. The Army will control competing non-native plant species (including *Schinus terebinthifolius*, *Psidium cattleianum*, *Clidemia hirta*, *Ardisia elliptica*, and *Lantana camara*) and monitor for new introductions of non-native plants species. Occurrences of *E. koolauensis* that have only a few remaining individuals (Papali Loop trail with one individual and Hanaimoa with three individuals) should be given priority. The Army will provide protection from fire as outlined in the WFMP (U.S. Army 2003b). The Army will construct exclosures to protect occurrences against feral pigs and from military foot traffic where these threats are identified as significant by the Oahu Implementation Team. Where exclosures are not feasible due to topography, other means of ungulate control will be employed. Full genetic representation of *E. koolauensis* will be collected for *ex situ* propagation and all occurrences within the action area will be monitored. The Army also will survey for additional occurrences in suitable habitat and coordinate the education of motocross users and the enforcement of regulations between the Army, Hawaii's Division of Forestry and Wildlife, and lessee (U.S. Army 2003a).

Ongoing Conservation Actions in Action Area The Service is currently not aware of other conservation efforts for this species in the action area.

Status of the Species - *Flueggea neowawraea* (Mehamehame)

Species Description *Flueggea neowawraea* is a long-lived perennial in the Euphorbiaceae (spurge family). It is a large dioecious tree up to 30 m (100 ft) tall with white oblong pores covering its scaly, pale brown bark. The leaves are 4 to14 cm (1.6 to 5.5 in) long, and are arranged alternately along the stems. The flowers of an individual plant are usually all female or all male and are borne in axillary clusters of two to six. The fruits are globose, measure 3 to 6 mm (0.12 to 0.24 in) in diameter, are juicy, usually contain six seeds, and are reddish brown to black when ripe. This species is the only member of the genus found in Hawaii and can be distinguished from similar Hawaiian species in the family by its hairless, whitish lower leaf surfaces and round fruits (Wagner *et al* 1999; Service 1999b).

Listing Status *Flueggea neowawraea* was federally listed as endangered on November 11, 1994 (59 FR 56333) and State-listed as endangered in Hawaii at the same time. A recovery plan was prepared for this species in 1999 (Service 1999b). Critical habitat was designated for this species on Oahu on June 17, 2003 (68 FR 35950), Maui on May 14, 2003 (68 FR 25934), Molokai on March 18, 2003 (68 FR 12982), Kauai on February 27, 2003 (68 FR 9116), and Hawaii on July 2, 2003 (68 FR 39624).

Historic and Current Distribution Historically, *Flueggea neowawraea* was known from Oahu, Kauai, Maui, Molokai, and the island of Hawaii. The remaining living trees and the dead remains of *F. neowawraea* indicate that the species was formerly not uncommon in at least some parts of the Hawaiian Islands. The recorded history of *F. neowawraea* is relatively short for a native Hawaiian tree, as it was not discovered until 1912. Reports of the species in the first half of the 1900s indicate that it had already been declining in numbers and health for a considerable time prior to its discovery. There were many reports of large mature trees, portions of which were already long dead; and there were no reports of younger trees and immature plants. The only record of immature plants to date is the report of a pair of plants in Pahole Gulch in the 1970s. One plant was reportedly a tree 6.1 m (20 ft) tall, with a main trunk measuring 5.1 cm (2 in) in diameter; and the other plant a sapling about 1.5 m (5 ft) tall with a trunk measuring 2.5 cm (1 in) in diameter. Currently, it is known from Kauai, Oahu, Maui, and Hawaii. Only two trees are known to persist on the southern flank of Haleakala, East Maui. Five to seven trees are known on the island of Hawaii. The species is most common on Kauai where an estimated 58 to 78 trees are known. On Oahu, a total of 34 trees are known to survive in ten occurrences: Mikilua (1 individual), north Kaluaa (1), Kauhiuhi (1), Halona (2), Makaha/Waianae Kai (5), Makaleha (10), Ohikilolo (3), Kahanahaiki to Kapuna (6), Palikea Gulch at Mt. Kaala NAR (4), and in north Mokiakea Gulch (1) (U.S. Army 2003a; J. Lau, HINHP, pers. comm. 2003; K. Kawelo, U.S. Army, pers. comm. 2003). The decline of *F. neowawraea* has undoubtedly been greatly accelerated by the introduction of the black twig borer in 1961. Of the individuals alive 20 years ago, more than half are now dead (J. Lau, HINHP, pers. comm. 2000; Nagata 1980).

Ecology *Flueggea neowawraea* occurs on gulch slopes, ridge crests, or near streams in dry or mesic forest at elevations of 323 to 1,006 m (1,059 to 3,300 ft). The species was formerly more common in the dry forest than today, as evidenced by numerous old logs and standing dead trunks. Most trees occur either in gulch bottoms or on north facing lower to mid-gulch slopes. Associated native plant species include *Alyxia oliviformis*, *Antidesma platyphyllum*, *Antidesma pulvinatum*, *Bobea* sp., *Chamaesyce herbstii*, *Chamaesyce multiformis*, *Charpentiera* sp., *Claoxylon sandwicensis*, *Diospyros hillebrandii*, *Diospyros sandwicense*, *Erythrina sandwicensis*, *Hedyotis terminalis*, *Hibiscus arnottianus*, *Metrosideros polymorpha*, *Morinda trimera*, *Myoporum sandwicense*, *Myrsine* sp., *Nestegis sandwicensis*, *Pipturus albidus*, *Pisonia sandwicensis*, *Pisonia umbellifera*, *Pittosporum* sp., *Pleomele* sp.,*Psydrax odorata*, *Pteralyxia* sp., *Rauvolfia sandwicensis*, *Sapindus oahuensis*, and *Streblus pendulina* (HINHP Database 2001; Wagner *et al* 1999). According to the literature on *F. neowawraea*, the species is

dioecious, bearing either all male flowers or all female flowers. However, the species apparently is not completely dioecious, as a cultivated plant isolated from others has been observed to produce viable seeds. Flowering occurs over a brief period sometime in the late summer through the fall. The timing of the flowering in a given area is apparently dependent on the area's weather patterns and the distribution of rainfall in the particular year. The flowering of the different trees in a given area is normally well synchronized. The pollination biology of *F. neowawraea* has not been studied, but insects presumably pollinate the small, inconspicuous flowers. The species' juicy fruits are suggestive of seed dispersal by fruit-eating birds. Little is known of *F. neowawraea*'s growth rate and age of maturation in the wild. In cultivation, however, the species grows rapidly and matures early. Within three years of germination, an individual can attain a height of over 2 m (6.6 ft) and be mature enough to flower and fruit (J. Lau, HINHP, pers. comm. 2000). *F. neowawraea* are often the most massive trees in the forests in which they are found. Many of the remaining live trees are partially dead, with a strip or strips of bark extending up the trunks to crowns that have died back. The remaining living branches are often relatively healthy. For this species, dying back may be a means of coping with environmental stresses. *F. neowawraea*'s wood is very hard and lasts a long time after the death of the tree. It rots in a very distinctive fashion, and as a result, the decayed trunks and limbs of the species are readily identified. Old logs on the ground and pieces of wood in gulch bottoms and streambeds document the former occurrence of the species throughout the Waianae Mountains (U.S. Army 2003a; J. Lau, HINHP, pers. comm. 2000).

Threats The primary threat to the continued existence of *Flueggea neowawraea* is the black twig borer that has affected all known *F. neowawraea* plants. The black twig borer burrows into the branches and introduces a pathogenic fungus. The end result is severe pruning of the host that often kills branches or the whole plant. All known plants of this species suffer slight to severe defoliation and reduced vigor due to the infestation of this non-native insect. The Chinese rose beetle also defoliates portion of the plant and could result in death once the tree is weakened by other threats. Other major threats to *F. neowawraea* include loss of habitat and degradation of the remaining habitat by non-native plants and animals. Non-native plants such as *Ageratina riparia*, *Aleurites moluccana*, *Blechnum appendiculatum*, *Clidemia hirta*, *Ficus macrophylla*, *Ficus microcarpa*, *Grevillea robusta*, *Kalanchoe pinnata*, *Lantana camara*, *Melinis minutiflora*, *Paspalum conjugatum*, *Passiflora suberosa*, *Psidium* spp., *Rivina* sp., *Schinus terebinthifolius*, *Syzygium cumini*, and *Toona ciliata* threaten *F. neowawraea* by altering its habitat and competing with it for nutrients, light, and space. Feral pigs can impact this species by consuming fruits and other plant parts or by rooting the soil which degrades the habitat. Feral goats are destructive browsers and can consume seedlings and cause general habitat destruction. Rats also pose a threat to this species due to consumption of plant parts and fruits. Fire is also a threat to this tree. Finally, the small population size with its limited gene pool and depressed reproductive vigor, compounded by a requirement for cross-pollination because the species is dioecious make this species extremely vulnerable to inbreeding depression and destruction due to the occurrence of a catastrophic event (HINHP Database 2001; Service 1999b).

Conservation Needs of the Species A State-wide management plan should be developed and implemented for the long-term conservation of all known occurrences of *Flueggea neowawraea.* This plan should also include broader landscape actions that are needed for the recovery of this plant throughout its range. The recovery plan for this species identifies important conservation needs. The black twig borer has been identified as the single most important threat to the continued survival of *F. neowawraea.* A number of parasitoids have been introduced to control the beetle, though none of them have become established. Further research on biological control of the beetle will need to proceed cautiously as there are a number of rare native scolytids in Hawaii which are closely related to the black twig borer. If successful, the experimental insecticide treatment to control the black twig borer on an individual at MMR could be applied to other occurrences. Since most occurrences of *F. neowawraea* have only one or two remaining individuals, efforts should be made immediately to fence and protect these trees to reduce impacts from feral and wild ungulates. Subsequent control or removal of ungulates from these areas will alleviate their impact on native ecosystems. Non-native plants should be controlled in the vicinity of all known occurrences of *F. neowawraea.* To prevent extinction of this species, better *ex situ* propagation methods should continue to be explored. When an *ex situ* method is developed, material should be collected from as many individuals as possible. Outplanting to enhance the remaining wild occurrences can begin when adequate propagated material is available and the *in situ* populations have been protected from ungulates. New occurrences can be established within the historic range of *F. neowawraea.* Since individual trees of *F. neowawraea* bear only male or female flowers, the flowers must be cross-pollinated from a different tree to produce viable seed. Most occurrences of *F. neowawraea* have only one or two remaining individuals, so specific efforts should be made, when practicable, to hand-pollinate isolated occurrences. Coordinated fire protection for endangered plant species should be instigated on State Natural Area Reserves where occurrences of *F. neowawraea* occur, such as Mt. Kaala and Pahole on Oahu, and Manuka on Hawaii. A fire protection plan is also warranted for endangered plants on the Lualualei Naval Magazine, where five occurrences are found (U.S. Army 2003a; Service 1999b).

Ongoing Conservation Actions One of the plants located on the Navy's Lualualei Naval Reservation has been fenced for protection from ungulates and a program of non-native plant removal within the exclosure is ongoing. A long-range management plan for the Honouliuli Preserve prescribes actions for non-native plant management, ungulate control, fire control, small mammal control, rare species recovery, and native habitat restoration. These actions are expected to benefit *F. neowawraea* on the Preserve. The National Tropical Botanical Garden, Lyon Arboretum, and U.S. Army have seeds in storage. It has been successfully cultivated by the U.S. Army, Hawaii's Division of Forestry and Wildlife, and Lyon Arboretum. Tissues have been collected from the west Makaleha, north Kaluaa, and Kauhiuhi occurrences for micropropagation at Lyon Arboretum (Service 1999b; Service 2002; U.S. Army, *in litt.* 2003). The Service is currently not aware of any other conservation efforts for this species.

Environmental Baseline

Status of the Species in the Action Area. Approximately five percent (five individuals) of the known

individuals of *Flueggea neowawraea* are found within the SBMR action area (U.S. Army 2003a; 68 FR 35950). Two occurrences within SBMR are the western fork of Palikea Gulch at Mt. Kaala Natural Area Reserve (4 individuals) and in north Mokiakea Gulch (1). Occurrences within the MMR action area are: Ohikilolo (3 individuals) and Kahanahaiki to Kapuna (6) (U.S. Army 2003a). Currently, there are no population units outside of the action areas considered to be stable, with more than 50 mature and reproducing plants (U.S. Army 2003a).

Threats in the Action Area The major threats to *Flueggea neowawraea* within the action area include fire, competition with non-native plant species, and detrimental impacts from the black twig borer, the Chinese rose beetle, and feral ungulates. There is also the potential for a direct impact from munitions due to a stray round landing outside of the impact area (U.S. Army 2003a).

Conservation Needs in the Action Area *Flueggea neowawraea* requires stabilization because three stable population units of greater than 50 mature, reproducing individuals each do not exist outside of any of the Army action areas. Since this species was addressed in the Makua Biological Opinion, the stabilization actions as outlined in the Makua IP will be implemented to stabilize this taxon. These stabilization measures will include: propagating *F. neowawraea* for genetic storage and reintroduction purposes, monitoring known occurrences, surveying for additional occurrences in suitable habitat, research on control of the black twig borer and the Chinese rose beetle, attempting to hand-pollinate the Makua and Flueggea Gulch females to increase the number of fertile fruit produced, continuing to collect propagation material from *F. neowawraea* occurrences to build-up *ex situ* representation, control of invasive plants surrounding population units slated for management, and continuing to control goats where they impact these trees (U.S. Army Garrison 2003; Service 1999a; U.S. Army 2003a).

Ongoing Conservation Actions in Action Area A mature plant located in Kahanahaiki Gulch was experimentally treated by the Army with an insecticide to control the black twig borer. In addition, one mature individual is within Kahanahaiki Gulch fenced area. Tissue has been collected by the Army from the Mohiakea Gulch occurrences for micropropagation at Lyon Arboretum. The Army has also experimented with genetic storage methods. Several air-layers have been successfully produced at the Army's greenhouse in Wahiawa (U.S. Army, *in litt.* 2003). The Service is currently not aware of any other conservation efforts for this species in the action areas.

Status of the Species - *Gardenia mannii* (Nanu)

Species Description *Gardenia mannii*, is a short-lived perennial in the Rubiaceae (coffee family). This species is a tree 5 to 15 m (16 to 50 ft) tall with lance-shaped leaves, 6 to 27 cm (2.4 to 11 in) long, and 3.5 to 10.0 cm (1.4 to 3.9 in) wide. The solitary white flowers are fragrant, open in the late afternoon, and last about two days. The corolla tube of the flower is 17 to 27 mm (0.7 to 1.1 in) long, and the lobes are 16 to 22 mm (0.6 to 0.9 in) long. The fruit is yellow to orange, broadly ellipsoid, and 1.8 to 4.5 cm (0.7 to 1.8 in) in diameter. This species is distinguished from others in the genus by the shape and number of the calyx spurs. *G. mannii* and *G. brighamii* are the only two species in the Waianae Mountains from the genus *Gardenia* (Wagner *et al.* 1999).

Listing Status *Gardenia mannii* was federally listed as endangered on October 10, 1991 (61 FR 53089) and State-listed as endangered in Hawaii at the same time. A recovery plan was prepared for this species in 1998 (Service 1998a). Critical habitat was designated for this species on Oahu on June 17, 2003 (68 FR 35950).

Historic and Current Distribution Historically, *Gardenia mannii* was known from seven widely scattered occurrences in the Waianae Mountains and 39 occurrences distributed along almost the entire length of the Koolau Mountains of Oahu. Currently, there are 23 occurrences of 93 to 105 *G. mannii* individuals. However, there may be a number of unrecorded plants, particularly in the wet forests of the Koolau Mountains. The majority of the known occurrences contain fewer than five individuals. They are distributed along a 42-km (26-mi) length of the Koolau Mountains, from Kaunala Gulch and Kaunala-Waimea Ridge in the north to Palolo in the south and along a 7-km (4-mi) distance in the Waianae Mountains from north Haleauau Valley to Kaluaa Gulch. Known occurrences are: Malaekahana-Waimea Summit Area (13 individuals), Pamalu (2), upper Kawainui (2), Kawailoa trail (12), Poamoho to Helemano (22), Opaeula (11 to 22), Kaiwai-Koele (1), south Kaukonahua Gulch (2), north Haleauau Gulch (4), Hanaimoa (1 to 2), Kaipapau (1), Kaluaa and Manauna (6), Kaluanui (1), Kapakahi Gulch (3), Laie trail (2), Makaua (2), Manana to Waimano Ridge (1), Papali (1), Pia Gulch (1), Pukele (1), lower Waimano (1), upper Waimano (2), and Puu Hapapa-Waieli Gulch (1). *G. mannii* occurrences are declining, and those that remain are small and widely dispersed, which puts the species at risk of extinction from naturally occurring events and/or lack of reproductive vigor (HINHP Database 2001; K. Kawelo, U.S. Army, pers. comm. 2003; J. Lau, HINHP, pers. comm. 2003; Service 1998a; U.S. Army 2003a).

Ecology *Gardenia mannii* is usually found on moderate to moderately steep gulch slopes, ridge crests, in gulch bottoms, and on stream banks in mesic or wet forests between 82 and 1,050 m (269 and 3,444 ft) in elevation. Associated native plant species include *Acacia koa*, *Alyxia oliviformis*, *Antidesma platyphyllum*, *Bobea* sp., *Boehmeria grandis*, *Broussaisia arguta*, *Cheirodendron trigynum*, *Cibotium glaucum*, *Coprosma foliosa*, *Dicranopteris linearis*, *Elaeocarpus* sp., *Freycinetia arborea*, *Hedyotis acuminata*, *Ilex anomala*, *Melicope* sp., *Metrosideros polymorpha*, *Perottetia sandwicensis*, *Pipturus albidus*, *Pisonia* sp., *Pouteria sandwicensis*, *Psychotria mariniana*, *Syzygium sandwicensis*, and *Thelypteris* sp. The two occurrences located in the Waianae Mountains (Kaluaa Gulch and SBMR) may represent unique environmental adaptations. *G. mannii* plants have been observed with fruit and flowers throughout the year. Little else is known about its flowering cycles, pollination vectors, seed dispersal agents, longevity, specific environmental requirements, and limiting factors (HINHP Database 2001; Service 1998a).

Threats The major threats to *Gardenia mannii* are habitat degradation and/or destruction by non-native plants and animals and impacts from military activities. The non-native plants such as *Clidemia hirta*, *Leptospermum scoparium*, *Passiflora suberosa*, *Psidium cattleianum*, *Psidium guajava*, *Rubus argutus*, *Schinus terebinthifolius*, and *Toona ciliata* threaten *G. mannii* by altering its habitat and competing with it for nutrients, light, and space. Feral pigs can impact this species by consumption of plant parts, including fruits, or by rooting the soil, which degrades the habitat. Rats also pose a threat to this species due to consumption of fruits and other plant parts

(HINHP Database 2001; Service 1998a; 61 FR 53089). Another threat to *G. mannii*, especially in Kapakahi Gulch, is the black twig borer. The black twig borer burrows into the branches and introduces a pathogenic fungus, pruning the host severely and often killing branches or whole plants. This pest causes slight to severe defoliation and reduced vigor (HINHP Database 2001; Service 1998a; 61 FR 53089). Occurrences of *G. mannii* located on military lands are threatened by fire caused by military actions and trampling from foot maneuvers. The wide distribution and small numbers of remaining individuals make this species extremely vulnerable to inbreeding depression and destruction due to the occurrence of a catastrophic event (HINHP Database 2001; Service 1998a; 61 FR 53089).

Conservation Needs of the Species A State-wide management plan should be developed and implemented for the long-term conservation of all known occurrences of *Gardenia mannii.* This plan should also include broader landscape actions that are needed for the recovery of this plant throughout its range. The recovery plan for this species has identified important conservation needs. Exclosures should be constructed around the known occurrences of *G. mannii* to reduce impacts from feral pigs, especially those occurrences containing a few individuals. Subsequent control or removal of pigs from these areas will alleviate their impact on native ecosystems. The black twig borer has been identified as a threat to one occurrence of *G. mannii*. It is not known how this plant will be affected by defoliation or reduced vigor due to infestations of this non-native insect. A number of parasitic invertebrates have been introduced to control the beetle, though none of them have become established. Further research on biological control of the beetle will need to proceed cautiously as a number of rare native Hawaiian scolytids are closely related to the black twig borer. A coordinated fire protection plan for endangered plant species on City and County of Honolulu, Federal, and private lands needs to be developed and implemented. Occurrences of this species are seriously threatened by rat predation. Rats are a threat to *G. mannii* and should be controlled in the vicinity of all known occurrences using approved rodenticides and ultimately an aerial dispersal of rodenticide (Service 1998a; U.S. Army 2003a).

Ongoing Conservation Actions The Army is currently experimenting with different methods to control pigs in areas adjacent to *Gardenia mannii* in SBMR. The Lyon Arboretum and the National Tropical Botanical Garden have successfully propagated and stored the seeds of this species. The Honolulu Botanical Garden has a living collection of *G. mannii* (Service 1998a; Service 2002). The Service is currently not aware of any other conservation efforts for this species.

Environmental Baseline

Status of the Species in the Action Areas There are 15 individuals from two occurrences at KTA, in the Malaekahana-Waimea Summit Area (13 individuals) and Pamalu (2). They represent approximately 15 percent of the total remaining individuals of this species. There are between 48 and 59 individuals from five occurrences in the KLOA action area: upper Kawainui (2), Kawailoa trail (12), Poamoho to Helemano (22), Opaeula (11 to 22), and Kaiwai-Koele (1). These individuals represents between 52 and 56 percent of the total remaining individuals of this species. Two plants from one occurrence are found in SBER action area at about 660 m (2,160 ft) elevation along south Kaukonahua Gulch. These individuals represent approximately two percent of the total

remaining individuals of this species. Four plants from two occurrences are found in SBMR action area in north Haleauau Gulch. These individuals represent approximately four percent of the total remaining individuals of this species. In total, between 73 and 77 percent of *G. mannii* are found within action areas. There are no stable population units of greater than 50 *G. mannii* individuals outside of any of the Army action areas (HINHP Database 2001; Service 1998a; U.S. Army 2003a; K. Kawelo, U.S. Army, pers. comm. 2003; J. Lau, HINHP, pers. comm., 2003).

Threats in the Action Areas The major threats to *Gardenia mannii* in the KTA, KLOA, SBMR, and SBER action areas include competition with non-native plant species, predation by rats, and habitat degradation and/or destruction by feral pigs. Fire is a major threats to *G. mannii* in the KTA, SBMR, and SBER action areas, and trampling by foot traffic is a major threat within the KLOA, KTA, and SBER action areas (U.S. Army 2003a).

Conservation Needs in the Action Areas A stabilization plan will be developed and implemented for the stabilization and long-term conservation of *Gardenia mannii*. This plan should include broader landscape actions that are needed to sustain this plant. *G. mannii* requires stabilization because three stable population units of greater than 50 mature, reproducing individuals each do not exist outside of any of the Army action areas (KTA, KLOA, SBER, and SBMR) and because greater than 50 percent of the known remaining individuals occur within Army action areas. The two occurrences located in the Waianae Mountains (Kaluaa Gulch in Honouliuli Preserve, and SBMR) should be given high priority for protection because these occurrences may represent unique environmental adaptations.

Stabilization for *G. mannii* will include the following actions. The Army will construct exclosures to protect *G. mannii* occurrences against feral pigs and military foot traffic where these threats are identified as significant by the Oahu Implementation Team. The Army will control and monitor competing non-native plant species in the vicinity of all occurrences identified by the Oahu Implementation Team as requiring management. These competitive non-native plant species include *Psidium cattleianum*, *Clidemia hirta*, *Rubus argutus*, and *Schinus terebinthifolius*. The Army will provide protection from fire as outlined in the WFMP (U.S. Army 2003b). The Army will implement control measures for the black twig borer, using the most current and affective methods available. The Army will reduce the threat of rat predation on *G. mannii* through the development and implementation of a rat control plan to protect existing occurrences. These efforts will be prioritized to first address occurrences that have immature plants or have only a few remaining individuals (mid-reach Poamoho, lower Peahinaia trail, Kawailoa trail, upper Poamoho trail, upper Kawainui, lower Helemano, south Kaukonahua, and Haleauau) (CEMML 2001; Service 1998a; U.S. Army 2003a).

Ongoing Conservation Actions in Action Areas Collections of *Gardenia mannii* have been made from the lower Peahinaia management unit at KLOA and eight percent are represented *ex situ*. The Army has experimented with alternative methods to control pig populations in areas adjacent to *G. mannii* individuals in SBMR because of the difficulty of hunting due to dangers associated with unexploded ordnance. The Army has been monitoring all occurrences within action areas, collecting

material for genetic storage, and surveying of additional areas of suitable habitat in accessible areas (U.S. Army 2003a; K. Kawelo, U.S. Army, pers. comm. 2003).

Status of the Species - *Hesperomannia arborescens* (No Common Name)

Species Description *Hesperomannia arborescens* is a long-lived member of the Asteraceae (aster family). It is a small shrubby tree that usually stands 1.5 to 5 m (5 to 16 ft) tall with wide lance- or egg-shaped leaves, 10.5 to 20 cm (4.1 to 7.9 in) long, 3 to 8 cm (1.2 to 3.1 in) wide. The yellow-brown flowers are either solitary or form clusters (between two to 10) at the stem tips. The flowers are perfect, possessing both male and female reproductive parts. The dry one-seeded fruit is large, heavy and glabrous, and 1.2 to 1.4 cm (0.5 to 0.6 in). They are produced between April and June. *H. arborescens* differs from the other members of this endemic genus by having erect to ascending flower heads, thick flower head stalks, and usually hairless and relatively narrow leaves (Wagner *et al.* 1999).

Listing Status *Hesperomannia arborescens* was federally listed as endangered on March 28, 1994 (59 FR 14482) and State-listed as endangered in Hawaii at the same time. A recovery plan was prepared for this species in 1998 (Service 1998a). Critical habitat was designated for this species on Oahu on June 17, 2003 (68 FR 35950) and Molokai on March 18, 2003 (68 FR 12982).

Historic and Current Distribution *Hesperomannia arborescens* was historically found on the islands of Oahu, Molokai, Lanai, and Maui. On Oahu, this species was scattered throughout the Koolau Mountains from Koolauloa and Pupukea in the north to Konahuanui in the south. Currently, *H. arborescens* is known from at least 23 occurrences totaling 192 individuals on the islands of Oahu, Molokai, and Maui; however, it is considered extinct on Lanai. Molokai has a single known occurrence with only three individuals. Maui has four known occurrences for a total of six individuals. On Oahu, the following occurrences remain extant: Maakua (22 individuals); Kaluanui-Maakua Ridge (2); Kaipapau (6); Kaluanui (2); Halawa (3); Kapakahi Gulch (1); Niu-Waimanalo summit Ridge (1); Poamoho trail (2); lower Peahinaia trail (15); lower north Kaukonahua Gulch (1); upper north Kaukonahua Gulch (4); upper Kawailoa trail (1) ; lower Kawailoa trail (2) ; Kawainui (42); Laie-Waimea Ridge (15); north Kaukonahua Gulch (13); and south Kaukonahua Gulch (46). However, much of the habitat for this species in the Koolau Mountains has not been surveyed, and additional occurrences may be present. In the Waianae Mountains, near Palikea Gulch, there is one known occurrence with five individuals. Occurrences of *H. arborescens* are declining, and those that remain are small, widely dispersed, and have a limited gene pool. The survival of the four remaining occurrences on Maui is questionable, as they are heavily impacted by pigs (HINHP Database 2001; Service 1998a; Wagner *et al.* 1999; K. Kawelo, U.S. Army, pers. comm. 2003; J. Lau, HINHP, pers. comm. 2003).

Ecology On Oahu, *Hesperomannia arborescens* is found in association with *Acacia koa*, *Antidesma platyphyllum*, *Bobea elatior*, *Broussaisia arguta*, *Cheirodendron trigynum*, *Cibotium glaucum*, *Coprosma* spp., *Dicranopteris linearis*, *Dubautia* spp., *Hedyotis terminalis*, *Hibiscus arnottianus*, *Labordia sessilis*, *Machaerina angustifolia*, *Melicope* sp., *Metrosideros*

polymorpha, *Myrsine* sp., *Nestegis sandwicensis*, *Perottetia sandwicensis*, *Pipturus albidus*, *Psychotria mariniana*, *Scaevola gaudichaudiana*, *Scaevola glabra*, *Syzygium sandwicensis*, *Tetraplasandra oahuensis*, and *Wikstroemia* spp. It typically grows on steep slopes, ridge tops, and gulches in lowland wet forests and occasionally in wet shrublands between 110 and 1,147 m (361 and 3,762 ft) in elevation (HINHP Database 2001; Service 1998a; Wagner *et al.* 1999). *H. arborescens* produces large, heavy, glabrous fruits between April and June and dispersal is probably low and may be why *H. arborescens* trees usually grow in close proximity to each other. Plants found in Palikea Gulch in the Waianae Mountains are morphologically different from all other known occurrences in the Koolau Mountains and on Molokai, and West Maui. Little else is known about its flowering cycles, pollination vectors, seed dispersal agents, longevity, specific environmental requirements, and limiting factors (Service 1998a; U.S. Army 2003a; 59 FR 14482).

Threats The major threats to *Hesperomannia arborescens* include loss of habitat and degradation of the remaining habitat by non-native plants and animals. Non-native plants such as *Axonopus fissifolius*, *Clidemia hirta*, *Leptospermum scoparium*, *Paspalum conjugatum*, *Psidium cattleianum*, and *Tibouchina herbacea* alter the natural habitat and compete for nutrients, light, and space. Feral pigs can directly impact this species by consumption of fruits and other plant parts, or indirectly due to their rooting behavior which further degrades the habitat. Wildfires and trampling by foot traffic due to military activities also pose a threat to the remaining *H. arborescens* occurrences. There is a risk of extinction of this species due to random environmental events or reduced reproductive vigor due to its limited numbers (HINHP Database 2001; 59 FR 14482).

Conservation Needs of the Species A State-wide management plan should be developed and implemented for the long-term conservation of all known occurrences of *Hesperomannia arborescens*. This plan should also include broader landscape actions that are needed for the recovery of this plant throughout its range. Based on the recovery plan for this species the following conservation needs have been identified. Fenced exclosures should be constructed around all known occurrences of *H. arborescens* to reduce impacts from feral ungulates. Ungulates should be controlled or removed from the vicinity of these exclosures to alleviate impact on native ecosystems. Occurrences that have only a few remaining individuals should immediately be weeded and protected (Service 1998a).

Ongoing Conservation Actions The State of Hawaii's Division of Forestry and Wildlife has attempted propagation of this species without success. They also conduct periodic invasive plant removal at the Laie occurrence. In addition, the Maui Division of Forestry and Wildlife intends to fence the four individuals in West Maui to protect them from feral pigs (Service 1998a, 2002). The Service is currently not aware of any other conservation efforts for this species.

Environmental Baseline

Status of the Species in the Action Areas Approximately 80 percent of the known individuals of *Hesperomannia arborescens* are within the KLOA, SBER, and SBMR action areas (U.S. Army 2003a). Within the KLOA action area in the Koolau Mountains there are eight occurrences for a total of 82 individuals distributed from Kamananui Gulch southward to Schofield-Waikane trail.

These locations include Poamoho trail (2 individuals); lower Peahinaia trail (15); lower north Kaukonahua Gulch (1); upper north Kaukonahua Gulch (4); upper Kawailoa trail (1); lower Kawailoa trail (2); Kawainui (42); and Laie-Waimea Ridge (15). These individuals represent 45 percent of the remaining individuals of this species. In the eastern part of the SBER action area, two occurrences of *H. arborescens* contain 13 and 46 individuals at north and south Kaukonahua Gulches, respectively. These 59 individuals represent 32 percent of the remaining individuals of this species. In the SBMR action area, five individuals of *H. arborescens* occur in the Palikea Gulch within the Waianae Mountains. These individuals represent three percent of the total remaining individuals of this species (HINHP Database 2001; Service 1998a; U.S. Army 2003a; Wagner *et al.* 1999; K. Kawelo, U.S. Army, pers. com. 2003; J. Lau, HINHP, pers. com. 2003). There are currently no stable population units of 50 or more mature, reproducing individuals outside of any of the action areas (U.S. Army 2003a)

Threats in the Action Areas The major threats to *Hesperomannia arborescens* in the KLOA, SBER, and SBMR action areas are similar and include impacts from military training (uncontrolled wildfires from weaponry training activities or direct trampling from foot maneuvers); competition from non-native plants; and habitat degradation and/or destruction by feral ungulates. Non-native plants compete for resources with native plants and some of these plant species can gain a foothold in areas that have been disturbed such as trails. Other invasive plant species do not require a disturbance to become established and can invade native forest. An additional threat to *Hesperomannia arborescens* in the SBMR action area includes the potential for a direct impact from munitions due to a stray round landing outside of the impact area (U.S. Army 2003a).

Conservation Needs in the Action Areas A stabilization plan will be developed and implemented for the stabilization and long-term conservation of *Hesperomannia arborescens*. This plan should include broader landscape actions that are needed to sustain this plant, including suitable habitat outside and within the action areas. *H. arborescens* requires stabilization because three stable population units of greater than 25 mature and reproducing individuals each do not exist outside of any of the Army action areas.

Stabilization for *H. arborescens* will include the following actions. *H. arborescens* will be managed *in situ*, and plants found in Palikea Gulch in the Waianae Mountains will be given special consideration since they are morphologically different from all other known occurrences in the Koolau Mountains and on Molokai, and West Maui. Morphological differences among the occurrences in the Waianae Mountains will be maintained as much as possible. If future research clearly shows that occurrences of the species are suffering from inbreeding depression, controlled experiments on the consequences of mixing the morphologically different stocks will be initiated and applied, if appropriate. The Army will erect fences where feral ungulates or trampling have been identified as significant by the Oahu Implementation Team and where feasible. Where fenced exclosures are not feasible due to topography, other means of ungulate control will be employed. The Army will also establish an *ex situ* stock of *H. arborescens,* control non-native plant species and monitor for new introductions of non-native plants species, especially at occurrences that have

only a few remaining individuals. The Army will also implement the WFMP. There are no stable population units of greater than 25 mature and reproducing *H. arborescens* outside of the Army action areas (U.S. Army 2003a).

Ongoing Conservation Actions in Action Areas The Army has been working with the Botany Department at the University of Hawaii at Manoa to provide samples of this species for pollen viability and genetic studies. The occurrences at SBMR benefit from ongoing ungulate removal in the area (Service 1998a; U.S. Army 2003a). The Service is currently not aware of any other conservation efforts for this species in the action areas.

Status of the Species - *Isodendrion longifolium* (Aupaka)

Species Description *Isodendrion longifolium* is short-lived perennial in the Violaceae (violet family). It is a slender, erect shrub with lance-shaped leaves,10 to 30 cm (3.9 to 11.8 in) long and 3.4 to 6.5 cm (1.3 to 2.6 in) wide, with netted venation that is raised on both surfaces. The purple flowers are fragrant and originate singly along the branches. The fruit is 1 cm (0.4 in) long and ovoid-ellipsoid in shape. *I. longifolium* is distinguished from other members of this endemic Hawaiian genus by the hairless, leathery, lance-shaped leaves (Wagner *et al.* 1999).

Listing Status *Isodendrion longifolium* was federally listed as endangered on October 10, 1996 (61 FR 53108) and State-listed as endangered in Hawaii at the same time. A recovery plan was prepared for this species in 1999 (Service 1999b). Critical habitat was designated for this species on Oahu on June 17, 2003 (68 FR 35950) and Kauai on February 27, 2003 (68 FR 9116).

Historic and Current Distribution Historically and currently, *Isodendrion longifolium* is known from scattered locations on Kauai and Oahu. Currently, on northwestern Kauai, there are 15 occurrences containing 800 to 854 individuals. On Oahu there are four occurrences of about 40 to 46 individuals in the Koolau Mountains and the Waianae Mountains, representing about four to five percent of all known individuals of *I. longifolium*: Kaawa Gulch (25 to 30 individuals); Makaua Gulch (2 to 3); south Kaukonahua Stream (10); and Palikea Gulch (3) (J. Lau, HINHP, pers. comm. 2003; K. Kawelo, U.S. Army, pers. comm. 2003; U.S. Army 2003a; HINHP Database 2001). Occurrences of *I. longifolium* that remain are small and widely dispersed (U.S. Army 2003a; Wagner *et al.* 1999).

Ecology On Oahu, *Isodendrion longifolium* is found on steep slopes and stream banks in mixed mesic or lowland wet *Metrosideros polymorpha-Dicranopteris linearis* forest, usually between 363 and 964 m (1,191 and 3,162 ft) elevation. Associated native plant species include *Acacia koa*, *Alyxia oliviformis*, *Antidesma* sp., *Bobea brevipes*, *Carex* sp., *Cyanea* sp., *Cyrtandra* sp., *Hedyotis terminalis*, *Isachne pallens*, *Melicope* sp., *Peperomia* sp., *Perrottetia sandwicensis*, *Pittosporum* sp., *Pouteria sandwicensis*, *Psychotria* sp., *Psydrax odorata*, *Selaginella arbuscula*, or *Syzygium sandwicensis*. Individuals are self-compatible and capable of self-pollination. Little is known about its flowering, pollination vectors, seed dispersal agents,

longevity, specific environmental requirements, and limiting factors of this species (HINHP Database 2001; Service 1999b).

Threats The major threats to *Isodendrion longifolium* include loss of habitat and degradation of the remaining habitat by non-native plants and animals. Non-native plants such as *Ageratina riparia*, *Clidemia hirta*, *Oplismenus hirtellus*, *Paspalum conjugatum*, *Psidium cattleianum*, *Schinus terebinthifolius*, and *Thelypteris parasitica* threaten *I. longifolium* by altering its habitat and competing with it for nutrients, light, and space. Feral pigs can directly impact this species by consumption of fruits and other plant parts, or indirectly due to their rooting behavior which degrades the habitat. Feral goats are destructive browsers and can consume the entire plant in conjunction with trampling and general habitat destruction. The small number and size of occurrences size may limit the gene pool and depress reproductive vigor making this species vulnerable to inbreeding depression and destruction due to the occurrence of a catastrophic event (HINHP Database 2001; 61 FR 53108).

Conservation Needs of the Species A State-wide management plan should be developed and implemented for the long-term conservation of all known occurrences of *Isodendrion longifolium.* This plan should also include broader landscape actions that are needed for the recovery of this plant throughout its range. Based on the recovery plan for this species the following conservation needs have been identified. Fenced exclosures should be constructed around the known occurrences of *I. longifolium* on State and private land to reduce impacts from feral ungulates. Subsequent control or removal of ungulates from these areas will alleviate their impact on native ecosystems and promote natural germination and growth of seedlings. Priority should be given to the smallest occurrences. Non-native plants should be controlled in the vicinity of all known occurrences of *I. longifolium. Ex situ* propagation should be continued and enhanced with material collected from occurrences that have few individuals. Propagated individuals should be outplanted to enhance the remaining wild occurrences. New occurrences should be established within the historic range of *I. longifolium*, in areas free from the impacts of feral ungulates and non-native plants, and at sites that are away from the vicinity of any existing wild occurrences of *I. laurifolium*. Coordinated fire protection is needed for endangered plant species on State natural area reserves, such as Mt. Kaala (Service 1999b).

Ongoing Conservation Actions *Isodendrion longifolium* has been successfully propagated at the Lyon Arboretum's micropropagation laboratory. Outplanting has been attempted at the National Tropical Botanical Garden but the plants did not survive. The National Tropical Botanical Garden has a small number of seeds in storage (Service 1999b; Service 2002). The Service is currently not aware of any other conservation efforts for this species.

Environmental Baseline

Status of the Species in the Action Areas Approximately three percent of the known individuals of *Isodendrion longifolium* are found in action areas. Ten individuals are found within the SBER action area along south Kaukonahua Stream at about 540 m (1,770 ft) elevation, representing about

two percent of the total known individuals. In the SBMR action area, three individuals are known within Palikea Gulch, representing less than one percent (three individuals) of the known individuals of this species. There are three stable population units of greater than 50 mature and reproducing *I. longifolium* outside the Army action areas, located on the island of Kauai (U.S. Army 2003a).

Threats in the Action Areas The major threats to *Isodendrion longifolium* in the SBER action area include fire from military actions, competition with non-native species, trampling of young plants or seedlings by foot traffic, and habitat degradation or destruction by feral goats and pigs (U.S. Army 2003a). The major threats to *I. longifolium* in the SBMR action area include fire from military actions, competition with non-native species, and habitat degradation or destruction by feral goats and pigs. There is also the potential for a direct impact from munitions due to a stray round landing outside of the impact area (U.S. Army 2003a).

Conservation Needs in the Action Areas *Isodendrion longifolium* does not require stabilization across its range because 50 percent of the known individuals do not occur in the action area and there are at least three stable occurrences of this taxon known outside the Army action areas. The Oahu Implementation Team will review this species to determine if any species-specific conservation actions are needed, such as collection for genetic storage. This species may benefit from habitat level management for other endangered species in SBMR and SBER action areas (U.S. Army 2003a).

Ongoing Conservation Actions in Action Areas The Army is currently not conducting specific actions for this species within the action area (U.S. Army 2003a). The Service is currently not aware of any other conservation efforts for this species in the action areas.

Status of the Species - *Labordia cyrtandrae* (Kamakahala)

Species Description *Labordia cyrtandrae* is a short-lived perennial in the Loganiaceae (logania family). This species is a shrub, 0.7 to 2 m (2.3 to 6.6 ft) tall, with ovate to broadly elliptic leaves, 12 to 30 cm (4.7 to 11.8 in) long and 4 to 14 cm (1.6 to 5.5 in) wide. The pale greenish-yellow flowers form compound paniculate cymes of eight to 80. The fruit is 3.2 to 3.5 cm (1.3 to 1.4 in) long, and are some of the largest in the genus. *Labordia* is an endemic Hawaiian genus of 12 species that are known to hybridize. However, no hybrids involving *L. cyrtandrae* have been documented even though this species overlaps in range with numerous other taxa in the genus. The New York Botanical Garden has attempted to hybridize this species with other members of the genus without success. *L. cyrtandrae* is distinguished from others in the genus by its fleshy, hairy, cylindrical stem which flattens upon drying, the shape and length of the floral bracts, and the length of the corolla tube and lobes (Wagner *et al.* 1999).

Listing Status *Labordia cyrtandrae* was federally listed as endangered on October 10, 1996 (61 FR 53089) and State-listed as endangered in Hawaii at the same time. A recovery plan was prepared for this species in 1998 (Service 1998a). Critical habitat was designated for this species on Oahu on June 17, 2003 (68 FR 35950).

Historic and Current Distribution Historically, *Labordia cyrtandrae* was known from both the Waianae and Koolau Mountains of Oahu. In the Koolau Mountains, this species extended from Kawailoa trail to Waialae Iki, almost the entire length of the mountain range. Currently, there are 19 known *L. cyrtandrae* individuals remaining in six occurrences: Kaalaea (2 individuals), east Makalaea (4), north Mohiakea (1), north Haleauau (3), south Haleauau (3), and Mount Kaala (6). However, there is a great deal of under-surveyed potential habitat for this taxon on the upper slopes of Mt. Kaala. Occurrences of this plant are declining, and those that remain are small and widely dispersed, which puts the species at risk of extinction from naturally occurring events and/or lack of reproductive vigor (Service 1998a; U.S. Army 2003a; K. Kawelo, U.S. Army, pers. comm. 2003; J. Lau, HINHP, pers. comm. 2003).

Ecology. *Labordia cyrtandrae* typically grows in shady gulches, slopes, and glens in mesic to wet forests and shrublands dominated by *Metrosideros polymorpha*, *Diplopterygium pinnatum*, and/or *Acacia koa*. It is found between 212 and 1,233 m (695 and 4,044 ft) elevation. Associated native plant species include *Antidesma* sp., *Artemisia australis*, *Bidens torta*, *Boehmeria grandis*, *Broussaisia arguta*, *Chamaesyce* sp., *Coprosma* sp., *Cyrtandra* sp., *Dicranopteris linearis*, *Diplazium sandwichianum*, *Dubautia plantaginea*, *Lysimachia hillebrandii*, *Peperomia membranacea*, *Perrottetia sandwicensis*, *Phyllostegia* sp., *Pipturus albidus*, *Pouteria sandwicensis* , *Psychotria* sp., or *Rumex* sp. (HINHP Database 2001; Service 1998a). *Labordia cyrtandrae* mostly flowers from May through June. Fruit appear from July through August, but this species is sporadically fertile year-round. The flowers are functionally unisexual with male and female flowers on separate plants. Little else is known about its flowering cycles, pollination vectors, seed dispersal agents, longevity, specific environmental requirements, and limiting factors (Service 1998a).

Threats The major threats to *Labordia cyrtandrae* include loss of habitat and degradation of the remaining habitat by non-native plants and animals. The non-native plants threaten *L. cyrtandrae* by altering its habitat and competing with it for nutrients, light, and space. These non-native plants include *Axonopus fissifolius*, *Clidemia hirta*, *Juncus planifolius*, *Psidium cattleianum*, *Rubus argutus*, *Setaria parviflora*, and *Schinus terebinthifolius*. Feral pigs can impact *L. cyrtandrae* by consuming fruits and other plant parts, or by rooting soil which degrades the habitat. Rats also threaten this species by consuming fruits and other plant parts. The small number of individuals of *L. cyrtandrae* and the loss of its normal pollinators may result in decreased genetic variability within and among occurrences over successive generations and could potentially lead to inbreeding depression. The small number of remaining individuals also makes this species vulnerable to extinction from random environmental events. Some individuals are threatened by fire from military activities (HINHP Database 2001; Service 1998a).

Conservation Needs of the Species A State-wide management plan should be developed and implemented for the long-term conservation of all known occurrences of *Labordia cyrtandrae.* This plan should also include broader landscape actions that are needed for the recovery of this plant throughout its range. The recovery plan for this species identifies important conservation needs for *L. cyrtandrae*. Where feasible, exclosures should be constructed around the remaining occurrences

of this plant to reduce impacts from feral pigs. Subsequent control or removal of pigs from these areas and the broader landscape will alleviate their impact on native ecosystems. If fencing is not logistically feasible, other methods of ungulate control are recommended. In this case, removal and control of pigs over a larger landscape is essential to the conservation of *L. cyrtandrae*. Non-native plants should be removed or controlled in the vicinities of all known occurrences. A coordinated fire protection plan for endangered plant species on Federal land needs to be developed and implemented. Occurrences of *L. cyrtandrae* are also seriously threatened by rat predation. Removal and control of rats using approved rodenticides should be emphasized during fruiting season and, when approved, should include aerial dispersal of rodenticides over the broader landscape. To prevent extinction of *L. cyrtandrae*, *ex situ* propagation should be initiated with material from all known occurrences. To date, *ex situ* propagation has not been successful. More research must be conducted to determine a successful method of *ex situ* propagation (Service 1998a).

Ongoing Conservation Action The Lyon Arboretum has seeds and a single plant of *Labordia cyrtandrae* in their collection (Service 2002). The Service is currently not aware of any other conservation efforts for this species.

Environmental Baseline

Status of the Species in the Action Area There are 13 known individuals of *Labordia cyrtandrae* in four occurrences within the SBMR action area: north Mohiakea (1 individual), north Haleauau (3), south Haleauau (3), and Mount Kaala (6). These plants represent approximately 68 percent of the remaining individuals. There are no stable population units of greater than 50 *L. cyrtandrae* outside the SBMR action area (HINHP database 2001; U.S. Army 2003a; K. Kawelo, U.S. Army, pers. comm. 2003; J. Lau, HINHP, pers. comm. 2003).

Threats in the Action Area The major threats to *Labordia cyrtandrae* within the SBMR action area include fire from military actions, competition from non-native species, predation by rats, and habitat degradation and/or destruction by feral pigs. There is also a potential impact from stray munitions landing outside of the impact area. Non-native plant species that compete for resources and can gain a foothold in areas that have been disturbed, such as trails and residual craters left from munition explosions (U.S. Army 2003a).

Conservation Needs in the Action Area A stabilization plan will be developed and implemented for the stabilization and long-term conservation of *Labordia cyrtandrae*. This plan should include broader landscape actions that are needed to sustain this plant. *L. cyrtandrae* requires stabilization because three stable population units of greater than 50 mature and reproducing individuals each do not exist outside of any of the Army action areas, and because greater than 50 percent of the known remaining individuals occur within SBMR action area. The stabilization plan must achieve three stable population units in the Koolau and Waianae Mountains. Stabilization for *L. cyrtandrae* will include the following actions. The Army will construct exclosures around all known *L. cyrtandrae* occurrences, or where exclosures are not feasible due to topography, control feral pigs through other methods. The Army will also control invasive plants within these exclosures, especially

Schinus terebinthifolius, Clidemia hirta, Rubus argutus, and *Psidium cattleianum*, and monitor for new introductions. Surveys will be conducted within and outside the SBMR action area. Seeds will be collected to initiate *ex situ* propagation and genetic storage. Additional occurrences will be reintroduced in suitable habitat. All known occurrences will be monitored. Protection from fire will be implemented as outlined in the WFMP (U.S. Army 2003b). The Army will control of rats, especially during fruiting season (CEMML 2001; Service 1998a; U.S. Army 2003a).

Ongoing Conservation Actions in Action Area The Army has constructed a small fence around one individual of *Labordia cyrtandrae* in SBMR. This fence protects the individual from both pigs and falling rocks. The Army has hand pollinated individuals of this species occurring on SBMR. The Army has successfully collected propagules and the Lyon Arboretum facility has successfully grown the propagules from the occurrences of this species at Kaala. Nine individuals have also successfully been reintroduced to Mt. Kaala Natural Area Reserve, and one is considered mature at this time (U.S. Army 2003a; K. Kawelo, U.S. Army, pers. comm. 2003). The Service is currently not aware of any other conservation efforts for this species in the action areas.

Status of the Species - *Lepidium arbuscula* (Anaunau)

Species Description *Lepidium arbuscula* is a short-lived perennial in the Brassicaceae (mustard family). This species is a gnarled shrub, 0.6 to 1.2 m (2 to 4 ft) tall, with leaves crowded at the ends of the branches. The leaves are 2.6 to 6.0 cm (1.0 to 2.4 in) long and 0.8 to 1.8 cm (0.3 to 0.7 in) wide. The small white flowers form one to three erect simple racemes, 7 to 15 cm (2.8 to 5.9 in) long. The fruit is short and ovate to suborbicular in shape, and 3.5 to 4 mm (0.1 to 0.2 in) long and wide. The reddish brown seeds are 1.5 to 2.0 mm (0.1 in) long. *L. arbuscula* is the only native *Lepidium* in the Waianae Mountains, and it is distinguished from others in the genus by its height (U.S. Army 2003a; Wagner *et al.* 1999).

Listing Status *Lepidium arbuscula* was federally listed as endangered on October 10, 1996 (61 FR 53089) and State-listed as endangered in Hawaii at the same time. A recovery plan was prepared for this species in 1998 (Service 1998a). Critical habitat was designated for this species on Oahu on June 17, 2003 (68 FR 35950).

Historic and Current Distribution Historically, *Lepidium arbuscula* was known from 10 occurrences in the Waianae Mountains on Oahu. Currently, there are 906 *L. arbuscula* individuals remaining from 10 occurrences. These occurrences are distributed from Kuaokala in the northern Waianae Mountains to Lualualei-Nanakuli Ridge in the southern Waianae Mountains. Known locations include Ohikilolo (1 individual); Makua-Keaau Ridge (60); Kapuhi Gulch (20); and Manini Gulch (1); Pahoa and Halona (30), northwest of Puu Kaua (120), Halona (600), Lualualei-Nanakuli Ridge (13), Kamaileunu Ridge (51), and Mohiakea Gulch (10). Occurrences of *L. arbuscula* are declining and those that remain are small and widely dispersed (Service 1998a; K. Kawelo, U.S. Army, pers. comm. 2003; J. Lau, HINHP, pers. comm. 2003).

Ecology *Lepidium arbuscula* generally grows on exposed ridge tops and cliff faces in mesic and dry vegetation communities between 131 and 978 m (430 and 3,208 ft) elevation. This species is typically associated with native plant species such as *Artemisia australis*, *Bidens* sp., *Carex meyenii*, *Carex wahuensis*, *Chamaesyce multiformis*, *Dodonaea viscosa*, *Dryopteris unidentata*, *Dubautia* sp., *Eragrostis variabilis*, *Leptecophylla tameiameiae*, *Lysimachia hillebrandii*, *Metrosideros polymorpha*, *Peperomia* sp., *Psydrax odorata*, *Rumex albescens*, *Schiedea ligustrina*, *Sida fallax*, or *Sophora chrysophylla* (HINHP Database 2001; Service 1998a). *Lepidium arbuscula* has been observed in flower in February but little else is known about its flowering cycles, pollination vectors, seed dispersal agents, longevity, specific environmental requirements, and limiting factors (Service 1998a).

Threats The primary threats to *Lepidium arbuscula* include loss of habitat and degradation of the remaining habitat by non-native plants and animals. The non-native plants that threaten *L. arbuscula* include *Clidemia hirta*, *Psidium cattleianum*, *Schinus terebinthifolius*, *Ageratina adenophora*, *A. riparia*, *Grevillea robusta*, *Melinis minutiflora*, *Erigeron karvinskianus* and *Lantana camara*. These non-native species compete with *L. arbuscula* for nutrients, light, and space. Feral goats also threaten *L. arbuscula* by browsing on the plant, trample individuals, and cause general habitat destruction (HINHP Database 2001; 61 FR 53089). The occurrences located on military land are threatened by fire caused by military actions. The occurrence at the head of Kapuhi Gulch is also threatened by its proximity to a road (HINHP Database 2001; 61 FR 53089).

Conservation Needs of the Species A State-wide management plan should be developed and implemented for the long-term conservation of all known occurrences of *Lepidium arbuscula*. This plan should also include broader landscape actions that are needed for the recovery of this plant throughout its range. The recovery plan for this species identifies important conservation actions. Where feasible, exclosures or strategic barrier fences should be constructed around all the known occurrences of *L. arbuscula* to reduce impacts from feral goats. Control or removal of goats from these areas and the broader landscape will alleviate their impact on native ecosystems. Occurrences that have only a few remaining individuals should be given priority. Non-native plants should be controlled or removed from the vicinity of all known occurrences of *L. arbuscula* (Service 1998a).

Ongoing Conservation Actions The National Tropical Botanical Garden has seeds of this species in storage (Service 2002). The Service is currently not aware of any other conservation efforts for this species.

Environmental Baseline

Status of the Species in the Action Area One occurrence of 10 individuals is known from SBMR action area in Mohiakea Gulch, representing one percent of the remaining individuals. Four occurrences totaling 82 individuals are found in MMR action area, representing nine percent of the species. Three stable population units greater than 50 *Lepidium arbuscula* exist outside the Army's action areas (HINHP Database 2001; Service 1998a; U.S. Army 2003a).

Threats in the Action Area The major threats to *Lepidium arbuscula* within the SBMR action area include fire from military activities, competition and predation from non-native plants, and habitat degradation and/or destruction by feral goats (U.S. Army 2003a).

Conservation Needs in the Action Area *Lepidium arbuscula* does not require stabilization across its range because 50 percent of the known individuals do not occur in the action area and there are at least three stable population units known outside of any of the Army action areas. The Oahu Implementation Team will review this species to determine if any species-specific conservation actions are needed, such as collection for genetic storage. This species will benefit from habitat level management for other Makua and SBMR endangered species (U.S. Army 2003a).

Ongoing Conservation Actions in Action Area The Army has completed a fence that runs the south and southeast perimeter of Makua Valley, protecting the Makua-Keaau Ridge plant from further goat damage (Service 1998a). The Service is currently not aware of any other conservation efforts for this species in the action areas.

Status of the Species - *Lobelia gaudichaudii* ssp. *koolauensis* (No Common Name)

Species Description *Lobelia gaudichaudii* ssp. *koolauensis* is a short-lived perennial in the Campanulaceae (bellflower family). This species is an unbranched, woody shrub, 0.3 to 1 m (1 to 3.5 ft) tall with lance or oblong shaped leaves, 8 to 19 cm (3.1 to 7.5 in) long and 1.3 to 2.8 cm (0.5 to 1.1 in) wide. The greenish or yellowish-white flowers are 5 to 7.5 cm (2 to 3 in) long and 8 to 15 mm (0.3 to 0.6 in) wide, and two to six branched. The ovoid-shaped fruit is 1.5 to 2 cm (0.6 to 0.8 in) long and the seeds are brown, ovoid, and slightly winged. There are more than 350 species of *Lobelia* known worldwide, including 13 endemic Hawaiian species. *L. gaudichaudii* ssp. *koolauensis* is distinguished from others in the genus by the length of the stem, the length and color of the corolla, the leaf width, the length of the floral bracts, and the length of the calyx lobes. The subspecies *koolauensis* is distinguished by the greenish or yellowish white petals and the branched flowering stalks (Wagner *et al.* 1999).

Listing Status *Lobelia gaudichaudii* ssp. *koolauensis* was federally listed as endangered on October 10, 1996 (61 FR 53089) and State-listed as endangered in Hawaii at the same time. A recovery plan was prepared for this species in 1998 (Service 1998a). Critical habitat was designated for this species on Oahu on June 17, 2003 (68 FR 35950).

Historic and Current Distribution Historically, *Lobelia gaudichaudii* ssp. *koolauensis* was known from two occurrences in the central Koolau Mountains on Oahu. Currently, this subspecies is known from two occurrences totaling 263 individuals; one occurrence in Waiawa-Waimano containing 237 individuals, and one occurrence of 26 individuals in south Kaukonahua (HINHP Database 2001; U.S. Army 2003a; K. Kawelo, U.S. Army, pers. comm. 2003; J. Lau, HINHP, pers. comm. 2003). Occurrences of *L. gaudichaudii ssp. koolauensis* are declining, and those that remain are small and widely dispersed (U.S. Army 2003a; 61 FR 53089).

Ecology *Lobelia gaudichaudii* ssp. *koolauensis* typically grows on moderate to steep slopes in *Metrosideros polymorpha* lowland wet shrublands and bogs at elevations between 383 and 867 m (1,256 and 2,844 ft). Associated native plant species include *Bidens* sp., *Broussaisia arguta*, *Cibotium* sp., *Dicanthelium koolauense*, *Isachne distichophylla*, *Machaerina angustifolia*, *Melicope* sp., *Sadleria pallida*, *Scaevola* sp., or *Vaccinium dentatum* (ohelo) (HINHP Database 2001; U.S. Army 2003a). *L. gaudichaudii* ssp. *koolauensis* has been observed in flower in September and in fruit in December. Little else is known about its flowering cycles, pollination vectors, seed dispersal agents, longevity, specific environmental requirements, and limiting factors (Service 1998a).

Threats The primary threats to *Lobelia gaudichaudii* ssp. *koolauensis* include loss and degradation of habitat by non-native plants and animals. The non-native plants such as *Axonopus fissifolius*, *Clidemia hirta*, *Psidium cattleianum*, *Pterolepis glomerata*, and *Sacciolepis indica* threaten *L. gaudichaudii ssp. koolauensis* by altering its habitat and competing for nutrients, light, and space. Feral pigs can impact *L. gaudichaudii ssp. koolauensis* by consuming fruits and other plant parts and by rooting up soil, which degrades the habitat. Rats also threaten this species by consuming fruits and other plant parts. Non-native slugs and snails threaten the species by feeding on its leaves, stems, and seedlings. Occurrences of *L. gaudichaudii ssp. koolauensis* found along trails are threatened by trampling from foot traffic. Because these plants are often found on steep slopes, they are also vulnerable to damage caused by landslides. The few remaining individuals make this species vulnerable to extinction from random environmental events and/or reduced reproductive vigor (HINHP Database 2001; 61 FR 53089).

Conservation Needs of the Species A State-wide management plan should be developed and implemented for the long-term conservation of all known occurrences of *Lobelia gaudichaudii* ssp. *koolauensis*. This plan should also include broader landscape actions that are needed for the recovery of this plant throughout its range. The recovery plan for this species identifies important conservation actions. Exclosures should be constructed around the all known occurrences of *L. gaudichaudii* ssp. *koolauensis* to reduce impacts from feral pigs. Pigs should be controlled or removed from these areas and the broader landscape to alleviate their impact on native ecosystems. Where fencing is not feasible due to topography or potential damage to sensitive habitat, other means of ungulate control including snaring should be judiciously used. Non-native plants should be controlled or removed from the vicinity of all known occurrences of *L. gaudichaudii* ssp. *koolauensis*. To prevent its extinction, a program of *ex situ* propagation for *L. gaudichaudii* ssp. *koolauensis* should be initiated. Propagation material should be collected immediately from the remaining occurrences (Service 1998a).

Ongoing Conservation Actions The National Tropical Botanical Garden has seeds of this species in storage (Service 2002). The Service is currently not aware of any other conservation efforts for this species.

Environmental Baseline

Status of the Species in the Action Area Ten percent (26 individuals) of the known individuals of *Lobelia gaudichaudii* ssp. *koolauensis* are found at south Kaukonahua within the SBER action area (U.S. Army 2003). There is one stable population unit with greater than 50 *L. gaudichaudii* ssp. *koolauensis* outside the SBER action area, located at Waiawa-Waimano Ridge (HINHP Database 2001; K. Kawelo, U.S. Army, pers. comm. 2003; J. Lau, HINHP, pers. comm. 2003; U.S. Army 2003a).

Threats in the Action Area The major threats to *Lobelia gaudichaudii* ssp. *koolauensis* within the SBER action area include trampling from foot traffic, competition from non-native plants, potential rat and slug predation, and habitat degradation and/or destruction by feral pigs. Non-native plant species compete for resources with native plants and can gain a foothold in disturbed areas such as trails. Non-native plants are also aided in their establishment by vehicle maneuvers, dismounted maneuvers, and/or range construction and maintenance (U.S. Army 2003a).

Conservation Needs in the Action Area A stabilization plan will be developed and implemented for the stabilization and long-term conservation of *Lobelia gaudichaudii* ssp. *koolauensis*. This plan should include broader landscape actions that are needed to sustain this plant. *L. gaudichaudii* ssp. *koolauensis* requires stabilization because three stable population units of greater than 50 mature, reproducing individuals each do not exist outside of any of the Army action areas. Stabilization for *L. gaudichaudii* ssp. *koolauensis* will include the following actions. The Army will erect fenced exclosures around all occurrence of *L. gaudichaudii* ssp. *koolauensis*. Where exclosures are not feasible due to topography, ungulates will be controlled by hunting and snaring, and areas off limits to training activities will be clearly marked. The Army will monitor plants at least annually and during the flowering season and collect fruit and plant material from remaining wild occurrences for propagation and to increase *ex situ* stock of *L. gaudichaudii* ssp. *koolauensis*. The Army will also establish new occurrences of *L. gaudichaudii* ssp. *koolauensis* in suitable habitat areas from *ex situ* stock and closely monitor their success. The Army will control non-native plant species within exclosures and in the broader vicinity of all known occurrence of *L. gaudichaudii* ssp. *koolauensis*. The Army will protect all known occurrences from fire as outlined in the WFMP (CEMML 2001; U.S. Army 2003b).

Ongoing Conservation Actions in Action Area The Army is currently not conducting specific actions for this species within the action area (U.S. Army 2003a).

Status of the Species - *Melicope lydgatei* (Alani)

Species Description *Melicope lydgatei* is a long-lived perennial in the Rutaceae (citrus family). This species is a small shrub that has leaves arranged oppositely or in groups of three. The leaves are crowded and opposite, elliptic-oblanceolate, elliptic, or elliptic-ovate, 4 to 10 cm (1.6 to 3.9 in) long, and 2.5 to 6 cm (1.0 to 2.4 in) wide. The 3 to 20 mm (0.1 to 0.8 in) stemmed flowers form

axillary cymes of one to five flowers. The flowers are green or red, with petals 10 mm (3.9 in) long and 5 mm (2 in) wide. The berries are white and ovoid shaped, 1 to 2.6 cm (0.4 to 1.0 in) long, and the seeds are about 0.5 mm (0.02 in) long. The species' leaf arrangement, the amount of fusion of the fruit sections, and the hairless exocarp (outermost layer of the fruit wall) and endocarp (innermost layer) distinguish it from other species in the genus (Wagner *et al.* 1999).

Listing Status *Melicope lydgatei* was federally listed as endangered on March 28, 1994 (59 FR 14482) and State-listed as endangered in Hawaii at the same time. A recovery plan was prepared for this species in 1998 (Service 1998a). Critical habitat was designated for this species on Oahu on June 17, 2003 (68 FR 35950).

Historic and Current Distribution *Melicope lydgatei* was formerly known throughout the Koolau Mountains of Oahu from Hauula to Kahana, Kipapa Gulch to Waimano, and Kalihi Valley to Wailupe Valley. Currently, two known occurrences containing between 39 and 40 individuals are known in the wild. One occurrence occurs in the Manana area and contains one or two individual plants. The other occurrence with 38 plants is along Opaeula/lower Peahinaia trail. No seedlings have been observed at these occurrences but juveniles are present (HINHP Database 2001; U.S. Army 2003a; K. Kawelo, U.S. Army, pers. comm. 2003; J. Lau, HINHP, pers. comm. 2003).

Ecology *Melicope lydgatei* typically grows in association with *Acacia koa*, *Bobea elatior*, *Dicranopteris linearis*, *Metrosideros polymorpha*, *Psychotria* sp., or *Syzygium sandwicensis* on ridges in mesic and wet forests at elevations between 349 and 671 m (1,145 and 2,201 ft). This species has been observed in flower in May and in fruit from June to July. Little else is known about its flowering cycles, pollination vectors, seed dispersal agents, longevity, specific environmental requirements, and limiting factors (HINHP Database 2001; Service 1998a; U.S. Army 2003a).

Threats The primary threats to *Melicope lydgatei* include loss of habitat and degradation of the remaining habitat by non-native plants, insects, and animals. Feral pigs impact this species by consuming fruits and other plant parts and by rooting soil, which degrades the habitat. The black twig borer burrows into the branches and introduces a pathogenic fungus, pruning the host severely and often killing branches or whole plants. Plants typically suffer slight to severe defoliation that leads to reduced vigor due to the infestation of this non-native insect (59 FR 14482). The occurrences located on military land are threatened by fire caused by military activities. The small number of individuals and occurrences with the related limited gene pool and depressed reproductive vigor make this species extremely vulnerable to inbreeding depression and destruction due to the occurrence of a catastrophic event (59 FR 14482).

Conservation Needs of the Species A State-wide management plan should be developed and implemented for the long-term conservation of all known occurrences of *Melicope lydgatei.* This plan should also include broader landscape actions that are needed for the recovery of this plant throughout its range. The recovery plan for *M. lydgatei* identifies important conservation actions.

Where it is topographically feasible, exclosure fences should be constructed around the all known occurrences of *M. lydgatei* to reduce impacts from feral pigs. Pigs should be controlled or removed from these areas and the broader landscape to alleviate impacts on native ecosystems. Control and removal of non-native plants should be carried out in the vicinity of all known occurrences. A number of parasitoids have been introduced to control the black twip borer, though none of them have become established. Further research on biological control of this beetle should be supported. Note that any biocontrol agents should be tested against native Hawaiian scolytids prior to their introduction into the State (Service 1998a).

Ongoing Conservation Actions The Lyon Arboretum has successfully propagated this species (Service 1998a). The Service is currently not aware of any other conservation actions for this species.

Environmental Baseline

Status of the Species in the Action Area Ninety-seven percent (38 individuals) of the known individuals of *Melicope lydgatei* are found along Opaeula/lower Peahinaia trail within the KLOA action area. No seedlings have been observed at this occurrences but juveniles are present. There are no stable population units of *M. lydgatei* outside the KLOA action area (U.S. Army 2003a; HINHP Database 2001; K. Kawelo, U.S. Army, pers. comm 2003; J. Lau, HINHP, pers. comm. 2003). There are no stable population units of *M. lydgatei* outside of the action area (U.S. Army 2003a).

Threats in the Action Area The major threats to *Melicope lydgatei* within the KLOA action area are competition from non-native plants, trampling of seedlings by military foot maneuvers, habitat destruction or modification by feral pigs; and potential infestation from the black twig borer (U.S. Army 2003a).

Conservation Needs in the Action Area A stabilization plan will be developed and implemented for the stabilization and long-term conservation of *Melicope lydgatei*. This plan should include broader landscape actions that are needed to sustain this plant. *M. lydgatei* requires stabilization because three stable population units of greater than 50 mature, reproducing individuals each do not exist outside of any of the Army action areas. Stabilization for *M. lydgatei* will include the following actions. Additional surveys will be conducted within and outside the action areas. The Army will construct exclosures around all remaining unfenced *M. lydgatei* occurrences. Where exclosures are not feasible due to topography, other means of ungulate control will be employed. The Army will control non-native plants from the vicinity of all known occurrences. All occurrences will be monitored and fruit or vegetative material will be collected from remaining wild individuals for propagation and to increase *ex situ* stock of *M. lydgatei*. The Army will establish new occurrences through reintroduction of propagated plants. Control measures will be implemented for the black twig borer, using the most current and affective methods available (U.S. Army 2003a).

Ongoing Conservation Actions in Action Area The Army is currently not conducting specific actions for this species within the action area (U.S. Army 2003a).

Status of the Species - *Myrsine juddii* (Kolea)

Species Description *Myrsine juddii* is a short-lived perennial in the Myrsinaceae (myrsine family). This species is a many branched shrub ranging from 1 to 2 m (3.5 to 6.6 ft) tall with leathery, lance-shaped to elliptic, narrowly inverse leaves 4 to 12 cm (1.6 to 4.7 in.) long and 1.5 to 3.2 cm (0.6 to 1.3 in.) wide. The leaf base is broadly wedge-shaped to heart-shaped, and the margins are smooth and curl under. The upper leaf surface is hairless, whereas the lower surface is sparsely to moderately covered with short, coarse, stiff, whitish or brownish hairs toward the base and along the midrib. The midrib is prominent and lateral veins are moderately conspicuous. The flowers are unisexual (dioeceous with male and female flowers are on separate plants) and occur in groups of four to eight in tight clusters surrounded by small bracts. The yellowish green petals are narrowly inverse lance-shaped, 2.8 to 3.2 mm (0.1 in.) long and with short hairs, becoming smooth. The fleshy, round drupe contains a single seed. This species is distinguished from others in the genus by the hairiness of the lower leaf surface and the shape of the leaf base (Service 1998a; Wagner *et al.* 1999).

Listing Status *Myrsine juddii* was federally listed as endangered on October 10, 1996 (61 FR 53089) and State-listed as endangered in Hawaii at the same time. A recovery plan was prepared for this species in 1998 (Service 1998a). Critical habitat was designated for this species on Oahu on June 17, 2003 (68 FR 35950).

Historic and Current Distribution *Myrsine juddii* has been reported from only three occurrences in the central Koolau Mountains: the north Kaukonahua-Kahana summit divide, Peahinaia trail, and Puu Kainapuaa to Poamoho trail. Currently, one occurrence of approximately 3,000 *M. juddii* are known in the wild. It is located between Puu Kainapuaa and north Kaukonahua in the Koolau Mountains (U.S. Army 2003a; J. Lau, HINHP, pers. comm. 2003; K. Kawelo, U.S. Army, pers. comm. 2003).

Ecology *Myrsine juddii* typically grows on ridge crests and gulch slopes in wet forests and shrublands dominated by *Metrosideros polymorpha* or a mixture of *M. polymorpha* and *Dicranopteris linearis* at elevations between 384 and 867 m (1,260 and 2,844 ft). Associated native plant species include *Cheirodendron platyphyllum*, *Cheirodendron trigynum*, *Machaerina* sp., *Melicope clusiifolia*, *Psychotria mariniana*, and *Syzygium sandwicensis*. This plant species has unisexual flowers, but very little is known about the life history requirements of this species (U.S. Army 2003a; HINHP Database 2001; Service 1998a; 61 FR 53089).

Threats The primary threats to *Myrsine juddii* include loss of habitat and degradation of the remaining habitat by non-native plants and animals. Non-native plants such as *Clidemia hirta* and

Psidium cattleianum threaten the species by altering its habitat and competing with it for nutrients, light, and space. Feral pigs can impact this species by consuming plant parts and fruits and by rooting soil, which degrades the habitat. This species is also threatened by trampling from military foot maneuvers. Due to the small number of extant occurrences, this species is threatened by a risk of extinction from naturally occurring events and/or reduced reproductive vigor (HINHP Database 2001; Service 1998a; 61 FR 53089).

Conservation Needs of the Species A State-wide management plan should be developed and implemented for the long-term conservation of all known occurrences of *Myrsine juddii.* This plan should also include broader landscape actions that are needed for the recovery of this plant throughout its range. The recovery plan for this species identifies important conservation actions. Fenced exclosures should be constructed around the all known occurrences of *Myrsine juddii* to reduce impacts from feral pigs. Pigs should also be controlled or removed from these areas and from the broader landscape to alleviate their impact on native ecosystems. Non-native plants should be controlled or removed from the vicinity of all known occurrences of *Myrsine juddii.* To prevent extinction of this species, *ex situ* propagation should be initiated. *Myrsine juddii* should only be outplanted within its historic range, in suitable habitat free of impacts from ungulates and non-native plants. Propagation material should be collected from all extant occurrences (Service 1998a).

Ongoing Conservation Actions The National Tropical Botanical Garden has collected seed from this species, but it has not been propagated (Service 2002). The Service is currently not aware of any other conservation efforts for this species.

Environmental Baseline

Status of the Species in the Action Area One hundred percent of the known individuals (3,000) of *Myrsine juddii* are found between Puu Kainapuaa and north Kaukonahua within the KLOA action area. There are no stable population units of *M. juddii* outside the KLOA action area (U.S. Army 2003a; J. Lau, HINHP, pers. comm. 2003; K. Kawelo, U.S. Army, pers. comm. 2003).

Threats in the Action Area The major threats to *Myrsine juddii* within the KLOA action area include competition with non-native species, trampling of seedlings by military foot maneuvers, and habitat degradation and/or destruction by feral pigs. Non-native plant species compete for resources with *Myrsine juddii* and can gain a foothold in disturbed areas such as trails (U.S. Army 2003a).

Conservation Needs in the Action Area A stabilization plan will be developed and implemented for the stabilization and long-term conservation of *Myrsine juddii.* This plan should include broader landscape actions that are needed to sustain this plant. *M. juddii* requires stabilization because three stable population units of greater than 50 mature, reproducing individuals each do not exist outside of any of the Army action areas to ensure that the Army's actions do not cause its extinction. To be considered stable, *M. juddii* must the criteria required for stability of a short-lived perennial (Service 1998a). Stabilization for *M. juddii* will include the following actions. Surveys will be conducted

within and outside the action areas. The Army will construct exclosures around all remaining unfenced *M. juddii* occurrences. Where exclosures are not feasible due to topography, other means of ungulate control will be employed and areas that contain unfenced occurrences of *M. juddii* will be clearly marked as off limits to training activities. Non-native plants will be controlled in the vicinity of all known occurrences. Fruits or vegetative material will be collected from remaining wild occurrences for propagation and to increase *ex situ* stock of *M. juddii*. The Army will establish new occurrences within and outside of KLOA through reintroduction of propagated plants. Control measures will be implemented for the black twig borer, using the most current and affective methods available (U.S. Army 2003a).

Ongoing Conservation Actions in Action Area The Army is currently not conducting specific actions for this species within the action area (U.S. Army 2003a).

Status of the Species - *Phlegmariurus nutans* (No Common Name)

Species Description *Phlegmariurus nutans* is a short-lived perennial member of the Lycopodiaceae (clubmoss family). This herbaceous epiphyte has a few tufted branches that can grow to greater than 50 cm (20 in) tall. Leaves are lance-shaped or linear, 10 to 15 mm (0.4 to 0.6 in) long, and 2 to 3 mm (0.1 in) wide. The reproductive cones are slender and range in length from 3 to 15 cm (1.2 to 5.9 in) and in width from 0.1 to 0.2 mm (0.0004 to 0.008 in). The sporophylls occur in four overlapping rows. *Phlegmariurus nutans* can be distinguished from other Hawaiian species in the genus by its habit and large, stiff leaves (59 FR 14482).

Listing Status *Phlegmariurus nutans* was federally listed as endangered on March 28, 1994 (57 FR 47028) and listed by the State of Hawaii at the same time. A recovery plan was prepared for *P. nutans* and 65 other plant taxa that occur on the island of Oahu in 1998 (Service 1998b). Critical habitat was designated for this species on Kauai and Oahu on February 27, 2003 (68 FR 9116) and July 17, 2003 (68 FR 35950), respectively.

Historic and Current Distribution Historically, *Phlegmariurus nutans* was known from the islands of Kauai and Oahu. The specimen from Kauai has no specific habitat information associated with its collection. On Oahu, it was found in various locations in the Koolau Mountains of Oahu between Kaluanui Valley to the north, Paalaa to the west, and Mount Tantalus to the south (Service 1996). Currently, 11 individuals are found at five occurrences on the island of Oahu: north Kaukonahua Gulch (5 individuals), Kaukonahua Gulch (1), Kahana (2), Kaipapau (2), and Koloa Gulch (1) (K. Kawelo, U.S. Army, pers. comm. 2003; J. Lau, HINHP, pers. comm. 2003). Occurrences and individuals of *P. nutans* are declining in the state of Hawaii. *Phlegmariurus nutans* is considered to be extirpated from the island of Kauai. Occurrences on Oahu are small and widely dispersed (U.S. Army 2003a).

Ecology *Phlegmariurus nutans* grows on open ridges and slopes in *Metrosideros polymorpha*-dominated wet forests and, occasionally, mesic forests. It is known from elevations

between 227 and 846 m (745 and 2,775 ft) with associated native plants that include *Antidesma platyphyllum, Broussaisia arguta, Cyrtandra laxiflora, Dicranopteris linearis, Elaphoglossum* sp., *Hedyotis terminalis, Hibiscus* spp., *Machaerina angustifolia, Psychotria mariniana, Syzygium sandwicensis,* and *Wikstroemia oahuensis* (HINHP Database 2001; Service 1998b). *Phlegmariurus nutans* has been observed with spores in May. Additional information on reproductive cycles, dispersal agents, longevity, specific environmental requirements, or limiting factors is not available (Service 1998b).

Threats The primary threat to *Phlegmariurus nutans* is habitat degradation by feral pigs and competition for light, space, and nutrients from non-native plant species such as *Clidemia hirta, Paspalum conjugatum, Psidium cattleianum, and Sacciolepis indica.* The small number of individuals and occurrences make *P. nutans* vulnerable to decreased reproductive vigor and extinction from stochastic events (HINHP Database 2001).

Conservation Needs of the Species A State-wide management plan should be developed and implemented for the long-term conservation of all known occurrences of *Phlegmariurus nutans.* This plan should also include broader landscape actions that are needed for the recovery of this plant throughout its range. The recovery plan for this species identifies the following important conservation actions. Exclosures should be constructed around the known occurrences of *P. nutans* to reduce impacts from feral pigs. Pigs should be controlled or removed from the greater landscape that is needed to sustain this clubmoss. Non-native plants should be controlled from the vicinity of *P. nutans.* Efforts should be made to establish this species *ex situ* for genetic storage (Service 1998b).

On-going Conservation Actions Propagation of the species was attempted at the National Tropical Botanical Garden; however, these efforts were unsuccessful (Service 1998b). The Service is currently not aware of any other conservation efforts for this species.

Environmental Baseline

Status of the Species in the Action Areas *Phlegmariurus nutans* is found in the action areas delineated for both KLOA and SBER. Four individuals of *P. nutans* are found in two occurrences at north Kaukonahua Gulch and along the Koolau summit trail north of Kahuku Cabin. Both of these sites are in the southeastern corner of the KLOA action area. One individual is found in the SBER action area in south Kaukonahua Gulch. Together, these five plants represent 45 percent of the total remaining individuals of this species statewide (K. Kawelo, U.S. Army, pers. comm. 2003; J. Lau, HINHP, pers. comm. 2003). There are no stable populations of 50 or more mature and reproducing *P. nutans* outside of the KLOA and SBER action areas (U.S. Army 2003a).

Threats in the Action Areas Within the KLOA and SBER action areas, *Phlegmariurus nutans* is threatened by habitat degradation by feral pigs; introduction and establishment of competitive non-native plant species; trampling from foot traffic; and fire caused by military training activities (U.S. Army 2003a).

Conservation Needs in the Action Areas A stabilization plan will be developed and implemented for the stabilization and long-term conservation of *Phlegmariurus nutans*. This plan should include broader landscape actions that are needed to sustain this plant. A stabilization plan must be developed and implemented for this taxon because there are no stable populations of 50 or more mature and reproducing individuals in the wild. To be considered stable, *P. nutans* must meet the criteria required for stability of a short-lived perennial (Service 1998b). Stabilization for *P. nutans* will include the following actions. The Army will fence exclosures to protect occurrences of *P. nutans* in KLOA and SBER, where fencing is feasible. The Army will also monitor, control, and/or remove of pigs and competitive non-native plant species within the exclosures and in the broader landscape needed to sustain this plant. Fire protection measures as outlined in the WFMP (U.S. Army 2003b) will also be implemented. The Army will conduct surveys within and outside of KLOA and SBER action areas (U.S. Army 2003a).

On-going Conservation Actions in the Action Areas The Service is not aware of any conservation actions currently being implemented for *Phlegmariurus nutans*.

Status of the Species - *Phyllostegia hirsuta* (No Common Name)

Species Description *Phyllostegia hirsuta* is an erect, short-lived perennial subshrub or liana in the Lamiaceae (mint family). Its hirsute oval-shaped leaves range in length from 14.5 to 30.0 cm (5.7 to 11.8 in) and width from 6.5 to 18.0 cm (2.6 to 7.1 in). The aromatic, two-lipped flowers are found in axillary verticillasters (false whorls) and range in length from 7 to 11 mm (0.3 to 0.4 in). Nutlets are about 2.5 to 3.0 mm (0.1 in) long (Wagner *et al.* 1999). In Hawaii, there are 27 recognized endemic species of *Phyllostegia*. The ranges for three of these species, *P. mollis, P. kaalaensis* and *P. parviflora* ssp. *lydgatei*, overlap with that of *P. hirsuta*; however, hybrids have never been observed (U.S. Army 2003a). *P. hirsuta* is considered to be most closely related to *P. parviflora* (Wagner *et al.* 1999).

Listing Status *Phyllostegia hirsuta* was federally listed as endangered on October 10, 1996 (61 FR 53089) and listed by the State of Hawaii at the same time. A recovery plan was prepared in 1998 for this species and 65 other plant taxa that occur on the island of Oahu (Service 1998a). Critical habitat was designated for *P. hirsuta* on June 17, 2003 (68 FR 35950).

Historic and Current Distribution Historically, *Phyllostegia hirsuta* was widely distributed throughout the Waianae and Koolau Mountains on Oahu. In these mountains, the species ranged from the head of Kukuiula Gulch (Pahole) to north Palawai Gulch and most of the entire length of the Koolau Mountains from Pupukea-Kahuku trail to Palolo (HINHP Database 2001). Currently, between 243 and 254 individuals are known to be extant in 19 occurrences at south Halemano (4 individuals), Opaeula (2), Kawai Iki (2), south branch of north Kaukonahua (1), north Kaukonahua and Poamoho (1), Kawainui (2), north Halemano and Punaluu (1), north Mohiakea Gulch (50), Waianae Kai/Haleauau Ridge (20), central Haleauau (20), south Kaukonahua (9), Puu Hapapa (20), leeward Puu Kaua (1), Ekahanui (51), Kaluaa (30), north Huliwai (20 to 30),

Makaha/Waianae Kai Ridge (2 to 3), Kaluanui (6), and Kaipapau (1) (K. Kawelo, U.S. Army, pers. comm. 2003; J. Lau, HINHP, pers. comm. 2003).

Ecology *Phyllostegia hirsuta* is typically found on steep, shaded slopes, cliffs, ridges, gullies, and stream banks in mesic or wet forests dominated by *Metrosideros polymorpha* or a mixture of *Metrosideros polymorpha* and *Dicranopteris linearis*. It occurs at elevations that range between 195 and 1,202 m (640 and 3,943 ft). Associated native plant species include *Antidesma platyphyllum, Astelia* spp., *Broussaisia arguta, Chamaesyce multiformis, Cibotium* spp., *Claoxylon sandwicense, Clermontia kakeana, Coprosma longifolia, Cyanea membranacea, Cyrtandra waianaeensis, Diplazium sandwichianum, Dryopteris unidentata, Dubautia laxa, Dubautia sherffiana, Elaeocarpus bifidus, Freycinetia arborea, Hedyotis schlechtendahliana, Hedyotis terminalis, Hibiscus* spp., *Ilex anomala, Labordia kaalae, Liparis hawaiiensis, Lysimachia hillebrandii, Machaerina angustifolia, Melicope* spp., *Myrsine lessertiana, Myrsine sandwicensis, Neraudia* spp., *Nothocestrum* spp., *Perottetia sandwicensis, Phyllostegia grandiflora, Pipturus* spp., *Pisonia* spp., *Pleomele* spp., *Pouteria sandwicensis, Psychotria* spp., *Rumex albescens, Scaevola gaudichaudiana, Streblus pendulinus, Zanthoxylum kauaense*, and several fern species (HINHP Database 2001; Service 1998a; 61 FR 53089). Wild specimens have been observed in flower in February and in fruit in June (K. Kawelo, U.S. Army, pers. comm. 2003) with cultivated material blooming in July. Additional information on reproductive cycles, longevity, pollinators, or limiting factors is limited. *P. hirsuta* is considered to be a short-lived perennial species (Service 1998a).

Threats The primary threats to *Phyllostegia hirsuta* include potential adverse effects of continued and future Army training activities, habitat degradation and/or destruction by feral pigs and goats, predation by rats, and competition from non-native plant species (*e.g., Adiantum raddianum, Athyrium* spp., *Axonopus fissifolius, Blechnum appendiculatum, Buddleia asiatica, Clidemia hirta, Drymaria cordata, Lantana camara, Melinis minutiflora, Passiflora suberosa, Paspalum conjugatum, Physalis peruviana, Pimenta dioica, Psidium cattleianum, Rubus argutus, Rubus rosifolius*, and *Schinus terebinthifolius*) (HINHP Database 2001).

Conservation Needs of the Species A State-wide management plan should be developed and implemented for the long-term conservation of all known occurrences of *Phyllostegia hirsuta*. This plan should also include broader landscape actions that are needed for the recovery of this plant throughout its range. The recovery plan for this species identifies the following important conservation actions. Conservation actions should include the construction of exclosures to protect the known occurrences from feral pigs and goats, subsequent control and/or removal of ungulates and rats, along with competitive non-native plant species. Priority for all of these actions should be given to those occurrences with only a few individuals (*e.g.*, south branch of north Kaukonahua, leeward Puu Kaua, Kaipapau). Additional surveys are also needed throughout suitable habitat to locate new occurrences and update the status of those occurrences that have not been seen in recent years (Service 1998a).

On-going Conservation Actions One accession of seeds was made from State lands in the Koolau Mountains in 1997. This collection resulted in 70 individual plants which flowered at Hawaii's Division of Forestry and Wildlife Pahole Rare Plant Facility (Service 1998a). Both Lyon Arboretum and National Tropical Botanical Garden have *Phyllostegia hirsuta* as seed or cuttings for genetic storage. Lyon Arboretum has material from two collections from the island of Oahu, while National Tropical Botanical Garden has approximately 485 seeds from two separate collections (Service 2002). The Service is currently not aware of any other conservation efforts for this species.

Environmental Baseline

Status of the Species in the Action Areas A total of 113 individuals of *Phyllostegia hirsuta* is present within the action areas of three installations: KLOA, SBMR, and SBER. These individuals represent approximately 46 percent of the species rangewide. Within the action areas, there is one stable population unit of 50 or more mature, reproducing individuals. This is at north Mohiakea in SBMR. Between 130 and 141 individuals occur outside of the action areas with one stable population unit of 50 or more mature, reproducing individuals at Ekahanui (; K. Kawelo, U.S. Army, pers. comm. 2003; J. Lau, HINHP, pers. comm. 2003). Fourteen individuals of *P. hirsuta* occur in the KLOA action area as part of seven occurrences in training areas KA-2 and KB-2. They are found in the Koolau Mountains at south Halemano (4 individuals), Opaeula (2), Kawai Iki (2), south branch of north Kaukonahua (1), north Kaukonahua and Poamoho (2), Kawainui (2), north Halemano and Punaluu (1) (K. Kawelo, U.S. Army, pers. comm. 2003; J. Lau, HINHP, pers. comm. 2003). Within the SBER action area, nine individuals are found in one occurrence in training area ER-13 in south Kaukonahua Gulch. At SBMR, 90 individuals of *P. hirsuta* are found in three occurrences distributed over a 10 km (6 mi) distance along the summit of the Koolau Mountains in north Mohiakea Gulch (50), Waianae Kai-Haleauau Ridge (20), and central Haleauau (20) (K. Kawelo, U.S. Army, pers. comm. 2003; J. Lau, HINHP, pers. comm. 2003).

Threats in the Action Areas Threats to *Phyllostegia hirsuta* include continued habitat destruction by feral pigs and goats, and rockslides; predation by rats; and those impacts attributable to Army training actions such as fire, trampling, and transport of non-native plant species.

Conservation Needs in the Action Areas A stabilization plan will be developed and implemented for the stabilization and long-term conservation of *Phyllostegia hirsuta*. This plan should include broader landscape actions that are needed to sustain this plant. This species must be stabilized, as there is only one stable populations of 50 or more mature, reproducing *P. hirsuta* outside of the three action areas (KLOA, SBER, and SBMR) and only one stable population is found within the action areas (SBMR). Stabilization for *P. hirsuta* will include the following actions. Exclosures to protect *P. hirsuta* against feral pigs and goats, as well as to restrict military foot traffic, in KLOA and SBER will be constructed where these threats are identified as significant by the Oahu Implementation Team. Non-native plants and rats will be monitored, controlled, and where feasible, eradicated, within these exclosures. The Army will establish an *ex situ* stock of *P. hirsuta* for reintroduction purposes. Fire protection measures as outlined in the WFMP (U.S. Army 2003b) will be implemented at KLOA, SBER and SBMR in order to avoid or minimize the potential adverse effects of wildfires on this species (U.S. Army 2003a).

Ongoing Conservation Actions in the Action Areas Goats are being controlled at SBMR; however, no fencing can be built due to the presence of unexploded ordinance. The Service is not aware of any other ongoing species-specific conservation actions being implemented for *Phyllostegia hirsuta* within the action areas of KLOA, SBMR, and SBER.

Status of the Species - *Phyllostegia kaalaensis* (No Common Name)

Species Description *Phyllostegia kaalaensis* is a perennial herb and a member of the Lamiaceae (mint family). This species is distinguished from others in the genus by the presence of spreading, pointed teeth on its egg-shaped leaf margins and by hairs along the margins of the calyces and bracts (Wagner *et al.* 1999). *P. kaalaensis* was accepted as a separate species from *P. glabra* only within the past decade (Wagner *et al.* 1999). Morphological characteristics, as well as different habitat requirements, distinguish the two species. Also, they are not sympatric, *P. kaalaensis* occurs in more xeric habitats than does *P. glabra* (U.S. Army 2003a).

Listing Status *Phyllostegia kaalaensis* was federally-listed as endangered on October 10, 1996 (61 FR 53089) and listed by the State of Hawaii at the same time. A recovery plan was prepared in 1998 for *P. kaalaensis* and 65 other plant taxa that occur on the island of Oahu (Service 1998a). Critical habitat was designated for this species on Oahu on June 17, 2003 (68 FR 35950).

Historic and Current Distribution *Phyllostegia kaalaensis* was formerly known from seven scattered locations in the Waianae Mountains of Oahu (Service 1998a). Currently, 33 to 38 individuals of *P. kaalaensis* are found in six occurrences: Palikea Gulch (10 individuals), Kapuna (2), Pahole Gulch (10 to 15), Keawapilau (2), central Ekahanui (1), and Waianae Kai (8) (K. Kawelo, U.S. Army, pers. comm. 2003; J. Lau, HINHP, pers. comm. 2003; U.S. Army *in litt* 2003). *Phyllostegia kaalaensis* has only been recognized since the 1970s, however, it is not difficult to identify a downward population trend. Individuals can no longer be found at a number of sites where the species had previously been recorded, including along the branches of Ekahanui Gulch in the southern Waianae Mountains and several spots in Pahole Gulch in the northern Waianae Mountains. Additionally, the Waianae Kai colony has experienced a marked decrease in size over the past decade. When first discovered in 1993, the colony contained about 30 plants. By 1998, only eight plants could be located (U.S. Army 2003a).

Ecology *Phyllostegia kaalaensis* is found on gulch slopes and bottoms and on almost vertical rock faces in mixed mesic forest or *Sapindus oahuensis* forest between 374 and 796 m (1,227 and 2,611 ft) elevation. Associated native plant species include *Antidesma platyphyllum, Claoxylon sandwicense, Diplazium sandwichianum, Freycinetia arborea, Hibiscus* sp., *Myrsine lanaiensis, Myrsine lessertiana, Neraudia melastomifolia, Pipturus albidus, Pouteria sandwicensis, Psychotria hathewayi, Streblus pendulinus,* and *Urera glabra* (HINHP Database 2001).

Flowering in *P. kaalaensis* has been reported from January to June (Nagata 1980). Moths are presumed to pollinate the flowers. The fleshy blackish fruits are indicative of those that are dispersed by birds. The branches are known to root when they touch the ground, with the rooted

stem capable of becoming a separate plant if the stem is severed. Reproduction in this species may be primarily through vegetative means, as most of the currently known plants are in dense patches far away from any other plants of the species. Information is extremely limited regarding flowering cycles, pollination vectors, seed dispersal agents, longevity, specific environmental requirements, and limiting factors (Service 1998a). The three largest occurrences may represent a single clone as there have been no reports of seedlings or immature plants that without doubt originated from seed (U.S. Army 2003a). *Phyllostegia kaalaensis* is considered to be a short-lived perennial species (Service 1998a).

Threats Major threats to *Phyllostegia kaalaensis* include potential adverse effects of continued and future Army training activities, habitat degradation and destruction by feral pigs and goats, and competition from non-native plant species. The spread of non-native grass species also increases the incidence and severity of wildfires. Since all of the occurrences of *P. kaalaensis* are found in small patches, they are especially vulnerable to extirpation due to natural disasters and stochastic events.

Conservation Needs of the Species A State-wide management plan should be developed and implemented for the long-term conservation of all known occurrences of *Phyllostegia kaalaensis*. This plan should also include broader landscape actions that are needed for the recovery of this plant throughout its range. The recovery plan for this species identifies the following important conservation actions: the construction of exclosures to protect the known occurrences from feral pigs and goats, subsequent control and/or removal of ungulates, and removal of competitive non-native plant species. Priority for all of these actions should be given to those occurrences with only a few individuals (*e.g.*, Kapuna, Keawapilau). Additional surveys are also needed throughout suitable habitat to locate new occurrences and update the status of those occurrences that have not been seen in recent years (Service 1998a).

Ongoing Conservation Actions This species is being successfully propagated at Hawaii's Division of Forestry and Wildlife Pahole Rare Plant Facility (Service 1998a). Genetic material, as seeds and cuttings from at least three separate collections (and totaling at least 29 seeds and/or cuttings), is also held in genetic storage at Lyon Arboretum (Service 2002). The Service is currently not aware of any other conservation actions for this species.

Environmental Baseline

Status of the Species in the Action Area Ten *Phyllostegia kaalaensis* (representing between 26 and 30 percent of the species rangewide) occur in Palikea Gulch within the SBMR action area and 14 to 19 individuals are found within the MMR action area (representing between 42 and 50 percent of the species rangewide) (K. Kawelo, U.S. Army, pers. comm. 2003; J. Lau, HINHP, pers. comm. 2003). There are no known stable population units of 50 or more mature, reproducing individuals of *Phyllostegia kaalaensis* rangewide (U.S. Army 2003a).

Threats in the Action Area Threats to *Phyllostegia kaalaensis* in SBMR include the continued degradation of suitable habitat by feral pigs and goats, as well as the risk of fire, trampling, and

subsequent introduction and establishment of non-native plant species associated with on-going and future Army training activities.

Conservation Needs in the Action Area This taxon must be stabilized because no stable populations exist outside of the Army action area. To be considered stable, *Phyllostegia kaalaensis* must meet the criteria required for stability of a short-lived perennial (Service 1998a). The stabilization plan for this taxon from the Makua IP must be implemented to achieve three stable population units. Stabilization measures include: reintroduction of *P. kaalaensis* into at least four management units outside of any action area, as designated for the Makua IP; collection and propagation of this taxon for genetic storage and reintroduction into the wild; monitoring and management of known population units as identified in the Makua IP; surveys for additional population units in suitable habitat, particularly in Honouliuli; development of fire management plans for population units outside of MMR and SBMR action areas; and implementation of the WFMP (U.S. Army Garrison 2003, U.S. Army 2003b).

Ongoing Conservation Actions in the Action Area Pursuant to urgent actions established for MMR, the State of Hawaii has collected seeds from occurrences where there are less than five mature, reproducing individuals of *Phyllostegia kaalaensis* (*e.g.*, Kapuna) to establish representation in a living collection (U.S. Army *in litt* 2003). The Service is not aware of any other conservation actions being implemented for *Phyllostegia kaalaensis* in the action areas.

Status of the Species - *Phyllostegia mollis* (No Common Name)

Species Description *Phyllostegia mollis* is a herbaceous perennial subshrub in the Lamiaceae (mint family). The leaves, which range in length from 5 to 13 cm (2.0 to 5.1 in), are oppositely arranged on long stems which extend from the base of the plant. Three to six tubular, white, and slightly fragrant flowers are found at the tip of the stems. The fruits, which turn black at maturity, are segmented into four sections, each containing a single seed surrounded by fleshy pulp. There are 27 endemic species of *Phyllostegia* recognized in Hawaii (Wagner *et al.* 1999). The ranges of three of these species, *P. hirsuta, P. kaalaensis* and *P. parviflora* ssp. *lydgatei*, overlap with *P. mollis*; however, hybrids are unknown (U.S. Army 2003a).

Listing Status *Phyllostegia mollis* was federally listed as endangered on September 28, 1990 (55 FR 39664) and listed by the State of Hawaii at the same time. A recovery plan was prepared in 1998 for *P. mollis* and 65 other plant taxa that occur on the island of Oahu (Service 1998a). Critical habitat was designated for this species on Maui on May 14, 2003 (68 FR 25934) and Oahu on June 17, 2003 (68 FR 35950).

Historic and Current Distribution Historically, *Phyllostegia mollis* was known from Molokai, Maui, and Oahu from the central and southern Waianae Mountains, Mt. Kaala to Honouliuli, and Makiki in the Koolau Mountains. Currently, this species is only known from Oahu and Maui. On Oahu, 98 to 118 individuals are found in eight occurrences: south Mohiakea Gulch (5 individuals), Mohiakea Gulch (50 to 70), north Palawai (1), central Kaluaa (1), Huliwai Gulch (2), Waieli (7), Pualii Gulch

(16), and Ekahanui (16) (J. Lau, HINHP, pers. comm. 2003; K. Kawelo, U.S. Army, pers. comm. 2003). On East Maui, it is known from Waiopai Gulch (Service 1998a).

Ecology *Phyllostegia mollis* typically grows on steep slopes and in gulches as a component of mesic to wet forest at elevations between 519 and 928 m (1,702 and 3,044 ft). Associated native plant species include *Acacia koa, Alyxia oliviformis, Antidesma platyphyllum, Carex meyenii, Chamaesyce multiformis, Claoxylon sandwicense, Diospyros hillebrandii, Dryopteris unidentata, Metrosideros polymorpha, Myrsine* spp., *Pipturus alba, Pisonia umbellifera, Pouteria sandwicensis, Psychotria hathewayi,* and *Urera glabra* (HINHP Database 2001; Service 1998a). Flowering in *P. mollis* has been reported from January to June (Nagata 1980) and moths are the presumed pollinators. Due to the presence of fleshy fruits, it is presumed that seeds are dispersed by birds. Branches of *P. mollis* have the ability to root when they touch the ground, with the rooted stems forming separate plants. It is believed that vegetative reproduction may be the primary method of reproduction as most extant individuals of this species are found in dense patches some distance from others in the species, and there are no reports of seedlings or individuals that obviously germinated from seed (U.S. Army 2003a).

Threats Threats to *Phyllostegia mollis* include potential effects of ongoing and future Army training activities, habitat degradation by feral ungulates, and competitive non-native plant species. Additionally, arthropod damage has been observed on the stems of this species (U.S. Army 2003a). Since all of the extant occurrences of *P. mollis* are found in small patches, they are vulnerable to extirpation due to natural disasters and stochastic events.

Conservation Needs of the Species A State-wide management plan should be developed and implemented for the long-term conservation of all known occurrences of *Phyllostegia mollis.* This plan should also include broader landscape actions that are needed for the recovery of this plant throughout its range. The recovery plan for this species identifies the following important conservation actions: construction of exclosures around known occurrences of this species to reduce impacts from feral ungulates, control and/or removal of feral ungulates, and control and/or removal of competitive non-native plant species (Service 1998a). The level of threat from arthropod activity should be determined and actions taken to reduce identified significant threats.

Ongoing Conservation Actions The occurrence of *Phyllostegia mollis* in Palawai Gulch has been fenced by The Nature Conservancy of Hawaii. In addition, genetic material of *P. mollis*, in the form of seeds and cuttings from five collections on Oahu, is being held at Lyon Arboretum and *P. mollis* is being successfully propagated at Lyon Arboretum and National Tropical Botanical Garden (Service 1998a, 2002). The Service is currently not aware of any other conservation efforts for this species.

Environmental Baseline

Status of the Species in the Action Area Fifty-five to 75 individuals are found in two occurrences within the SBMR action area but outside of the impact zone (K. Kawelo, U.S. Army, pers. comm. 2003). These individuals are located in south Mohiakea Gulch (5 individuals) and Mohiakea Gulch

(50 to70) and together represent between 56 to 64 percent of the species rangewide (K. Kawelo, U.S. Army, pers. comm. 2003; J. Lau, HINHP, pers. comm. 2003). No stable population units of 50 or more mature, reproducing individuals of *Phyllostegia mollis* occur outside of the action area; however, one stable population units exists within the action area at Mohiakea Gulch (U.S. Army 2003a).

Threats in the Action Area Threats to *Phyllostegia mollis* in SBMR include the continued degradation of suitable habitat by feral ungulates and non-native plant species, in addition to those potential adverse effects which would result from ongoing and future Army training. Threats which could result from Army training activities include introduction and establishment of non-native plant species, fire, and trampling from foot traffic (U.S. Army 2003a).

Conservation Needs in the Action Area A stabilization plan will be developed and implemented for the stabilization and long-term conservation of *Phyllostegia mollis*. This plan should include broader landscape actions that are needed to sustain this plant, including suitable habitat outside and within the action areas. *P. mollis* will be stabilized because three stable population units do not currently exist outside of the Army action areas (SBMR). To be considered stable, *P. mollis* must meet the criteria required for stability of a short-lived perennial (Service 1998a). Stabilization for *P. mollis* will include the following actions. The Army will establish exclosures to protect plants from feral ungulates. Fruits and other plant material will be collected from unrepresented individuals of *P. mollis* to increase the *ex situ* stock, using different alternative techniques for genetic storage. This stock will also be used for reintroduction and augmentation of occurrences once they are protected from feral ungulates. In addition, competitive non-native plant species will be controlled, and where feasible, eradicated, within the ungulate exclosures. Fire protection measures, including both general and specific Standard Operating Procedures, as provided in the WFMP (U.S. Army 2003b) will be implemented at SBMR (U.S. Army 2003a).

Ongoing Conservation Actions in the Action Area Army Natural Resource staff have 31 cuttings in propagation for future outplanting purposes (U.S. Army 2003a). The Service is currently not aware of any other conservation efforts for this species in the action areas.

Status of the Species - *Plantago princeps* (Ale)

Species Description *Plantago princeps* is a short-lived perennial member of the Plantaginaceae (plantain family). It differs from other native Hawaiian members of the genus by its large branched stems, flowers which are oriented at nearly right angles to the axis of the flower cluster, and fruits that break open at a point two-thirds from the base. *Plantago princeps* is endemic to the Hawaiian Islands. All of the varieties except *P. princeps* var. *longibracteata* are woody shrubs. The species is divided into four varieties: *P. princeps* var. *anomala (*Kauai); *P. princeps* var. *laxiflora* (Molokai, Maui, and Hawaii); *P. princeps* var. *longibracteata* (Kauai and the Koolau Mountains of Oahu); and *P. princeps* var. *princeps* (Waianae and Koolau Mountains of Oahu). Aside from their geographic distribution, they are distinguished from one another by the degree of pubescence

on stems, leaves, and flowers; leave size and venation of leaves; and orientation of flowers (Wagner *et al.* 1999).

Listing Status *Plantago princeps* was federally listed as an endangered species on November 10, 1994 (59 FR 56333) and listed by the State of Hawaii at the same time. A recovery plan was prepared in 1999 for *P. princeps* and 25 other plant taxa that occur on multiple Hawaiian islands in 1999 (Service 1999b). Critical habitat was designated for *P. princeps* on the island of Kauai on February 27, 2003 (68 FR 9116); on the island of Molokai on March 18, 2003 (68 FR 12982); on the island of Maui on May 14, 2003 (68 FR 25934); and the island of Oahu on June 17, 2003 (68 FR 35950).

Historic and Current Distribution *Plantago princeps* was historically found on Kauai, Oahu, Molokai, Hawaii, and Maui. It is no longer extant on the island of Hawaii. *Plantago princeps* var. *longibracteata* was known from Kauai and Oahu; but there are currently no remaining Oahu occurrences in the Koolau Mountains. *P. princeps* var. *princeps* has been recorded from three general areas on the island of Oahu, with most of the currently known plants scattered throughout the leeward and windward sides of the Waianae Mountains. There are also historical records for this variety from the southeastern Koolau Mountains in the valleys of Kalihi, Nuuanu, and Manoa. It has not been observed in that region for over 50 years. *Plantago princeps* was discovered for the first time in the central Koolau Mountains in 2001, when *P. princeps* var. *princeps* was identified at Waiawa just a short distance to the lee of the Koolau Summit Ridge. *Plantago princeps* var. *princeps* is currently known from eight occurrences (a total of 201 to 251 individuals) on Oahu: Puu Kalena (40 individuals), north Mohiakea (30), Ohikilolo (14), Pahole Gulch (12), the north branch of north Palawai (7), the south branch of north Palawai (25), Ekahanui (23), and Halona (50 to 100) (J. Lau, HINHP, pers. comm. 2003; K. Kawelo, U.S. Army, pers. comm. 2003).

Ecology *Plantago princeps* (henceforth as variety *princeps*) occurs in two extremely different types of habitat on the island of Oahu. Recorded elevations for the plant range from 480 to792 m (1,580 to 2,600 ft) (HINHP 2002). In the Waianae Mountains, plants are found in mesic habitat on cliff faces, ledges, and bases. The majority of these plants are accessible only by rappelling with the aide of ropes. This cliff habitat is composed predominantly of native grasses, sedges, herbs, and shrubs. In contrast, the Waiawa plants occur on a streamside embankment in wet, rainforest habitat close to the Koolau summit ridge (U.S. Army 2003a). This area receives more precipitation than anywhere else on the island. Flowering and fruiting specimens have been collected throughout the year (Wagner *et al.* 1999) but little else is known about the phenology, pollination, seed dispersal, longevity, specific environmental requirements, or limiting factors for this taxon. *P. princeps* is considered to be a short-lived perennial species (Service 1999b).
When *P. princeps* was discovered in 1987 in the Waianae Mountains, it had not been seen there for over 100 years. The species had not been seen in the Koolau Mountains for over 50 years before it was rediscovered there in 2001. Since all of the currently known occurrences were only discovered relatively recently, population trends are not well documented. The occurrence of *P. princeps* that was discovered in 1987 in the north branch of north Palawai Gulch is the only colony for which a

trend has been documented. When first observed, there were approximately 20 individuals; only seven individuals have been seen in recent years. In this particular case, the rapid decline is attributed to competition from *Erigeron karvinskianus*, an invasive non-native plant species (U.S. Army 2003a).

Threats Threat to *Plantago princeps* include potential effects of on-going and future Army training activities, feral ungulates, and competition from competitive non-native plant species. Goats are present in the Waianae Mountains and in lower numbers in the Koolau Mountains (none are known from the wet forests of the Koolaus). Pigs are common, however, in the Koolau Mountains and may threaten the individuals at the Waiawa occurrence. While threats from non-native plant species are greater in the drier Waianae Mountain sites than in the wet forests of the Koolau Mountains, in both the spread of flammable non-native grasses increases the incidence and destructiveness of wildfire (Service 1999a; U.S. Army 2003a).

Conservation Needs of the Species A State-wide management plan should be developed and implemented for the long-term conservation of all known occurrences of *Plantago princeps*. This plan should also include broader landscape actions that are needed for the recovery of this plant throughout its range. The recovery plan for this species identifies the following important conservation actions: the construction of exclosures protect the known occurrences from feral pigs and goats, subsequent control and/or removal of ungulates, and removal of competitive non-native plant species. Priority for all of these actions should be given to those occurrences with only a few individuals (*e.g.*, Ohikilolo, the north branch of north Palawai) (Service 1999b).

Ongoing Conservation Actions *Plantago princeps* has been fenced to exclude feral ungulates in Pahole Natural Area Reserve. In addition, there are nine individuals in Hawaii's Division of Forestry and Wildlife Pahole Rare Plant Facility (U.S. Army 2003a). Two plants of an unspecified variety of *P. princeps* are also in cultivation at National Tropical Botanical Garden (Service 1999b). The Service currently is not aware of any other conservation actions for this species.

Environmental Baseline

Status of the Species in the Action Area Seventy *Plantago princeps* (representing between 28 to 35 percent of the species rangewide) occur in Puu Kalena (40 individuals) and north Mohiakea (30 individuals) within the action area at SBMR and 26 individuals are found within the MMR action area (representing between 10 and 13 percent) (K. Kawelo, U.S. Army, pers. comm. 2003; J. Lau, HINHP, pers. comm. 2003). There is only one stable population unit of greater than 50 mature and reproducing individuals of *P. princeps* outside of the SBMR and MMR action areas (U.S. Army 2003a).

Threats in the Action Area Threats to *Plantago princeps* in SBMR include potential effects from ongoing and future Army training activities, and on-going habitat degradation by feral ungulates and non-native plant species. The primary threats to *P. princeps* from military training include fire, trampling from foot traffic, and the introduction and establishment of non-native plant species (U.S. Army 2003a).

Conservation Needs in the Action Area This taxon must be stabilized because no stable populations exist outside of the Army action area. To be considered stable, *Plantago princeps* must meet the criteria required for stability of a short-lived perennial (Service 1999b). The stabilization plan for this taxon from the Makua IP must be implemented to achieve three stable population units. Stabilization measures include: collection and propagation of this taxon for genetic storage, monitoring and management of known population units as identified in the Makua IP, and implementation of the WFMP (U.S. Army 2003b).

Ongoing Conservation Actions in the Action Area There are no ongoing species-specific conservation actions being implemented for *Plantago princeps* at SBMR (U.S. Army 2003a).

Status of the Species - *Pteris lidgatei* (No Common Name)

Species Description *Pteris lidgatei* is a short-lived perennial member of the Adiantaceae (maidenhair fern family). It is a coarse herb, 0.5 to 1 m (1.6 to 3.3 ft) in height arising from a horizontal rhizome 1.5 cm (0.6 in) thick and at least 10 cm (3.9 in) long when mature. The fronds, including the leaf stalks, range in length and width from 60 to 95 cm (24 to 37) and 20 to 45 cm (8 to 18 in), respectively. The leafy portion of the frond is oblong-deltoid to broadly ovate-deltoid, thick, brittle, and dark gray-green. The sori are apparently marginal in position, either fused into long linear sori, or more typically separated into distinct shorter sori, with intermediate conditions being common. It can be distinguished from other Hawaiian species in the genus by the rough, brittle texture of its fronds, overall dark green color, and the tendency of the sori along the leaf margins to be broken into short segments rather than fused into a continuous marginal sori (Palmer 2003).

Listing Status *Pteris lidgatei* was federally listed as an endangered species on September 26, 1994 (59 FR 49025) and listed by the State of Hawaii at the same time. A recovery plan was prepared for *P. lidgatei* and other fern taxa in 1998 (Service 1998b). Critical habitat for this species was designated on the island of Molokai on March 18, 2003 (68 FR 12982); on the island of Maui on May 14, 2003 (68 FR 25934); and on the island of Oahu on June 17, 2003 (68 FR 35950).

Historic and Current Distribution *Pteris lidgatei* is an endemic species that historically occurred in the Koolau Mountains of Oahu, and on Maui and Molokai (where it was collected only once in 1912). It has always been rare and in recent years has not been seen in areas where it had been previously observed, though living plants are still being found in new locations on Oahu and Maui (Palmer 2003). On these islands, there are an estimated 45 individuals in eight occurrences. On Oahu, 25 individuals are found as part of six occurrences in Kawainui (3 individuals), Kawai Iki (3), north Kaukonahua (1), south Kaukonahua (14), Kaluanui (1), and Waimano (3). On Maui, 20 individuals are found as part of two occurrences at Kauaula Valley (12) and Kahakuloa Stream (8) (Service 1998b; K. Kawelo, U.S. Army, pers. comm. 2003; J. Lau, HINHP pers. comm. 2003).

Ecology On Oahu, *Pteris lidgatei* is generally found on streambanks and near waterfalls. It occurs at approximately 75 m (246 ft) elevation in wet *Metrosideros polymorpha-Dicranopteris linearis* forest with *Asplenium* spp, *Broussaisia arguta, Cibotium chamissoi, Cyrtandra* spp.,

Diplopterygium pinnatum, *Doodia lyonii*, *Dryopteris sandwicensis*, *Elaphoglossum crassifolium*, *Isachne pallens*, *Machaerina angustifolia*, *Sadleria squarrosa*, *Selaginella arbuscula*, and *Sphenomeris chinensis*. *M. polymorpha* is typically the dominant native overstory tree species (HINHP Database 2002; U.S. Army 2003a).

Threats The major threats to *Pteris lidgatei* include habitat degradation and consumption by feral pigs, competition from non-native plants, potential effects of on-going and future Army training activities, and the risk of extinction due to the small number of remaining individuals and stochastic events. The non-native plants *Ageratina riparia, Christella parasitica, Clidemia hirta, Paspalum conjugatum, Psidium cattleianum, Pterolepis glomerata, Sacciolepis indica* threaten *P. lidgatei* by altering its habitat and competing with it for nutrients, light, and space (Service 1998b).

Conservation Needs of the Species A State-wide management plan should be developed and implemented for the long-term conservation of all known occurrences of *Pteris lidgatei*. This plan should also include broader landscape actions that are needed for the recovery of this plant throughout its range. The recovery plan for this species identifies the following important conservation actions: construction of exclosures protect the known occurrences from feral pigs and goats, subsequent control and/or removal of ungulates, and removal of competitive non-native plant species. Priority for all of these actions should be given to those occurrences with only a few individuals (*e.g.*, north Kaukonahua, Kaluanui). Additional surveys are also needed throughout suitable habitat to locate new occurrences and update the status of those occurrences that have not been seen in over 20 years (Service 1998b).

On-going Conservation Actions The Nature Conservancy of Hawaii's ungulate control program in Kapunakea Preserve on Maui includes construction of fences to protect rare plants, annual monitoring of ungulates, and trained staff and volunteer hunting (68 FR 25934). These efforts have reduced the spread of feral pigs into the nearby area in Kauaula Valley where an occurrence of *Pteris lidgatei* is found (Service 1998b). The Service is not aware of any other conservation actions are being implemented for this species.

Environmental Baseline

Status of the Species in the Action Areas *Pteris lidgatei* is found within the action areas of KLOA and SBER where their combined 21 individuals are found in four occurrences and represent 47 percent of the total remaining individuals of this species rangewide. In the KLOA action area, seven individuals are found in three occurrences: Kawai Iki (3 individuals), Kawainui (3) and north Kaukonahua (1). Within the action area for SBER, 14 individuals are found as one occurrence at south Kaukonahua (K. Kawelo, U.S. Army, pers. com. 2003; J. Lau, HINHP, pers. com. 2003). There are no stable populations of 50 or more mature, reproducing individuals of *P. lidgatei* (U.S. Army 2003a).

Threats in the Action Areas Without control of feral ungulates, habitat destruction by feral pigs and goats will continue to adversely affect *Pteris lidgatei* and threaten its survival and recovery.

Additionally, fire, transport and establishment of non-native plant species, and trampling from foot traffic are threats to *P. lidgatei* which could result from on-going and future training activities at KLOA and SBER (U.S. Army 2003a).

Conservation Needs in the Action Areas A stabilization plan will be developed and implemented for the stabilization and long-term conservation of *Pteris lidgatei*. This plan should include broader landscape actions that are needed to sustain this plant. This species needs to be stabilized because no population units of 50 or more mature, reproducing *P. lidgatei* exist outside of the KLOA and SBER action areas.
Stabilization for *P. lidgatei* will include the following actions. Fences will be constructed around the known occurrences of this plant (particularly those in KLOA) to protect individuals from feral pigs. Feral pigs will then be controlled or removed from these fenced areas. Competitive non-native plants species will also be removed from these fenced areas and their levels monitored for subsequent control. Fire protection measures as outlined in the WFMP (U.S. Army 2003b), both general and those Standard Operating Procedures which are installation-specific, will be implemented at KLOA and SBER (U.S. Army 2003a).

On-going Conservation Measures in the Action Areas Currently, the Service is not aware of any conservation actions are being conducted for *Pteris lidgatei* within Army action areas at KLOA and SBER.

Status of the Species - *Sanicula purpurea* (No Common Name)

Species Description *Sanicula purpurea* is a stout and erect perennial member of the Apiaceae (parsley family). It ranges in height from 8 to 36 cm (3.1 to 14.2 in) with stems originating from numerous kidney- to heart-shaped basal leaves that are 3 to 7-lobed and 2 to 8 cm (0.8 to 3.1 in) wide. The small purple or cream-colored flowers form branched terminal umbels of 6 to 10 flowers. Fruits are spherical, prickly, and 2.0 to 3.5 mm (0.08 to 0.14 in) long and 2 to 3 mm (0.08 to 0.12 in) wide (Wagner *et al.* 1999).

Listing Status *Sanicula purpurea* was federally listed as endangered on October 10, 1996 (61 FR 53108) and listed by State of Hawaii at the same time. A recovery plan was prepared in 1999 for *S. purpurea* and 25 other plant taxa that occur on multiple Hawaiian islands (Service 1999b). Critical habitat was designated for this species on the island of Maui on May 14, 2003 (68 FR 25934) and on the island of Oahu on June 17, 2003 (68 FR 35950).

Historic and Current Distribution *Sanicula purpurea* is known from Oahu and Maui. On Oahu, it occurred along the Koolau Mountain summit crest from 700 to 1,698 m (2,300 to 5,570 ft) elevation on wet, windswept slopes. Currently, on Oahu, 45 individuals are found as part of six occurrences at Helemano-Punaluu divide (10 individuals), north Kaukonahua-Punaluu Summit (8), Kaukonahua-Kahana summit (22), Waimalu-Kahaluu summit divide (1), Puu Keahiakahoe (1), and Wailupe-Waimanalo summit divide (3) (HINHP Database 2001; K. Kawelo, U.S. Army, pers.

comm. 2003; J. Lau, HINHP, pers. comm. 2003). On West Maui, 200 individuals are distributed throughout seven scattered occurrences along 2.5 km (1.6 mi) of the Puu Kukui trail and on the West Maui Natural Area Reserve in the Puu Kukui watershed. In total, there are 245 individuals of *S. purpurea* known to remain in the wild (Service 1999b; K. Kawelo, U.S. Army, pers. comm. 2003; J. Lau, HINHP, pers. comm. 2003).

Ecology *Sanicula purpurea* occurs in open mixed montane bogs or *Metrosideros polymorpha*-dominated mixed montane bogs and windswept shrublands within the cloud zone between 415 and 959 m (1,361 and 3,146 ft) elevation. Associated native plant species include *Bidens* spp., *Cheirodendron* spp., *Dicanthelium koolauense, Gahnia beechyi, Leptecophylla tameiameiae, Lycopodium* spp., *Machaerina angustifolia, Plantago pachyphylla, Sadleria pallida,* and *Vaccinium* spp. (HINHP Database 2001). Flowering cycles, pollination vectors, seed dispersal agents, longevity, specific environmental requirements, and limiting factors for *S. purpurea* are unknown. *S. purpurea* is considered to be a short-lived perennial (Service 1999b).

Threats Threats to *Sanicula purpurea* on Oahu include potential effects of on-going and future Army training activities, habitat degradation by feral pigs, competition from non-native plant species, reduced reproductive vigor, and a risk of extinction due to the small number of existing occurrences and stochastic events. The non-native plant species *Axonopus fissifolius* and *Clidemia hirta* threaten *S. purpurea* by altering its habitat and competing with it for nutrients, light, and space (HINHP Database 2001; Service 1999b).

Conservation Needs of the Species A State-wide management plan should be developed and implemented for the long-term conservation of all known occurrences of *Sanicula purpurea.* This plan should also include broader landscape actions that are needed for the recovery of this plant throughout its range. The recovery plan for this species identifies the following important conservation actions: construction of exclosures protect the known occurrences from feral pigs and goats, subsequent control and/or removal of ungulates, and removal of competitive non-native plant species. Priority for all of these actions should be given to those occurrences with only a few individuals (*e.g.*, Waimalu-Kahaluu Summit Divide, Puu Keahiakahoe). Additional surveys are also needed throughout suitable habitat to locate new occurrences and update the status of those occurrences that have not been seen in recent years (Service 1999b).

Ongoing Conservation Actions *Sanicula purpurea* is found in bog habitat in the Puu Kukui watershed owned by Maui Land and Pineapple on Maui. Since 1988, Maui Land and Pineapple has managed Puu Kukui Watershed and is receiving funding from the Service to survey for rare plants on their lands and build feral ungulate exclosures to protect listed species, including *S. purpurea*, that occur in the watershed. Maui Land and Pineapple have also constructed a boardwalk in Puu Kukui that spans the known range of this occurrence of *S. purpurea.* Entry into this area is strictly regulated to prevent the inadvertent introduction of competitive non-native plant species (Service 1999b; 68 FR 25934).

Environmental Baseline

Status of the Species in the Action Areas *Sanicula purpurea* occurs within the KLOA and SBER action areas. Within KLOA, 18 individuals are found as two occurrences, eight individuals occur at north Kaukonahua-Punaluu summit and 10 individuals occur at Halemano-Punaluu summit divide. Within SBER, 22 individuals are found in one occurrence at Kaukonahua-Kahana summit (J. Lau, HINHP, pers. comm. 2003; K. Kawelo, U.S. Army, pers. comm. 2003). Altogether these 40 individuals of *S. purpurea* represent 16 percent of the remaining individuals of the species rangewide. No stable population units of 50 or more mature, reproducing individuals of *S. purpurea* occur on Oahu, although there are two stable population units on Maui (U.S. Army 2003a).

Threats in the Action Areas Feral pigs are a threat to *Sanicula purpurea* within the action areas due to their rooting and other habitat debilitating actions. In addition, *S. purpurea* is threatened by ongoing and future Army actions which include fire, introduction and establishment of non-native plant species, and trampling from foot traffic (U.S. Army 2003a).

Conservation Needs in the Action Areas A stabilization plan will be developed and implemented for the stabilization and long-term conservation of *Sanicula purpurea*. This plan should include broader landscape actions that are needed to sustain this plant, including suitable habitat outside and within the action areas. *S. purpurea* will be stabilized because three stable population units do not currently exist outside of the Army action areas. To be considered stable, *S. purpurea* must meet the criteria required for stability of a short-lived perennial (Service 1999b). Stabilization for *S. purpurea* will include the following actions. Occurrences of *S. purpurea* at KLOA and SBER will be fenced to protect them from the effects of feral pig activity and foot traffic where these threats are identified as significant by the Oahu Implementation Team. The Army will control non-native plant species within these fenced areas and monitor for new introductions of non-native plants. These efforts will be prioritized for occurrences with few remaining individuals (U.S. Army 2003a).

Ongoing Conservation Actions in the Action Areas Army Natural Resource staff are currently growing plant material for reintroduction (U.S. Army 2003a). The Service is not aware of any other conservation actions for this species within the KLOA and SBER action areas.

Status of the Species - *Schiedea hookeri* (No Common Name)

Species Description *Schiedea hookeri* is a member of the Caryophyllaceae (pink family). It is a sprawling perennial herb with stems that range in length from 0.3 to 0.5 m (1 to 1.6 ft). These stems curve slightly upward or lie close to the ground producing matted clumps. Leaves are opposite, narrow lance-shaped to elliptic, and range from 3 to 8 cm (1.2 to 3.2 in) in length and 0.4 to 1.5 cm (0.2 to 0.6 in) in width. Flowers are apetalous, perfect, and borne in open branched inflorescences which are hairy and somewhat sticky. Sepals are green to purple in color and 3 to 4.5 mm (1.2 to 1.8 in) long. *S. hookeri* is distinguished from others in this endemic Hawaiian genus by its open, hairy, and sometimes sticky inflorescence and capsule size (Wagner *et al.* 1999).

Listing Status *Schiedea hookeri* was federally listed as endangered on October 10, 1996 (61 FR 53108) and listed by the State of Hawaii at the same time. A recovery plan was prepared for *S. hookeri* and 24 other plant taxa that occur on the multiple islands in the state of Hawaii in 1999 (Service 1999b). Critical habitat for this species was designated on the island of Oahu on June 17, 2003 (68 FR 35950).

Historic and Current Distribution Historically, *Schiedea hookeri* was known from the Waianae Mountains of Oahu and a single fragmentary collection from Maui that may, in fact, represent a different species. Currently on Oahu, 265 individuals are found in 13 occurrences in the following locations: Mohiakea Gulch (5 individuals), Kaluakauila Gulch (6), Makua-Makaha Ridge (4), between Kolekole Pass and Puu Hapapa (10), Kalena-Kaala Ridge (present but numbers unknown), Kaluaa Gulch (60), Kamaileunu Ridge (11), Makaha, Makaha-Waianae Kai Ridge (40), Palikea Gulch (10), southwest of Puu Kaua (25), Waianae Kai (43), Waianae Kai Ridge (20), and the west side of Puu Kaua (30)
(Service 1999b; J. Lau, HINHP, pers. comm. 2003; K. Kawelo, U.S. Army, pers. comm. 2003).

Ecology *Schiedea hookeri* occurs in diverse mesic or dry lowland forests typically dominated by *Metrosideros polymorpha* or *Diospyros* spp. Elevations at which the species is found range between 365 and 790 m (1,200 and 2,600 ft). However, one occurrence is found at 850 to 900 m (2,800 to 2,950 ft). Other associated plant species include *Dodonaea* spp., *Artemisia australis*, *Bidens* spp., *Carex meyenii*, and *Eragrostis grandis* (Service 1999b). Mature fruits have been observed on *S. hookeri* in June and August. A series of self-pollination experiments which included within-occurrence crosses and crosses among occurrences have demonstrated that *S. hookeri* shows moderately strong inbreeding depression, which could detrimentally affect wild occurrences that have only a few individuals. *S. hookeri* appears to be an out-crossing species, and in greenhouses, flowers do not set seed unless they are hand-pollinated. In the field, the species is presumed to be pollinated by insects, although none have been observed. A related species, *S. lydgatei* on Molokai, is apparently pollinated by native, night-flying moths. *S. hookeri* appear to be long-lived, but there is no evidence of reproduction from seed under field conditions. Seedlings from other *Schiedea* species that occur in mesic or wet sites are apparently consumed by introduced slugs and snails. In contrast, *Schiedea* species that occur in dry areas produce abundant seeds and seedlings following winter rains, presumably because the drier sites have fewer non-native predators. *S. hookeri* differs considerably through its range in its potential for clonal growth. Plants from Kaluakauila Gulch at Makua are upright, and show little potential for clonal growth and spread. In contrast, clonal growth has been detected for individuals at Kaluaa Gulch where the growth form is decumbent and plants demonstrate nodal rooting (HINHP Database 2001; Service 1999b; Weller and Sakai, unpublished data). Additional information on flowering cycles, seed dispersal agents, longevity, specific environmental requirements, or limiting factors is not available for this species.

Threats The primary threats to *Schiedea hookeri* include habitat degradation and/or destruction and predation by feral goats and pigs; competition with non-native plant species for light, space, and

nutrients; and predation by introduced slugs and snails. The Kaluakauila Gulch occurrence is also potentially threatened by fire and military activities (Service 1999b).

Conservation Needs of the Species A State-wide management plan should be developed and implemented for the long-term conservation of all known occurrences of *Schiedea hookeri.* This plan should also include broader landscape actions that are needed for the recovery of this plant throughout its range. The recovery plan for this species identifies the following important conservation actions: the construction of exclosures around all known occurrences of *S. hookeri* and subsequent control of feral ungulates and non-native slugs, snails, and plant species within these areas (Service 1999b).

Ongoing Conservation Actions Lyon Arboretum, the Honolulu Botanical Garden, and the National Tropical Botanical Garden have cuttings of *Schiedea hookeri.* No other conservation actions are known for this species.

Environmental Baseline

Status of the Species in the Action Area There are five individuals of *Schiedea hookeri* within the SBMR action area. These individuals represent approximately two percent of the species rangewide. On Oahu, 10 individuals are known from the MMR action area, representing four percent of the species (K. Kawelo, U.S. Army pers. comm. 2003; J. Lau, HINHP, pers. comm. 2003). At least three stable population units of 50 mature, reproducing individuals are known outside of the action areas (U.S. Army 2003a).

Threats in the Action Area Within the SBMR action area, *Schiedea hookeri* is threatened by the introduction and establishment of competitive non-native plant species, fire due to military activities, trampling from foot maneuvers, feral ungulates, and non-native slugs and snails (U.S. Army 2003a).

Conservation Needs in the Action Area. *Schiedea hookeri* does not require stabilization across its range because 50 percent of the known individuals do not occur in the action area and there are at least three stable population units known outside of any of the Army action areas. The Oahu Implementation Team will review this species to determine if any species-specific conservation actions are needed, such as collection for genetic storage. This species will benefit from habitat level management for other Makua and SBMR endangered species (U.S. Army 2003a).

Ongoing Conservation Actions in the Action Area There are currently no conservation actions being implemented for *Schiedea hookeri* within the SBMR action area (U.S. Army 2003a).

Status of the Species - *Schiedea kaalae* (No Common Name)

Species Description *Schiedea kaalae* is a member of the Caryophyllaceae (pink family). This plant lacks a main stem and rises from a short woody caudex which is typically less than 20 cm (8 in) in length. Leaves are opposite, thick, single-veined, and clustered at the top of the stem. The

inflorescence is 20 to 40 cm (8 to 16 in) long. Flowers lack petals but have purple bracts and sepals that resemble petals. The fruit is an ovoid capsule filled with dark grayish-brown seeds which are about 1.0 mm (0.0004 in) long (Wagner *et al.* 1999). The endemic Hawaiian genera *Schiedea* and *Alsinidendron* constitute a complex of species descended from a single colonizing ancestor. *Schiedea kaalae* belongs to a subgroup of its genus that includes *S. nuttallii* and *S. pentandra* (Wagner *et al.* 1999).

Listing Status. *Schiedea kaalae* was federally listed as endangered on October 29, 1991 (56 FR 55770) and listed by the State of Hawaii at the same time. A recovery plan was prepared for *S. kaalae* and 65 other plant taxa that occur on the island of Oahu in 1998 (Service 1998a). Critical habitat for this species was designated on the island of Oahu on June 17, 2003 (68 FR 35950).

Historic and Current Distribution Historically, *Schiedea kaalae* was known from the north-central and south-central Waianae Mountains and the northern Koolau Mountains of Oahu. Approximately 22 to 23 individuals are found in eight extant occurrences at north Mohiakea Gulch (1 individual), Pahole Gulch (3), Huliwai (1 to 2), Maakua (4), north branch of south Ekahanui (3), north Kaluaa (2), north Palawai (1), and the south branch of Ekahanui (7) (K. Kawelo, U.S. Army, pers. comm. 2003; J. Lau, HINHP, pers. comm. 2003).

Ecology In the Koolau Mountains, *Schiedea kaalae* has been found in habitats that range from mesic to wet. The species occurs at elevations between 64 and 869 m (210 and 2,850 ft) in gulch bottoms and on lower gulch slopes. Plants can grow on gentle to moderate slopes, steep rock embankments, and nearly vertical cliffs. Some Koolau sites are constantly wet from seeping water. In many cases, *S. kaalae* occurs in the same drainages as its relatives *S. nuttallii, S. pentandra, S. hookeri,* and *Alsinidendron obovatum.* In such cases, *S. kaalae* is usually found in the more xeric areas of these drainages, while the other taxa occupy areas of the drainages that are more mesic. Associated native species include *Alyxia oliviformis, Athyrium arnottii, Athyrium sandwichianum, Boehmeria grandis, Charpentiera sp., Claoxylon sandwicense, Cyrtandra calpidicarpa, Cyrtandra laxiflora, Diospyros hillebrandii, Dryopteris unidentata, Freycinetia arborea, Hedyotis acuminata, Nothocestrum longifolium, Pipturus albidus, Pisonia sandwicensis, Pisonia umbellifera, Pouteria sandwicensis, Psychotria hathewayi, Selaginella arbuscula,* and *Xylosma hawaiiense* (HINHP Database 2001; Service 1998a). Individuals of *S. kaalae* are considered to be short-lived perennials (Service 1998a). *S. kaalae* has perfect flowers (each flower having both anthers and stamen). Flowering occurs from March through June (Service 1998a). A series of experimental self-pollinations, within-population crosses, and crosses among occurrences has demonstrated that *S. kaalae* experiences moderately strong inbreeding depression. These results indicate that reductions in population size could result in expression of inbreeding depression among progeny, with potentially deleterious consequences for the long-term persistence of this species. Consistent with the evidence for inbreeding depression, *S. kaalae* appears to be an out-crossing species. Under greenhouse conditions, flowers do not set seed unless hand-pollinated. In the field, plants have been being visited by an introduced syrphid fly that was likely feeding on pollen. Seedlings of *S. kaalae*, like other species of *Schiedea* that occur in mesic or wet sites, are

believed to be eaten by introduced slugs and snails. In contrast, *S.* species that occur in dry areas produce abundant seedlings following winter rains. Hybridization between *Schiedea* species has been documented in the wild and is not uncommon for species growing together in cultivation. Little else is known about its flowering cycles, pollination vectors, seed dispersal agents, longevity, specific environmental requirements, and limiting factors (Service 1998a).

Threats The major threats to *Schiedea kaalae* include habitat loss and predation by feral pigs and goats; competition from the non-native non-native plants for light, space, and nutrients; predation by introduced slugs and snails; fire; reduced reproductive vigor due to inbreeding; and a risk of extinction from stochastic natural events such as landslides. Non-native plants that are of concern include *Ageratina adenophora, Ageratina riparia, Blechnum appendiculatum, Christella parasitica, Clidemia hirta, Cordyline fruticosa, Melinus minutiflora, Morella faya, Oplismenus hirtellus, Passiflora suberosa, Psidium cattleianum, Psidium guajava, Rubus rosifolius,* and *Schinus terebinthifolius* (HINHP Database 2001; Service 1998a).

Conservation Needs of the Species A State-wide management plan should be developed and implemented for the long-term conservation of all known occurrences of *Schiedea kaalae.* This plan should also include broader landscape actions that are needed for the recovery of this plant throughout its range. The recovery plan for this species identifies the following important conservation actions: construction of exclosure fences round all known occurrences of *S. kaalae* and control of feral ungulates and foot traffic within these exclosures. These fenced areas should be monitored, and non-native plants, introduced slugs, and snails should be removed from the exclosure (Service 1998a).

Ongoing Conservation Actions Seeds and other genetic material are also being held in refugia for *Schiedea kaalae.* The Waimea Arboretum and National Tropical Botanical Garden currently house six and 10 cuttings, respectively; the Lyon Arboretum holds seeds and cuttings; and 3,000 seeds are being stored at the Lyon Arboretum Seed Storage Facility (Service 2002). The Service is currently not aware of any other conservation efforts for this species.

Environmental Baseline

Status of the Species in the Action Area There is only one individual of *Schiedea kaalae* known from the SBMR action area. This individual is located in north Mohiakea Gulch at about 640 to 885 m (2,100 to 2,900 ft) elevation and represents four percent of the species state-wide. Three individuals, representing 14 percent of the species, are found within the MMR action area. No populations of greater than 50 mature, reproducing individuals exist (U.S. Army 2003a).

Threats in the Action Area Within the SBMR action area, *Schiedea kaalae* is threatened by competition from non-native plant species for light, space, and nutrients; fire that results from Army training activities; and feral animals that continue to threaten the long-term survival of this plant (U.S. Army 2003a).

Conservation Needs in the Action Area This taxon must be stabilized because no stable populations exist outside of the Army action area. To be considered stable, *Schiedea kaalae* must meet the criteria required for stability of a short-lived perennial (Service 1998a). The stabilization plan for this taxon from the Makua IP must be implemented to achieve three stable population units. Stabilization measures include: reintroduction of *S. kaalae* into at least one management unit within and three outside of any action area, as designated for the Makua IP; collection and propagation of this taxon for genetic storage and reintroduction into the wild; monitoring and management of known population units as identified in the Makua IP; development of fire management plans for population units outside of MMR and SBMR action areas; and implementation of the WFMP (U.S. Army 2003b).

Ongoing Conservation Actions in the Action Area The three individuals of *Schiedea kaalae* that occur at Pahole have been fenced and are being managed as part of urgent actions established for Makua IP (U.S. Army, *in litt.* 2003). The Service is currently not aware of any other conservation efforts for this species in the action areas.

Status of the Species - *Tetraplasandra gymnocarpa* (Ohe ohe)

Species Description *Tetraplasandra gymnocarpa* is a member of the Auraliaceae (ginseng family). This tree species ranges in height from 2.5 to 10.0 m (8.2 to 32.8 ft) and has odd-pinnate compound leaves which are 30 to 55 cm (11.8 to 21.7 in) long. Flowers are perfect (both anthers and stamens) and found in terminal compound-umbellate or racemose-umbellate inflorescences. The fruit is a drupe and purple at maturity (Wagner *et al.* 1999).

Listing Status *Tetraplasandra gymnocarpa* was federally listed as endangered on March 28, 1994 (59 FR 14493) and listed by the State of Hawaii at the same time. A recovery plan was prepared for *T. gymnocarpa* and 65 other plant taxa that occur on the island of Oahu in 1998 (Service 1998a). Critical habitat was designated for this species on June 17, 2003 (68 FR 35950).

Historic and Current Distribution *Tetraplasandra gymnocarpa* was historically known from Punaluu, Waikakalaua Gulch, Mount Olympus, and the region between Niu and Wailupe in the Koolau Mountains of Oahu. This species was also observed in the Waianae Range at Palikea in 1954. Currently, *T. gymnocarpa* is restricted to 16 occurrences totaling at least 176 individuals in the summit regions of the Koolau Mountains (Wagner *et al.* 1999; K. Kawelo, pers. comm. 2003; J. Lau, pers. comm. 2003). Specifically, these occurrences are found at Paumalu and Kaunala Gulches (4 individuals), lower Peahinaia trail (2), lower Kawai Iki (8), Peahinaia trail (midreach; 1), Kawailoa trail (1), upper Kawai Iki (1), south Kaukonahua summit (1), Waimano to south Kaukonahua Gulch (at least 25), Waikakalaua (1), Kaipapapa to Kaluanui (at least 25), Kawalao to Waiau (25), Aiea trail (2), Halawa-Haiku Ridge to Moanalua-Haiku Ridge (at least 25), Puu Keahiakahoe (21), Konahuanui (9), and East Honolulu-Wiliwili Nui to Kuliouou (at least 25) (Wagner *et al.* 1999; J. Lau, HINHP, pers. comm. 2003; K. Kawelo, U.S. Army, pers. comm. 2003).

Ecology *Tetraplasandra gymnocarpa* is typically found on windswept summit ridges, slopes, or gullies in wet or sometimes mesic lowland forests and shrublands between elevations of 93 and 959 m (305 and 3,146 ft). Associated native plant species include *Acacia koa, Antidesma platyphyllum, Bidens* spp., *Bobea elatior, Broussaisia arguta, Cheirodendron* spp., *Cibotium chamissoi, Cibotium glaucum, Cyanea humboldtiana, Dicranopteris linearis, Diplopterygium pinnatum, Dubautia laxa, Freycinetia arborea, Hedyotis fosbergii, Hedyotis terminalis, Labordia* sp., *Lobelia hypoleuca, Machaerina angustifolia, Melicope* sp., *Metrosideros polymorpha, Myrsine fosbergii, Pouteria sandwicensis, Psychotria* spp., *Sadleria* sp., *Syzygium sandwicensis, Tetraplasandra oahuensis*, and *Wikstroemia* sp. (HINHP Database 2001; Service 1998a). *T. gymnocarpa* has been observed flowering and fruiting in November (Service 1996) and fruiting in May and September (Service 1998a). There is little other information on its reproductive cycles, longevity, specific environmental requirements, or limiting factors.

Threats The major threats to *Tetraplasandra gymnocarpa* are similar to those of other wet forest plants. Feral pigs root soil and destroy habitat. The two-spotted leafhopper causes a systemic infection that defoliates the plant. Non-native plant species such as *Aleurites moluccana, Araucaria columnaris, Ardisia elliptica , Axonopus fissifolius, Clidemia hirta, Erigeron karvinskianus, Eucalyptus* sp., *Paspalum conjugatum, Psidium cattleianum, Pterolepis glomerata, Sacciolepis indica,* and *Setaria palmifolia* compete for light, space, and nutrients. The small size of occurrences results in reduced reproductive vigor and the risk of extinction from stochastic events (HINHP Database 2001; Service 1998a; 59 FR 14482).

Conservation Needs of the Species A State-wide management plan should be developed and implemented for the long-term conservation of all known occurrences of *Tetraplasandra gymnocarpa.* This plan should also include broader landscape actions that are needed for the recovery of this plant throughout its range The recovery plan for this species identifies the following important conservation actions. Fenced exclosures need to be constructed around all known occurrences of *T. gymnocarpa.* Emphasis should be placed on those occurrences with five or less individuals (*e.g.*, Paumalu and Kaunala Gulches, Kawailoa trail). Feral pigs and competitive non-native plant species should be removed or controlled from exclosures and from the greater landscape needed to recovery this plant. Monitoring should be conducted at each occurrence to determine the presence, and effect of, the two-spotted leafhopper on *T. gymnocarpa.* If this leafhopper is detected and its presence is adversely affecting seedlings or trees, the insect should be controlled using approved pest management methods.

Ongoing Conservation Actions Both the Lyon Arboretum and Waimea Arboretum have genetic material of *Tetraplasandra gymnocarpa* in genetic storage. The Lyon Arboretum houses 10 plants/seeds from two sources and Waimea Arboretum houses two plants from one source (Service 2002). Seed germination attempts at Lyon Arboretum have not been successful (Service 1998a). The Service is currently not aware of any other conservation efforts for this species.

Environmental Baseline

Status of the Species in the Action Areas Forty-four individuals of *Tetraplasandra gymnocarpa* occur within the action areas of KTA, KLOA, and SBER. Together, they make up approximately 25 percent of the known individuals rangewide. Within the KTA action area there are four individuals reported from one occurrence in Paumalu-Kaunala Gulches (HINHP 2002; U.S. Army 2003a; K. Kawelo, U.S. Army, pers. comm. 2003; J. Lau, HINHP, pers. comm. 2003). These individuals represent less than one percent of the total remaining individuals of this species. Within the KLOA action area there are 13 individuals from five occurrences at lower Peahinaia trail, lower Kawai Iki, Peahinaia trail (midreach), Kawailoa trail and upper Kawai Iki. These individuals represent seven percent of the total remaining individuals. With the SBER action area there are at least 27 individuals from three occurrences: Waimano to south Kaukonahua Gulch, south Kaukonahua summit, and Waikakalaua. These individuals represent 14 percent of the total remaining individuals of this species. There are four stable populations of greater than 25 mature, reproducing *T. gymnocarpa* exist outside of the action areas. These populations are located at Kaipapapa to Kaluanui, Kawalao to Waiau, Halawa-Haiku Ridge to Moanalua Ridge, and East Honolulu-Wiliwili Nui to Kuliouou (K. Kawelo, U.S. Army, pers. comm. 2003; J. Lau, HINHP, pers. comm. 2003).

Threats in the Action Areas Within the KTA, KLOA, and SBER action areas, the following threats from Army actions have been identified: introduction and establishment of competitive non-native plant species, fire, and trampling from foot maneuvers (U.S. Army 2003). Feral pigs occur in these action areas and, without management actions to control, will continue to threaten the long-term survival of *T. gymnocarpa*. Two-spotted leafhopper may also be a threat to this species in the action areas.

Conservation Needs in the Action Area *Tetraplasandra gymnocarpa* does not need to be stabilized because four stable populations exist outside of the action areas and only 16 percent of all known individuals occur within the action areas. It is expected that this species will benefit from habitat-level management that will occur at KTA, KLOA, and SBER for other listed taxa addressed in this consultation.

Ongoing Conservation Actions within the Action Areas There are currently no specific ongoing conservation actions for *Tetraplasandra gymnocarpa* being implemented within Army action areas.

Status of the Species - *Viola chamissoniana* (Pamakani)

Species Description *Viola chamissoniana* is a perennial member of the Violaceae (violet family). Individual branches arise from the base, reaching lengths between 20 and 100 cm (8 and 40 in). Some individuals, especially those on steep cliffs, have relaxed, reclining, or drooping branches while others have erect branches and form upright shrubs that attain heights of up to 90 cm (3 ft). *Viola chamissoniana* contains three subspecies: *Viola chamissoniana* ssp. *chamissoniana* (endemic to the Waianae Mountains of Oahu), *V. chamissoniana* ssp. *tracheliifolia* (endemic to Kauai, Oahu,

Molokai, and Maui), and *V. chamissoniana* ssp. *robusta* (endemic to Molokai). *V. chamissoniana* ssp. *chamissoniana* has large white flowers which are held above its leaves while the other two subspecies have relatively inconspicuous flowers found among the leaves (Wagner *et al.* 1999).

Listing Status *Viola chamissoniana* ssp. *chamissoniana* was federally listed as endangered on October 29, 1991 (56 FR 55770) and listed by the State of Hawaii at the same time. A recovery plan was prepared for *V. chamissoniana* ssp. *chamissoniana* and 65 other plant taxa that occur on the island of Oahu in 1998 (Service 1998a). Critical habitat was designated for this species on June 17, 2003 (68 FR 35950). *V. chamissoniana* ssp. *tracheliifolia* and *V. chamissoniana* ssp. *robusta* are not listed as threatened or endangered or otherwise considered to be rare.

Historic and Current Distribution Historically, *Viola chamissoniana* ssp. *chamissoniana* was known from the central and southern Waianae Mountains and Makaleha Valley on the island of Oahu. Currently, 371 individuals in five occurrences occur at Makaha-Kamaileunu (88 individuals), Puu Kumakalii (17), Ohikilolo (250), Halona (3), and Puu Hapapa (13). Since all the known individuals of *V. chamissoniana* ssp. *chamissoniana* were discovered in the last two decades, population trends are not well known. This taxon typically occurs on steep cliffs that are inaccessible to feral ungulates, and its numbers have not declined as severely as those of most other listed Hawaiian plant species (J. Lau, HINHP, pers. comm. 2003; K. Kawelo, U.S. Army, pers. comm. 2003; U.S. Army 2003a).

Ecology *Viola chamissoniana* ssp. *chamissoniana* typically grows on dry cliffs, rocky ledges, and steep slopes in mesic shrubland and cliff vegetation at elevations between 414 and 1,149 m (1,358 to 3,769 ft). Associated native species include *Artemisia australis, Bidens torta, Carex meyenii, Chamaesyce* spp., *Dodonaea viscosa, Dubautia* spp., *Eragrostis* spp., *Leptecophylla tameiameiae, Lipochaeta tenuis, Metrosideros polymorpha, Peperomia* spp., *Rumex* spp., *Schiedea* spp., and *Sida fallax* (HINHP Database 2001; Service 1998a; 56 FR 55770). *Viola chamissoniana* ssp. *chamissoniana* is considered to be a short-lived perennial species (Service 1998a).

Threats Invasive non-native plant species threaten *Viola chamissoniana* ssp. *chamissoniana* by competing for light, space, and nutrients. Feral ungulates do not threaten individuals found on cliffs and cliff faces, but do threaten individual *V. chamissoniana* ssp. *chamissoniana* that grow in more accessible locations. At these sites, predation, and habitat degradation due to feral ungulates threaten *V. chamissoniana* ssp. *chamissoniana*. Ungulate activity also may disturb cliff substrate, increasing the size and frequency of landslides and rock falls (Service 1998a).

Conservation Needs of the Species A State-wide management plan should be developed and implemented for the long-term conservation of all known occurrences of *Viola chamissoniana* ssp. *chamissoniana*. This plan should also include broader landscape actions that are needed for the recovery of this plant throughout its range. The recovery plan for this species identifies the following

important conservation actions. Fenced exclosures need to be constructed around all known occurrences of *V. chamissoniana* ssp. *chamissoniana*. Feral pigs should be controlled or removed from the vicinity of all known occurrences and from the broader landscape required to recover this plant. These fenced areas should be monitored for invasive plant species and such species removed from the vicinity of all known occurrences of *V. chamissoniana* ssp. *chamissoniana*, and all sites should be monitored on a regular basis (Service 1998a).

Ongoing Conservation Actions The Service is currently not aware of any other conservation efforts for this species other than those conducted by the Army (see Ongoing Conservation Actions in the Action Area, below).

Environmental Baseline

Status of the Species in the Action Area Seventeen individuals are known from one occurrence at Puu Kumakalii in the SBMR action area (J. Lau, HINHP, pers. comm. 2003; K. Kawelo, U.S. Army, pers. comm. 2003). These individuals are found outside of the impact area along the southern boundary of the action area at an elevation range of 780 to 825 m (2,560 to 2,700 ft) (HINHP Database 2002). These 17 individuals represent approximately five percent of the total remaining individuals of the taxon rangewide. One stable population of 250 mature, reproducing *Viola chamissoniana* ssp. *chamissoniana* exists at Ohikilolo, which is in the MMR action area (J. Lau, HINHP, pers. comm. 2003; K. Kawelo, U.S. Army, pers. comm. 2003).

Threats in the Action Area Within the SBMR action area, non-native plant species threaten *Viola chamissoniana* ssp. *chamissoniana* by competing for light, space, and nutrients. Fire due to military activities also threatens this plant at SBMR (U.S. Army 2003a). Feral animals will continue to threaten those individuals of *V. chamissoniana* ssp. *chamissoniana* that are in accessible sites.

Conservation Needs in the Action Area A stabilization plan has been developed and will be implemented for the stabilization and long-term conservation of *Viola chamissoniana* ssp. *chamissoniana*. This plan should include broader landscape actions that are needed to sustain this plant. *V. chamissoniana* ssp. *chamissoniana* requires stabilization because three stable population units of greater than 50 mature, reproducing individuals each do not exist outside of any of the Army action areas and more than 50 percent of the extant individuals occur within the action areas for MMR and SBMR. Since this species was addressed in the Makua biological opinion, the stabilization actions as outlined in the Makua IP will be implemented to stabilize this taxon. These stabilization measures will include: reintroduction of *V. chamissoniana* ssp. *chamissoniana* into at least three management units outside of any action area, as designated for the Makua IP; collection and propagation of this taxon for genetic storage and reintroduction into the wild; and monitoring and management of known population units within management units, as identified in the Makua IP (Service 1998a). In addition, the Army will establish fuel breaks to assist in control of wildfires which may result from Army and fire protection measures implemented as outlined in the WFMP (U. S. Army 2003b; U.S. Army Garrison 2003).

Ongoing Conservation Actions within the Action Area Seeds collected from Makua Military Reservation were delivered to the Lyon Arboretum for genetic storage testing in October 2001 and testing is ongoing. Seed was again collected from MMR in June 2003 from those occurrences which have fewer than five mature, reproducing individuals of *Viola chamissoniana* (*i.e.*, Halona). These activities are part of urgent actions associated with the Makua IP (U.S. Army, *in litt.* 2003). The Service is currently not aware of any other conservation actions being implemented for *V. chamissoniana* ssp. *chamissoniana* within the SBMR action area.

Status of the Species - *Viola oahuensis* (No Common Name)

Species Description *Viola oahuensis* is a woody shrub and member of the Violaceae (violet family). Similar to *V. chamissoniana*, this growth habit is unusual in the genus as most non-Hawaiian species of *Viola* are small herbs. *Viola oahuensis* is an erect, usually unbranched sub-shrub which ranges in height from 6 to 40 cm (2.4 to 15.7 in). The elliptic leaves are somewhat clustered at the ends of the branches. The pale yellow flowers occur on stalks of one to two flowers with petals that range from 8 to 16 mm (0.3 to 0.6 in). Fruits are 9 to 16 mm (0.4 to 0.6 in) long and contain ovoid pale brown seeds (Wagner *et al.* 1999).

Listing Status *Viola oahuensis* was federally listed as endangered on October 10, 1996 (61 FR 53089) and listed by the State of Hawaii at the same time. A recovery plan was prepared for *V. oahuensis* and 65 other plant taxa that occur on the island of Oahu in 1998 (Service 1998a). Critical habitat was designated for this species on June 17, 2003 (68 FR 35950).

Historic and Current Distribution Historically, *Viola oahuensis* was known from 17 occurrences scattered over approximately 37 km (23 mi) from Puu Kainapuaa to Palolo in the Koolau Mountains of Oahu. Only eight occurrences, with 329 individuals, are now extant. These are found between Kawainui-Koloa summit divide and Waimalu-Koolaupoko divide, specifically in the following locations: north and south Kaukonahua (22 individuals), Kamananui Gulch (1), Kawainui-Koloa Ridge (29), north Kaukonahua (5), Kawai Iki to Halemano (greater than 100), Konahuanui (22), Koolau summit between Kipapa and Manana (100), and Wailau-Kahaluu summit ridge (50) (HINHP Database 2001; J. Lau, HINHP, pers. comm. 2003; K. Kawelo, U.S. Army, pers. comm. 2003).

Ecology *Viola oahuensis* is generally found on exposed, windswept ridges at elevations that range from 415 to 959 m (1,361 to 3,146 ft). It occurs on moderate to steep slopes in wet *Metrosideros polymorpha-Dicranopteris linearis* shrublands and *M. polymorpha*-mixed montane bogs of the cloud zone. *V. oahuensis* typically grows among wind-stunted *Antidesma* spp., *Bidens macrocarpa, Broussaisia arguta, Cibotium* spp., *Dubautia laxa, Hedyotis terminalis, Labordia* spp., *Machaerina* spp., *Melicope* spp., *Sadleria* spp., *Syzygium sandwicensis*, *Vaccinium* spp., and *Wikstroemia* spp. (HINHP Database 2001; Service 1998a; 61 FR 53089). The species has been observed flowering in August and September but little else is known about its flowering cycles, pollination vectors, seed dispersal agents, longevity, specific environmental requirements, and limiting factors. *V. oahuensis* is considered to be a short-lived perennial species (Service 1998a).

Threats The primary threats to *Viola oahuensis* include predation and habitat destruction by feral pigs; competition for light, space, and nutrients from non-native plant species (*e.g., Axonopus fissifolius, Clidemia hirta, Paspalum conjugatum, Psidium cattleianum*, and *Pterolepis* spp.); reduced reproductive vigor due to the small number of occurrences; and risk of extinction from stochastic events (HINHP Database 2001; Service1998 ; 61 FR 53089).

Conservation Needs of the Species A State-wide management plan should be developed and implemented for the long-term conservation of all known occurrences of *Viola oahuensis*. This plan should also include broader landscape actions that are needed for the recovery of this plant throughout its range. The recovery plan for this species identifies the following important conservation actions: construction of exclosures around all known occurrences of *V. oahuensis* to reduce and, ultimately, eliminate impacts from feral pigs. In areas where fencing is not possible due to severe topography or potential damage to plant communities, other means of pig control should be implemented. Immediate fencing and protection is needed for those which have only a few remaining individuals (*e.g.,* scattered locations along the Kawanui-Koloa summit divide, Kaukonahua Ridge). The occurrences should also be monitored for the presence of competitive non-native plant species, and when detected these invasive plants should be removed (Service 1998a).

Ongoing Conservation Actions. The Lyon Arboretum has *Viola oahuensis* seed in genetic storage (Service 2002). The Service is currently not aware of any other conservation efforts for this species.

Environmental Baseline

Status of the Species in the Action Areas *Viola oahuensis* occurs within the KLOA and SBER action areas. Combined, the individuals from KLOA and SBER total 179 and represent 54 percent of the species statewide. At KLOA, 157 individuals are known from five occurrences between Kamananui Gulch and Helemano in the Koolau Mountains where they are found at elevations between 635 and 915 m (2,090 and 3,000 ft). Twenty-two individuals of *V. oahuensis* occur within the action area for SBER at Konahuanui (HINHP 2002; J. Lau, HINHP, pers. comm. 2003; K. Kawelo, U.S. Army, pers. comm. 2003). There are two known stable populations of 50 or more mature, reproducing *V. oahuensis* outside the Army action areas. These are located at Koolau summit between Manana and Kipapa and at Wailua-Kahaluu summit ridge (J. Lau, HINHP, pers. comm. 2003; K. Kawelo, U.S. Army, pers. comm. 2003).

Threats in the Action Areas Within the KLOA and SBER action areas, the following threats have been identified: introduction and establishment of non-native plant species that compete for light, space and nutrients; fire due to military activities; trampling from foot maneuvers; and habitat destruction and predation from feral pigs (U.S. Army 2003a).

Conservation Needs in the Action Areas A stabilization plan will be developed and implemented for the stabilization and long-term conservation of *Viola oahuensis*. This plan should include broader landscape actions that are needed to sustain this plant. This species must be stabilized as greater than 50 percent of the known remaining individuals occur withing Army action areas and only two

known stable populations of 50 or more mature, reproducing *V. oahuensis* occur outside of these areas. To be considered stable, *V. oahuensis* must meet the criteria required for stability of a short-lived perennial (Service 1998a).

Stabilization for *V. oahuensis* will include the following actions. Surveys will be conducted within the historic range of the species and other areas of suitable habitat. Fenced exclosures will be constructed around all known occurrences of this species in KLOA and SBER. In areas where fencing is not possible due to severe topography or potential damage to plant communities, other means of pig control will be implemented. The Army will monitor for the presence of competitive non-native plant species, and when detected these invasive plant will be removed (U.S. Army 2003a).

Ongoing Conservation Actions within the Action Areas Currently, no on-the-ground management actions are being performed for this species outside of the work being conducted by Army Natural Resource staff within KLOA. Some plants are protected from ungulates by the Opaeula Watershed Protection Project fence. A fence proposed for Helemano will also protect additional individuals (U.S. Army 2003a).

Status of the Species - *Achatinella* tree snails (Oahu Tree Snails)

Tree Snail Species Addressed in this Consultation All 41 species of *Achatinella* tree snails are listed as endangered. Twenty-four species of *Achatinella* tree snails have historic ranges that overlap with the consultation action areas. Eleven of these 24 species have been observed in the action areas since 1982, and are addressed in this current consultation. Five of these 11 species are not currently known from previously occupied sites but may still occur at other sites within the action areas. The remaining 13 species have not been observed within or outside of the action areas since 1982. For these 13 species, the actions proposed by the Army in this consultation are not likely to result in adverse affects due to the absence of the species in the action area. If new occurrences of these 13 tree snail species are discovered, the Army should immediately notify the Service and cease any actions that may affect these species. It should also be noted that with the exception of *Achatinella mustelina* in the Waianae Mountains, status surveys for the listed *Achatinella* tree snails have not been adequate, and snails may still be resident in some areas. The following general information is applicable to all of the *Achatinella* tree snails and specific reference is made to each of the tree snail species covered in this consultation.

Oahu tree snail species that have been observed since 1982 within the action areas (occurrences for the species in bold are currently occupied and within the action area):

(1) *Achatinella apexfulva* (seen at KLOA; historic at SBER): last seen in 2001.
(2) *Achatinella bulimoides* (seen at KLOA; historic at SBER and KTA): last seen in 1982.
(3) *Achatinella byronii* (synonymous with *A. decipiens* - see below)
(4) *Achatinella curta* (seen at KLOA; historic at KTA): last seen in 1990.
(5) *Achatinella decipiens* (seen at KLOA and SBER)

(6) *Achatinella leucorraphe* (seen at SBER; historic at KLOA): last seen in 1989.
(7) *Achatinella lila* (seen at KLOA: historic at SBER)
(8) *Achatinella livida* (seen at KLOA: historic at SBER)
(9) *Achatinella mustelina* (seen at SBMR)
(10) *Achatinella pulcherrima* (seen at KLOA; historic at SBER): last seen in 1993.
(11) *Achatinella sowerbyana* (seen at KLOA and SBER; historic at KTA)

Oahu tree snail species that have not been observed since 1982 but historic ranges overlap the action areas:

(1) *Achatinella caesia* (historic at KLOA, SBER, and KTA)
(2) *Achatinella casta* (historic at south edge of SBER)
(3) *Achatinella decora* (historic at KLOA)
(4) *Achatinella dimorpha* (historic at KLOA, SBER, and KTA)
(5) *Achatinella elegans* (historic at KLOA, SBER, and KTA)
(6) *Achatinella juncea* (historic at KLOA)
(7) *Achatinella lehuiensis* (historic at south edge of SBMR)
(8) *Achatinella papyracea* (historic at KLOA and SBER)
(9) *Achatinella rosea* (historic at KLOA and SBER)
(10) *Achatinella spaldingi* (historic at SBMR)
(11) *Achatinella swiftii* (historic at KLOA and SBER)
(12) *Achatinella thaanumi* (historic at SBMR)
(13) *Achatinella valida* (historic at KLOA and KTA)

Species Description Adult *Achatinella* snails have oblong to ovate shells 17 to 24 mm (0.03 to 0.04 in) in length and with a glossy to semi-glossy surface. With two exceptions, the shells of each species under consultation may coil either to the left (sinistral) or to the right (dextral). The shell of *Achatinella lila* coils only to the left while that of *A. pulcherrima* coils only to the right. The adult shell has between five to seven whorls, and the umbilicus (the space along the axis of coiling) is closed or has only a very small opening. The lip at the opening of the adult shell is smooth and simple with no ribs, ridges, or folds, and in some species it may become thickened or flare outward at maturity. The columella (the internal shell material around the axis of coiling) has a well developed spiral lamella (ridge). The shells are often strikingly colored and may have spiral bands or may have streaks that run vertically along the direction of the growth lines (Pilsbry and Cooke 1912-1914).

Listing Status All 41 species of Oahu tree snails were listed on January 13, 1981 as endangered under the single genus name *Achatinella* (46 FR 3178) and simultaneously listed under the State of Hawaii Endangered Species Act (HRS 195D-4a). A recovery plan covering all 41 snail species was prepared in 1993 (Service 1993). Critical habitat has not been designated for these snails. The Oahu Tree Snail Recovery Plan maps four essential habitat areas in the Waianae and Koolau Mountains (north and south in each range).

Historic and Current Distribution Before human settlement of the Hawaiian Islands, dry, mesic, and wet forests covered about 127,000 ha on Oahu (HINHP 1991). It is likely that the *Achatinella* tree snails occupied all but the most dry of these forest environments. This view is supported by the known historic and current distributions of these snails. Historically, tree snails were reported at elevations as low as 300 m (1,000 ft) and this lower limit was set by the clearing of forests for agriculture and cattle pastures (Pilsbry and Cooke 1912-1914). Sub-fossil shell collections show that snails occurred almost to the shore on the windward coast of Oahu. Historic distribution shows that *A. mustelina* flourished in mesic forests in the Waianae Mountains of Oahu. Shells found at lower and dryer locations in the Waianae Mountains indicate that this snail species can tolerate moderately dry conditions.

Hadfield (1986) reviewed the literature on the historic abundance of Hawaiian tree snails and reports that Hawaiian tree snails were generally very abundant in many forested areas. Shell collectors often spoke of hundreds or thousands of snails in each collecting lot, and they would often collect from horse back as they rode through the forests of the Koolau and Waianae Mountains. There are several reports indicating that hundreds to thousands of snails could be collected in a single afternoon. In Nuuanu Valley, Cooke (1903) reported collecting 3,000 *A. bellula* from an area 91 by 366 m (300 ft by 1,200 ft) and at an elevation of 300 to 427 m (984 to 1,401 ft). In Palolo Valley, snails of *A. viridans* were so dense that they "...hung in clusters on the hoe vines". Thus we can conclude that many *Achatinella* tree snails were very abundant prior to impacts from humans. The population trend for all Oahu tree snails is an overall decline in numbers of individuals within an occurrence and a decline in the number of occurrences throughout the range of the species. This has resulted in a significant reduction in the occupied range of each species, which was probably already substantially reduced for some species by the early 1900s (Pilsbry and Cooke 1912-1914).

Current assessments of the status and current trends of *Achatinella* tree snails are tentative at best, due to the continuing loss of individuals and occurrences and the lack of comprehensive surveys in the northern Koolau Mountains. Data used to assess the current status of these snails was obtained from the Recovery Plan (Service 1993), the Biological Assessment (U.S. Army 2003a), and from the consultation on training activities at the MMR (U.S. Army Garrison 2000). Since most of the recent information on snail occurrences is from the Biological Assessments for Oahu and MMR, the detailed status and location information for each species will be presented in the environmental baseline. The status of all these species are summarized in Table 1.

Species with currently known occurrences within the action areas:

Achatinella byronii has not been observed in the wild since 1982. However, *A. byronii* may be the same species as *A. decipiens*, which has been observed since 1982, and almost entirely within the action areas; some of these observations may be the *A. byronii* synonym. For the purposes of this assessment *A. byronii* and *A. decipiens* will be considered as a single entity. *Achatinella byronii/decipiens* was historically known from middle to upper elevation locations in the northern Koolau mountains and along the Koolau summit. It has recently been observed in the wild at five occurrences within the KLOA and SBER action areas.

Achatinella lila was historically known from the north-central summit area of the Koolau Mountains. It is currently known from three occurrences within the KLOA action area. Some of the individuals (46 percent of the known snails) in these occurrences are found along the windward cliff face of the Koolau mountains just outside of the KLOA action area.

Achatinella livida was historically known from middle to upper elevation locations in the northern Koolau Mountains. It is currently known from three occurrences on the Koolau summit within the KLOA action area.

Achatinella mustelina was historically known from middle to upper elevation locations throughout the northern and southern Waianae Mountains. Currently, it is the most abundant of the Oahu tree snails, and is known from 22 occurrences (about 950 snails), 11 of which are within the SBMR action area (see Environmental Baseline for status and location information). Eleven of these occurrences are outside of the SBMR action area and they support 775 snails (82 percent of the known individuals). Snails are known from Alaiheihe (25 snails), central and north Kaluaa (5), central Makaleha-culvert 39 (81), east Makaleha-culvert 45 (29), east Makaleha-culvert 69 (40), Huliwai (30), Kahanahaiki (55), Kapuna (25), Makaha (17), Mohiakea (10), Ohikilolo (300), Pahole (50), Palikea Gulch (7), Puu Hapapa (36), Puu Kalena (37), Puu Kaua (12), Puu Kumakalii (20), Puu Palikea (40), Schofield south range (32), Schofield west range/Haleauau (18), Waianae Kai (32), and Waieli/Kaluaa (50).

A. sowerbyana was historically known from middle to upper elevation locations in the northern Koolau Mountains. It is currently known from 11 occurrences within the KLOA and SBER action areas.

Table 1. Current (post-1981) status of *Achatinella* tree snails covered in this consultation.

Oahu Tree Snail Species	Training Areas With Snails: Current (Historic)	Total Number on Oahu		Number of Snails in Captive Propagation
		Occurrences† (percent in the action areas)	Individuals†† (percent in the action areas)	
*Achatinella byronii**	SBER	See *A. decipiens*		
Achatinella decipiens	KLOA, SBER	5 (100%)**	324 (97%)	23
Achatinella lila	KLOA (SBER)	3 (100%)**	50 (54%)	186
Achatinella livida	KLOA (SBER)	3 (100%)	141 (100%)	74
Achatinella mustelina	SBMR	22 (50%)	950 (18%)	240
Achatinella sowerbyana	KLOA, SBER (KTA)	12 (100%)	265 (100%)	45
Totals for species with known occurrences:		45 occurrences	1,730 snails	568 snails

Achatinella apexfulva	KLOA (SBER)	1 (100%)	3 (100%)	9
Achatinella bulimoides	KLOA (SBER, KTA)	1 (100%)	few (100%)	0
Achatinella curta	KLOA (KTA)	3 (100%)	5 (100%)	0
Achatinella leucorraphe	SBER (KLOA)	1 (100%)	1 (100%)	0
Achatinella pulcherrima††	KLOA (SBER)	2 (100%)	3 (100%)	0
Totals for all 11 species:		53 occurrences	1,745 snails	577 snails

† An occurrence is equivalent to a population or a population unit, and may be as small as a single snail.

†† Systematic status surveys for all listed *Achatinella* tree snails, except *A. mustelina*, have never been done, and snails may be resident in some areas.

* Achatinella byronii may be a synonym of *A. decipiens* and they cannot be reliably distinguished in the field; *A. pulcherrima* may be a synonym of *A. sowerbyana* but field occurrences can still be uniquely distinguished.

** One or more of these occurrences extends outside of the action areas.

Species seen within the action areas since 1982 but with no presently known occurrences:

Achatinella apexfulva was historically known from lower to middle elevation locations in the northern Koolau Mountains. Its most recently observe occurrences are entirely within the KLOA action area.

Achatinella bulimoides was historically known from upper elevation locations on both sides of the northern Koolau summit ridge. The only known recent occurrence for this snail species is in the KLOA action area.

Achatinella curta was historically known from middle to upper elevation locations on both sides of the northern Koolau summit ridge. It is currently known from three occurrences within the KLOA action area.

Achatinella leucorraphe was historically known from upper elevations in the north-central part of the Koolau Mountains. It is currently known from within the SBER action area.

Achatinella pulcherrima was historically known from middle to upper elevation locations in the northern Koolau Mountains. It is known from three occurrences within the KLOA action area.

Ecology *Achatinella* tree snails are arboreal and feed on fungus and algae that grown on the surface of leaves of native plants (Pilsbry and Cooke 1912-1914; Hadfield and Miller 1989). The snails are most often found in mesic and wet forests above about 366 m (1,200 ft) elevation in the Waianae and Koolau Mountains but are not found above about 1,158 m (3,800 ft) elevation on Mount Kaala, the highest point on Oahu. They are occasionally seen on alien vegetation, but rarely

establish populations on non-native plants and usually avoid native trees and shrubs with pubescent leaves (Service 1993; Pilsbry and Cooke 1912-1914). Snails seal themselves to leaves or stems during the day, and at night they move about freely. Movement is limited, and marked snails have been observed in the same bush or tree for years at a time (Service 1993; Hadfield and Miller 1989; Hadfield *et al.* 1993; Kobayashi and Hadfield 1996). Dispersal appears to be mostly due to occasional storms or high winds that blow snails out of the trees. Subsequently, the snails will crawl on the ground until they encounter vegetation that allows them to get back up into a host tree. Following periods of high winds, marked snails have been observed to be dispersed as much 18 m (60 ft) from where they were last seen (Hadfield, pers. comm. 1986).

Tree snails become sexually mature in three to five years, and they may live for 15 to 20 years. Sexual maturity is marked by a termination of shell growth and a thickening of the growth margin of the shell. All members of the genus are hermaphroditic, and a species of the sister genus *Partulina* is known to be capable of self-fertilization (Kobayashi and Hadfield 1996), this may also apply to some of the *Achatinella* species. Reproductive output is low with an adult snail giving birth to 4-6 live young per year. Each new born snail is between 3.5 and 5 mm long at birth (Service 1993; Hadfield and Miller 1989; Hadfield *et al.* 1993; Kobayashi and Hadfield 1996).

The genetic structure of *Achatinella mustelina* was recently investigated by Holland and Hadfield (2002). This study was based on gene sequence analyses of cytochrome oxidase I sampled from multiple tree snail occurrences. The results showed that population genetic structure was strongly correlated to mountain topography; the maximum genetic distances were independent of geographic distances, and instead were influenced by deep valleys or steep mountain peaks. Six evolutionarily significant units were identified in this study, and four additional occurrences were included in conservation measures by the Makua implementation process (U.S. Army Garrison 2003).

Threats Rats (*Rattus rattus*, *R. norvegicus*, and *R. exulans*) and predatory snails (*Euglandina rosea*) are known to occur throughout the Waianae and Koolau Mountains and are two major causes of decline and extinction of tree snail populations (Hadfield and Mountain 1980; Hadfield 1986; Hadfield and Miller 1989; Hadfield *et al.* 1993). The Recovery Plan for the Oahu Tree Snails (Service 1993) reviews documented declines in tree snail occurrences associated with predation by non-native snails and rats. Other alien species that may prey upon Oahu tree snails include two terrestrial flatworms (*Geoplana septemlineata* and *Platydemis manokwari*) and a small terrestrial snail *Oxychilus alliarius*. *Platydemis manokwari* is a documented major predator on tree snails from other Pacific Islands and is known to occur at low elevations on Oahu. *Geoplana septemlineata* and *Oxychilus alliarius* are regularly found feeding on the tissues of dead Oahu tree snails, but it is not known if these two animals were the cause of death or just opportunistically consuming snail tissues.

Habitat disturbance and destruction also threaten Oahu tree snails. Rooting by pigs, browsing by goats, and hiking, hunting, camping or similar activities can disturb native habitat and destroy host trees that support snails. These activities also promote the spread of non-native plants that displace

native plants used by Oahu tree snails. Fire is not a likely threat to Oahu tree snails that occur in wet forested areas. However, given the very low number of occurrences and individuals of Oahu tree snails, any fires that impact these snails would have a very large effect on their stability and future survival. If new occurrences of Oahu tree snails are discovered at lower elevations in mesic or dry forest, the threat from fire would be an important factor in the long-term conservation of these occurrences. Finally, the small numbers of individuals that remain in each of the Oahu tree snail species may make them highly vulnerable to stochastic effects, such as inbreeding or genetic drift, as well as catastrophic events such as large storms or landslides that could reduce or eliminate any of the smaller occurrences.

Conservation Needs of the Species A State-wide management plan should be developed and implemented for the long-term conservation of all known occurrences of Oahu tree snails. This plan should also include broader landscape actions that are needed for the recovery of these species throughout its range. The Recovery Plan for the Oahu tree snails identifies important conservation actions and, along with the stabilization plan for *Achatinella mustelina* (U.S. Army Garrison (STAB) 1999), should be used to guide conservation actions. The stabilization plan for *Achatinella mustelina* provides a detailed assessment of all the critical tree snail conservation issues and may be generally applied to all of the Oahu tree snails. Based on the current information on the life history of Oahu tree snails and on the nature of the threats to these snails, the conservation needs of these snails are dependent on the following ecological features: 1) the presence of suitable habitat, which includes a functionally intact native forest with a close or closed canopy and an understory of native plants that can support tree snail occurrences; 2) a population structure that includes all age classes and supports reproductive rates that are high enough to sustain the occurrence; 3) a landscape distribution of occurrences that preserves the remaining genetic diversity of each of the tree snail species; and 4) ecological conditions that can support metapopulation dynamics where specific occurrences may decline or disappear over time while new occurrences within the landscape become established and grow. To achieve these biological requirements, land management actions must 1) effectively control alien species that prey on tree snails, particularly *Euglandina rosea* and all rat species; 2) must protect native forests from disturbance and destruction by ungulates, especially pigs and goats on Oahu; by fire, which can affect lower elevation occurrences in the Waianae Mountains; and by invasive non-native plants that can displace native plants used by tree snails; and 3) must assist in protecting existing occurrences and establishing new occurrences throughout the known range of these snails. Captive propagation of tree snails can greatly aid in achieving the conservation needs and management actions. Note, however, that captive populations can undergo occasional declines due to disease or other effects, and that these declines may be rapid. To secure snails using a captive breeding program, a captive population should exceed 100 individuals and there should be two to four populations located at more than one site. For the 18 species that are no longer known from the wild (see the beginning of this section for a list of those species), great effort should be made to locate and protect occurrences in the field and to establish populations in a tree snail captive propagation facility such as the one at the University of Hawaii. Without this effort, these species will go extinct, if they are not already extinct. One of these snails

(*Achatinella apexfulva*) is already in captive propagation. Great effort should be given to increasing the numbers of this species and reestablishing secure occurrences in the field.

Ongoing Conservation Actions As indicated in Table 1, six *Achatinella* species are represented in the tree snail captive propagation facility at the University of Hawaii. *Achatinella apexfulva* and *A. decipiens* have low numbers of individuals (9 snails and 23 snails, respectively); *A. sowerbyana* and *A. livida* have moderate numbers (45 snails and 74 snails, respectively); and *A. lila* and *A. mustelina* are well represented (186 snails and 240 snails, respectively). The nine *A. apexfulva* are the only known individuals of this species.

Currently, the tree snail captive propagation facility at the University of Hawaii is working at or near maximum capacity. The addition of more species or more individuals from the field will require an expansion in the capacity of the facility. The habitat of *Achatinella lila* receives some protection from pig damage by being within fenced area that is part of the Opaeula Watershed Project. The Nature Conservancy of Hawaii does some management of *A. mustelina* at its Honouliuli Preserve. The State of Hawaii, Department of Land and Natural Resources, funded two snail enclosures for *A. mustelina* at the Pahole Natural Area Reserve and on the south ridge of the Makua Military Reservation. These enclosures exclude rats and predatory snails and are managed by the Army Natural Resource staff and the State. The recently approved MMR Implementation Plan (U.S. Army Garrison 2003) includes predator protection for 10 occurrences (each with 300 individuals) of *A. mustelina* throughout the Waianae Mountains, including SBMR. These actions will use a variety of techniques such as poison rat baits, rat snap traps, manual killing of any cannibal snails, and the construction of enclosure fences.

Environmental Baseline

Status of the Species in the Action Area With the exception of *Achatinella byronii/decipiens, A. lila*, and *A. mustelina*, all post-1982 records for the tree snail species in this consultation are from observations within the action areas. The records of occurrences within the action areas are summarized Table 2.

Table 2. Current (post-1981) status of *Achatinella* tree snails covered in this consultation for each Action Area.

Military Training Area and Its Associated Action Area	Number of Tree Snails Species	Occurrences† (percent of all known occurrences)	Individuals (percent of all known individuals)
KLOA	8	28 (52.8%)*	746 (42.7%)
SBER	4	3 (5.7%)*	16 (0.9%)
SBMR	1	11 (20.8%)	175 (10.0%)
Total for all Action Areas:	11	42 (79.2%)	937 (53.7%)

† An occurrence is equivalent to a population or a population unit, and may be as small as a single snail.

* One or more of these occurrences extends outside of the action area.

According to the Biological Assessment, the following information is the most current information on the status of the Oahu tree snails within the action areas.

Species with currently known occurrences within the action areas:

Achatinella byronii/decipiens have recently been observed in the wild at five locations: Schofield Waikane trail, north Kaukonahua stream drainage, Puu Kaaumakua, west of Puu Pauao and along the summit trail. Approximately 300 snails (93 percent of the total remaining individuals) are found in KLOA action area in three occurrences: Poamoho trail, Helemano-Poamoho ridge, and in north Kaukonahua Gulch. These occurrences are between about 605 and 770 m (1980-2520 ft) elevation. Approximately 14 snails (four percent of the total remaining individuals) are found in the SBER action area. Five of these individuals are from two occurrences along Schofield-Waikane trail: one snail in Ewa Forest Reserve and the other four snails along the eastern boundary of SBER. Nine other snails were reported from the southeast corner of the SBER action area.

Achatinella lila is known from 27 individuals (54 percent of the total remaining individuals) at three occurrences within the KLOA action area: Peahinaia trail and summit area, Poamoho/summit junction on the windward side, and north of the Poamoho/summit junction.

Achatinella livida is known from 141 individuals (100 percent of the total known individuals) at three occurrences along the Koolau summit trail southeast of Puu Kainapuaa between 690 and 705 m (2270-2320 ft) elevation. All three occurrences are within the KLOA action area.

Achatinella mustelina is the most abundant of the Oahu tree snail species. Currently, it is known from 11 occurrences with a total of 153 to 175 individuals (approximately 18 percent of the total known individuals) within the SBMR action area. Locations include Mohiakea (10 snails), Puu Hapapa (36), Puu Kalena (37), Puu Kumakalii (20), Schofield South Range (32), and Schofield West Range/Haleauau (18).

Achatinella sowerbyana is known from about 265 individuals (100 percent of the total known individuals) at 11 occurrences, all within the KLOA action area except for one snail that is in the SBER action area. Occurrences are found mostly in the Koolau summit region at Castle trail, Poamoho trail, and SBER. They also occur from Kawainui-Kaipapau divide near the summit trail south to Poamoho trail, and along Peahinaia trail. The single individual in the SBER action area was reported from Schofield-Waikane trail.

Species seen in the action areas since 1982 but with no presently known occurrences; it is likely that other occurrences may still reside in the largely unsurveyed habitats withing the action areas:

Achatinella apexfulva was last seen along Poamoho trail in the KLOA action area at about 550 m (1,800 ft) elevation. One snail was collected in 1998 and two snails were collected in 2001. All were placed in the captive propagation facility at University of Hawaii.

Achatinella bulimoides was last reported in 1985 from one occurrence along Poamoho trail in the KLOA action area (Service 1993). No information is available on the numbers of individuals in this occurrence. However, it is the only known recent occurrence for this snail species and so represents 100 percent of the known individuals.

Achatinella curta is currently known from three occurrence that support five individuals (100 percent of the known individuals), all within KLOA. None of these occurrences have been seen in the past 13 years. They were observed at Paalaa Uka on the ridge south of Opaeula Gulch, Peahinaia trail in the Kawailoa Forest Reserve, and on the Kawailoa trail. This species was known from lower elevations where snails are no longer reported.

Achatinella leucorraphe was reported in 1989 from a single individual near the Schofield-Waikane trail.

Achatinella pulcherrima is known from three individuals (100 percent of the total known individuals) at three occurrences, all within the KLOA action area. Two snails were reported in 1993 along the summit trail near the head of the south fork of Opaeula stream, and third snail was reported on the Peahinaia rail about 1 km (0.6 mi) from the summit trail.

Threats in the Action Area. As stated above in the Status of the Species, Threats section, rats (*Rattus rattus*, *R. norvegicus*, and *R. exulans*) and predatory snails (*Euglandina rosea*) are the greatest threats to the Oahu tree snails and are the major causes of decline and extinction of tree snail occurrences. Other alien species that may prey on Oahu tree snail include two terrestrial flatworms (*Geoplana septemlineata* and *Platydemis manokwari*) and a small terrestrial snail *Oxychilus alliarius*. Additional threats also include loss of habitat from pigs, goats, hiking, hunting, camping, or other activities that can disturb or destroy native habitat, damage tree snail host trees, or spread of non-native plants that displace native plants used by tree snails.

As previously stated, fire is not as likely a threat to Oahu tree snails that occur in wet forested areas. The threat of fire is mostly to *Achatinella mustelina* in the Waianae Mountains near SBMR and in the mountains above DMR. Uncontrolled fires originating in these areas could destroy tree snail habitat and tree snail occurrences within SBMR and up slope of DMR. Finally, small numbers of individuals remaining in each Oahu tree snail species makes them vulnerable to stochastic effects, such as inbreeding or genetic drift, as well as catastrophic events such as large storms or landslides that could reduce or eliminate any of the known occurrences.

Conservation Needs in the Action Area A stabilization plan will be developed and implemented for the stabilization and long-term conservation of *Achatinella byronii*, *A. decipiens*, *A. lila*, *A. livida*, and *A. sowerbyana*. This plan should include broader landscape actions that are needed to sustain these snails. A stabilization plan has already been developed for *Achatinella mustelina* as part of the Makua Implementation Plan (U.S. Army Garrison 2003). This plan provides a detailed assessment of critical tree snail conservation issues and may be generally applied to all of the Oahu tree snails as a guiding document. In addition, efforts should be undertaken to locate extant field

occurrences of *Achatinella apexfulva*, *A. bulimoides*, *A. curta*, *A. leucorraphe*, *A. pulcherrima*, *A. caesia*, *A. casta*, *A. decora*, *A. dimorpha*, *A. elegans*, *A. juncea*, *A. lehuiensis*, *A. papyracea*, *A. rosea*, *A. spaldingi*, *A. swiftii*, *A. thaanumi*, *A. valida*.

Based on the Biological Assessment (U.S. Army. 2003a) and the Makua Implementation Plan (U.S. Army Garrison 2003), conservation needs on military lands include the following: 1) protect tree snail occurrences from alien species that prey on tree snails, particularly *Euglandina rosea* and all rat species; 2) protect tree snail habitat from disturbance and destruction by ungulates; 3) where conditions and training uses warrant, protect tree snail habitat from fire; 4) control invasive non-native plants that can displace native plants used by tree snails; and 5) employ captive propagation to protect existing occurrences and to support the establishing new occurrences throughout the known range of these snails.

Ongoing Conservation Actions in the Action Area Current conservation actions are being conducted within the Army military installations at SBMR, SBER, and KLOA. Current field conservation actions are mainly focused on surveys conducted by Army Natural Resource staff. These surveys cover all Oahu tree snail species that have occurred within the boundaries of the Army installations. In addition to these surveys, the Army Natural Resource staff monitor and occasionally trap rats at two occurrences of *Achatinella livida* and at several known occurrences of *A. sowerbyana*, both in the north Koolau Mountains, and at several known occurrences of *A. mustelina* in the Waianae Mountains.

Status of the Species - *Chasiempis sandwichensis ibidis* (Oahu elepaio)

Species Description The Oahu elepaio (*Chasiempis sandwichensis ibidis*) is a small (12.5 grams (g) average weight (0.44 ounces (oz); 15 cm (5.9 in) total body length) nonmigratory forest bird in the monarch flycatcher family (Monarchidae) and is endemic to the Hawaiian Islands (VanderWerf 1998). Three subspecies of elepaio are recognized, the Hawaii elepaio (*C. s. sandwichensis*), the Oahu elepaio (*C. s. ibidis*), and the Kauai elepaio (*C. s. sclateri*). The Oahu form was known as *C. s. gayi* until Olson (1989) pointed out that the epithet *ibidis* (Stejneger 1887) has priority.

Oahu elepaio are dark brown above and white below, with light brown streaks on the upper breast. The tail is long (6.5 cm (2.6 in)) and often held up at an angle. Adults have conspicuous white wing bars, a white rump, and white tips on the tail feathers. The throat is white with black markings in both sexes, but males tend to have more black than females, especially on the chin. Juveniles and subadults are rufous above and on the breast, with a white belly and rusty wing-bars. The bill is medium-length (1.3 cm (0.51 in)), straight, and black, with the base of the lower mandible bluish-gray in adults and yellow in juveniles. The legs and feet are dark gray and the iris is dark brown. Males average approximately 10 percent larger than females in wing length, tarsus length, and weight, but bill length does not differ between the sexes (VanderWerf 1998). The primary song, given almost exclusively by males, is a whistled "el-e-pai-o," with an accent on the third syllable, from which the Hawaiian name is derived. The female often answers the male song with a loud two-note call. Both sexes give a variety of scolding calls and chatter.

Listing Status The Oahu elepaio was federally-listed as endangered on May 18, 2000 (65 FR 20760). The elepaio subspecies on Kauai and Hawaii are not listed. Species listed under the Federal Endangered Species Act are automatically listed under the State of Hawaii Endangered Species Act (HRS 195D-4a). A draft recovery plan was prepared for the Oahu elepaio as part of the Draft Revised Recovery Plan for Hawaiian Forest birds, which covers 21 taxa of forests birds (Service 2003).

Historic and Current Distribution Before humans arrived, forest covered about 127,000 ha (313,823 ac) on Oahu (HINHP 1991), and it is likely that elepaio once inhabited much of that area (VanderWerf et al. 2001). Reports by early naturalists indicate that elepaio were once widespread and abundant on Oahu. Bryan (1905) called the Oahu elepaio "the most abundant Hawaiian species on the mountainside all the way from the sea to well up into the higher elevations." Perkins (1903) remarked on its "universal distribution..., from the lowest bounds to the uppermost edge of continuous forest." Seale (1900) stated the elepaio was "the commonest native land bird to be found on the island," while MacCaughey (1919) described it as "the most abundant representative of the native woodland avifauna" and "abundant in all parts of its range." The historical range of the Oahu elepaio thus apparently included most forested parts of the island, and it was formerly abundant.

Despite its adaptability, the Oahu elepaio has seriously declined since humans arrived, and it has disappeared from many parts of Oahu where it was formerly common (Shallenberger 1977, Shallenberger & Vaughn 1978, Williams 1987, VanderWerf et al. 1997). Intensive island-wide surveys from 1992-1998 indicated a total population of approximately 1,970 birds (Table 3; VanderWerf *et al.* 2001). The only previous population estimate (200 to 500 birds; Ellis *et al.* 1992) was not accurate because little information was available when the estimate was made. The total geographic area occupied by all current populations is approximately 5,451 ha (13,464 ac; Table 3; VanderWerf *et al.* 2001). The Oahu elepaio thus currently occupies only about four percent of its presumed prehistoric range, and it has declined by 96 percent since humans arrived in Hawaii 1,600 years ago. In 1975 elepaio inhabited approximately 20,900 ha (51,623 ac) on Oahu, almost four times the area of the current range (VanderWerf *et al.* 2001). The range of the elepaio has declined by roughly 75 percent in the last 25 years.

The Oahu elepaio currently is distributed in six relatively large populations and several small population remnants (Table 3; VanderWerf *et al.* 2001). The number of birds is divided almost evenly between the Waianae Mountains in the west and the Koolau Mountains in the east, with three relatively large populations in each mountain range. Several tiny population remnants consisting entirely of males remain in both the Waianae and Koolau mountains (Table 3), but since there is no chance of reproduction without females and population rescue by immigration is unlikely, these relicts likely will disappear in a few years as the last adult birds die.

Table 3. Estimated size and area of Oahu elepaio subpopulations.
Data from VanderWerf *et al.* (2001).

Subpopulation	Total population size	Breeding population size	Area (hectares)
Waianae Mountains Southern Waianae (Honouliuli Preserve, Lualualei Naval Magazine)	458	418	1,170
Schofield Barracks West Range	340	310	532
Makaha, Waianae Kai Valleys	123	112	459
Pahole, Kahanahaiki	18	4	256
Schofield Barracks South Range	6	0	20
Makua Valley	7	2	49
Kaala Natural Area Reserve	3	0	21
Makaleha Gulch	2	0	7
Kuaokala	3	2	14
Kaluakauila Gulch	1	0	6
Koolau Mountains Southern Koolau (Pia, Wailupe, Kapakahi, Kuliouou, Waialae Nui)	475	432	1,063
Waikane, Kahana Valleys	265	242	523
Central Koolau (Moanalua, north and south Halawa, Aiea, Kalauao)	226	206	1,396
Palolo Valley	46	42	78
Waihee Valley	5	4	32
Manoa	2	0	19
Hauula	1	0	4
Waianu Valley	1	0	8
TOTAL	1,982	1,774	5,657

Ecology Oahu elepaio are adaptable and occur in a variety of forest types composed of both native and introduced plant species (Conant 1977, VanderWerf 1993, 1994, 1998). Plant species composition in elepaio habitat varies considerably depending on location and elevation, but some of the most common native plants in areas where elepaio occur are *Pisonia umbellifera*, *Diospyros sandwicensis*, *Pipturus albidus*, *Sapindus oahuensis*, and *Pouteria sandwicensis*, and some of the most common introduced plants are *Psidium cattleianum*, *P. guajava*, *Aleurites moluccana*, *Mangifera indica*, and *Schinus terebinthifolius* (VanderWerf 1998). Shallenberger and Vaughn (1978) found the highest relative abundance of elepaio in

forest dominated by introduced *Psidium* and *Aleurites* trees, but they were also found in the following forest types (in order of decreasing abundance): mixed native-exotic; tall exotic; *Acacia koa* dominant; mixed *Acacia* and *Metrosideros polymorpha*; low exotic; *Metrosideros* dominant; and *Metrosideros* scrub. They currently are not found in very wet, stunted forest on windswept summits or in very dry scrubland.

Unlike many Hawaiian forest birds, elepaio have adapted well to disturbed forest composed of introduced plants (Conant 1977, VanderWerf 1998). VanderWerf *et al.* (1997) found that: 1) forest structure was more important to elepaio than plant species composition, 2) most elepaio occurred in areas with a continuous forest canopy and a dense understory, and 3) population density was roughly twice as high in tall riparian vegetation in valleys than in scrubby vegetation on ridges. Fifty-five percent of the current range is dominated by introduced plants, and 45 percent is dominated by native plants (VanderWerf *et al.* 2001). This does not imply that elepaio prefer introduced plant species, but simply reflects a preference by elepaio for riparian vegetation in valleys and the high degree of habitat disturbance and abundance of alien plants in riparian areas (VanderWerf *et al.* 1997). Of the 45 percent dominated by native plants, 23 percent is categorized as wet forest, 17 percent as mesic forest, and 5 percent as dry forest, shrubland, and cliffs (HINHP 1991).

Elepaio are non-migratory and defend all-purpose territories year-round (Conant 1977, VanderWerf 1998). The average territory size on Oahu was 1.45 ha (3.6 ac) in Honouliuli Preserve (The Nature Conservancy of Hawaii, unpubl. data), 1.55 ha (3.8 ac) in southeastern Oahu (VanderWerf and Smith 2002), and 2.0 ha (4.9 ac) in Manoa Valley (Conant 1977). Oahu elepaio are socially monogamous, and site fidelity is high, with 96 percent of males and 67 percent of females remaining on the same territory between years. Young birds are subordinate and act as floaters while they attempt to acquire a territory and a mate. Annual survival of adults is high (approximately 80 percent) in the absence of disease and nest predation (VanderWerf and Smith 2002).

The nesting season usually extends from February to May, but active nests have been found from January to July (VanderWerf 1998). The nest is a finely woven, freestanding cup made of rootlets, bark strips, leaf skeletons, lichen, and spider silk, and is placed in a fork or on top of a branch (Conant 1977, VanderWerf 1998). Nests have been found in a variety of plants, including six native species and 13 introduced species (E. VanderWerf unpublished data). Both sexes participate almost equally in all aspects of reproduction, but the female plays a slightly larger role in nest building and the male provides more food for the nestlings (VanderWerf 1998). Clutch size is usually two, sometimes one or three, and eggs hatch after 18 days (Conant 1977, VanderWerf 1998). The nestling period averages 16 days, and fledglings are fed by their parents for more than a month after leaving the nest, remaining on the natal territory for up to nine months until the start of the next breeding season (VanderWerf 1998). Fecundity is low; even if nest predators are removed the mean number of fledglings per pair is 0.75 per year (VanderWerf and Smith 2002). Oahu elepaio will re-nest once or twice after failure, but they rarely attempt to re-

nest if the first nest is successful. Other than introduced predators, the most common cause of nest failure is storms with heavy rain and strong winds (VanderWerf and Smith 2002).

The foraging behavior and diet of elepaio are extremely varied. In a study on Hawaii Island, VanderWerf (1993, 1994) found that elepaio foraged at all heights on all available plant species, and that they caught insects from a variety of substrates, including the ground and fallen logs (2 percent), trunks (5 percent), branches (24 percent), twigs (38 percent), foliage (20 percent), and in the air (11 percent). Elepaio are versatile and agile in pursuit of prey, using a diversity of foraging behaviors that is among the highest recorded for any bird, including perch-gleaning (48 percent), several forms of flight-gleaning (30 percent), hanging (11 percent), aerial flycatching (7 percent), and active pursuit (4 percent) (VanderWerf 1994). The diet consists of a wide range of arthropods, particularly insects and spiders, and includes nonnative taxa such as fruit flies (Tephritidae; VanderWerf 1998). Large prey such as moths and caterpillars are beaten against a branch before being eaten.

Critical Habitat Critical habitat for the Oahu elepaio was designated on December 10, 2001, to provide additional protection for occupied and unoccupied lands considered essential to the conservation of the species (66 FR 63752). Critical habitat was designated in five units totaling 26,661 ha (65,879 ac), primarily encompassing undeveloped high elevation areas of the island. The primary constituent elements of the critical habitat required by the Oahu elepaio for foraging, sheltering, roosting, nesting, and rearing of young are undeveloped wet, mesic, and dry forest habitats with a closed canopy and a dense understory and composed of native and/or introduced plant species. In addition, the primary constituent elements associated with the biological needs of dispersal and genetic exchange among populations are undeveloped wet or dry shrub land and wet or dry cliff habitats.

Threats Much of the historical decline of the Oahu elepaio can be attributed to habitat loss, especially at low elevations. Fifty-six percent of the original prehistoric range has been developed for urban, agricultural, and military use, and practically no elepaio remain in developed areas (VanderWerf *et al.* 2001). Loss and modification of forest habitat due to browsing and digging by feral ungulates and fires ignited during military training at SBMR continue to threaten elepaio on Oahu.

More recently, declines have occurred in several areas that still contain suitable forest habitat, demonstrating that habitat loss is not the only threat. Elepaio were observed regularly into the 1970s or early 1980s at Poamoho, Schofield-Waikane, Manana, Waimano, and other areas (Shallenberger 1977, Shallenberger and Vaughn 1978), but they have disappeared from all these areas even though the forest is still intact (VanderWerf *et al.* 2001).

Recent declines in Oahu elepaio populations are due to a combination of low adult survival and low reproductive success. The two main factors reducing these parameters on Oahu are nest predation by alien black rats (*Rattus rattus*) and introduced diseases, particularly avian pox

(*Poxvirus avium*), which is carried by the introduced southern house mosquito (*Culex quinquefasciatus*). Each of these threats is known to reduce both nesting success and adult survival.

An experiment in which automatic cameras were wired to artificial nests containing quail eggs showed that a black rat was the predator in all 10 predation events documented (VanderWerf 2001). All predation events occurred at night, and most occurred on the first night nests were placed in the field, indicating predation pressure was very high. Control of rats with snap traps and diphacinone bait stations in southeastern Oahu from 1996 to 2000 resulted in a 112 percent increase in reproduction and a 66 percent increase in survival of adult females compared to control areas (VanderWerf and Smith 2002). Both sexes of elepaio incubate the eggs and brood the nestlings, but only females incubate at night, making them more vulnerable to predation by nocturnal predators like rats (VanderWerf and Smith 2002).

Oahu elepaio also are threatened by human actions, such as the potential introduction of the brown tree-snake (*Boiga irregularis*) from the Mariana Islands.

The remaining elepaio subpopulations are small and isolated, comprising six core subpopulations that contain between 100 and 500 birds, and numerous small remnant subpopulations. Because all remaining elepaio populations are small, they are vulnerable to extinction due to a variety of natural processes, including reduced reproductive vigor caused by inbreeding depression, loss of genetic variability and evolutionary potential over time due to random genetic drift, stochastic fluctuations in population size and sex ratio, and natural disasters such as hurricanes (Lande 1988, International Union for the Conservation of Nature 2000).

Conservation Needs of the Species Based on the nature of the threats, the conservation needs of the Oahu elepaio are integrally linked with following biological principles: (1) the presence of functionally intact forest with a closed canopy and a dense understory, (2) the absence or effective control of alien nest predators, particularly black rats, and (3) large, well-connected blocks of forest with self-sustaining elepaio populations in relatively close proximity to one another to facilitate dispersal and genetic exchange.

Ongoing Conservation Actions Conservation efforts for the Oahu elepaio have included surveys to determine the current distribution and abundance (VanderWerf *et al.* 1997, 2001), demographic monitoring to assess population status and identify threats (VanderWerf 1999), removal of introduced predators in some areas (VanderWerf and Smith 2002), investigation of the effects of alien diseases on demography (VanderWerf 1999), and investigation of genetic population structure.

Rat control is a highly effective conservation action that has been used to increase reproductive success and survival of adult female Oahu elepaio. Ground-based rat control using snap traps and diphacinone bait stations has been conducted by the Hawaii State Division of Forestry and

Wildlife in the Honolulu Forest Reserve since 1997, by the U.S. Army Environmental Division at SBMR and MMR since 1998, by The Nature Conservancy of Hawaii at Honouliuli Preserve since 2000, and by the U.S. Navy and U.S. Department of Agriculture Wildlife Services in Lualualei Valley beginning in 2002.

Blood samples have been collected from over 150 Oahu elepaio for use in disease screening, determination of genetic population structure, and to assist in identification of potentially disease-resistant populations or individuals (VanderWerf 1999). If disease-resistant or tolerant birds can be identified, translocation or captive propagation and release of these birds might help populations recover more quickly and perhaps obviate the need to control mosquitoes that transmit disease.

If habitat management alone proves insufficient to allow recovery, captive propagation and/or rear and release of Oahu elepaio may become necessary, and would be especially valuable if genetically disease-resistant birds can be identified for use as breeding stock. In anticipation of the possible need to implement a captive propagation program for recovery of this species, the Zoological Society of San Diego has begun captive breeding of the Hawaii elepaio (*C. s. sandwichensis*) as a surrogate to develop techniques for a possible captive propagation or rear and release program for the Oahu elepaio. Techniques have been developed for the collection and transfer of eggs, artificial incubation and hand-rearing of chicks, as well as long-term maintenance of birds in captivity (Zoological Society of San Diego 2000, 2001), but captive management has yet to produce a successful captive breeding or a release of elepaio from captive-bred animals.

Environmental Baseline

Status of the Species in the Action Area Approximately 344 Oahu elepaio occur within the action area at SBMR, which is 17 percent of the total population of 1,980 birds island-wide (VanderWerf et al. 2001). This is the third largest and densest elepaio population on the island. Due to a male biased sex-ratio, approximately 310 of these birds consist of breeding pairs, the rest are lone males. The majority of birds (342) are found at SBMR, the remainder (2) are in Mt. Kaala Natural Area Reserve. In addition, approximately six elepaio are found on the SRAA (VanderWerf et al. 2001), but they are outside the proposed Action Area. In the past, elepaio occurred on SBER and KLOA, but they are now gone from those areas (VanderWerf et al. 2001).

Due to the threats discussed above, elepaio populations on Oahu, including SBMR, are not stable and are declining. Without rat control, the annual survival rate of female elepaio is 0.50 and the reproductive rate is 0.33 fledglings per pair per year, leading to a population decline of approximately 24 percent per year (VanderWerf and Smith 2002). If the threats to elepaio at SBMR are not managed, this elepaio population likely will disappear in two decades.

Oahu elepaio critical habitat In addition to the individuals of Oahu elepaio mentioned above, the proposed Action Areas contain the following amounts of designated critical habitat for the Oahu elepaio:

- 774 ha (1,913 ac) on SBMR
- 917 ha (2,266 ac) on SBER
- 1,760 ha (4,349 ac) on KLOA

Threats in the Action Area The primary threats to Oahu elepaio in the action areas on Oahu military installations are nest predation by alien rodents, range fires ignited during military training (primarily at SBMR), impacts of high explosive rounds during live-fire training, diseases carried by alien mosquitoes, particularly avian poxvirus, and degradation of forest structure by feral ungulates and other anthropogenic agents. Rats are the most common predator in elepaio habitat (VanderWerf 2001), and rat control results in large increases in elepaio nest success and survival of female elepaio (VanderWerf and Smith 2002). Range fires caused by military training have destroyed designated critical habitat, reducing the amount of forest habitat for elepaio at Schofield Barracks, and continue to pose direct and indirect threats. Fires can kill eggs and nestlings, destroy forest needed by elepaio for foraging and nesting, and facilitate spread of alien plant species not used by elepaio, such as *Casuarina* and *Eucalyptus robusta*. High explosive rounds regularly land above the fire break road and may have killed elepaio and destroyed nests, but no information is available on the frequency with which this may occur. Feral pigs and goats can destroy habitat by digging up understory plants, browsing, and preventing recruitment of canopy trees, thereby altering the structure and species composition of the forest. These feral animals have become abundant in portions of the action area and already have altered areas of critical habitat. Creation of muddy pools by the rooting of feral pigs also may increase the amount of breeding habitat for mosquitoes, thereby increasing the rate of transmission of alien diseases to elepaio.

Conservation Needs in the Action Area The primary conservation needs of Oahu elepaio in the action areas on Oahu military installations are:

- Control of alien rodents to reduce nest predation.
- Implementation of effective fire prevention and suppression measures to avoid loss of nests and forest habitat.
- Adherence to training protocols designed to prevent ignition and spread of wildfires above the fire break road.
- Reduction in the number of high explosive rounds that land above the fire break road.
- Control of alien ungulates to reduce degradation of forest structure and loss of primary constituent elements of critical habitat.

Ongoing Conservation Actions in the Action Area Conservation actions for the Oahu elepaio in the proposed action area have focused on surveys, demographic monitoring, and rat control.

Extensive surveys for elepaio have been conducted in much of SBMR, SBER, SRAA, and in parts of KLOA, and KTA. The current status of the species in each area is fairly well documented (VanderWerf et al. 2001). In addition, a total of 46 elepaio have been mist-netted and banded at SBMR and SRAA since 1996 to facilitate monitoring of survival and reproduction. Rat control was initiated at SBMR in 1998. In 2001, rats were controlled in 19 elepaio territories using snap traps and 39 diphacinone bait stations (U.S. Army Garrison 2001). However, the current level of access to West Range is not frequent enough to allow adequate maintenance of the bait stations or to allow sufficient demographic monitoring to allow evaluation of the efficacy of the control program. Bait stations must be restocked regularly (weekly during the first 3-4 weeks) for the rat control program to be effective.

In 2000, a study of the effects of noise from military training was conducted at SBMR (VanderWerf et al. 2000), which showed that elepaio are not affected by noise at SBMR. More frequent access provided to SBMR in 2000 to conduct the noise study made it possible to maintain the bait stations more frequently, and reproduction of elepaio that year was similar to other areas where rats were controlled (VanderWerf et al. 2000, VanderWerf and Smith 2002).

EFFECTS OF THE ACTION ON LISTED SPECIES

General Impact Issues

This section outlines impacts that will effect many, if not all species in this biological opinion, and is meant as a review to facilitate an effects analysis for almost 50 species. The installation review is intended to present information that is pertinent to understanding effects at each installation. The installation sections are also intended to review the important training issues at each installation prior to the species by species effects.

Fire

When assessing the fire risk for an installation, the following elements were considered: fuel types, training activities, fire history, significant topographic barriers, buffers, defensible boundaries, and fire minimization and prevention. Fire resulting from training exercises is the most significant threat to the federally listed species in the Action Areas. The alien plant species most likely to be spread by Army activities are those that have a high fuel load, are fire adapted, carry fire into the remaining native forests, and/or can establish rapidly in newly burned areas. Fire caused by military training increases the spread of these alien species. Fire is a threat to native taxa and natural communities in Hawaii. Few native Hawaiian plants and animals are adapted to wildfires, and none have been found to be dependent on fire for survival. Consequently, most native plants and animals perish during fires with little subsequent recovery. Once a fire sweeps through native habitat it allows for the intrusion of non-native invasive plants and prohibits the regeneration of native plants. Each successive fire that reaches native forest stands reduces habitat for listed species, affects the moisture and canopy of the forest boundary, and increases the number of alien plants in areas of native vegetation. Invasive plant encroachment increase after a major disturbance event such as a fire and this threat would have a significant effect on any threatened or endangered plant species not destroyed by the fire.

Fires caused by activities of the original Polynesians in Hawaii probably played a large part in the decline of the native vegetation of the drier plains and foothills. These early settlers used fire exclusively in the lowlands in a shifting pattern of agricultural land use. Slash and burn agriculture created anthropogenic lowland vegetation. Although fires are not frequent in the mountainous regions, extensive fires have occurred in the lowland mesic areas with up to one-half of the alien species dominated areas being damaged by fires. Of these lowland ecological communities, shrublands and grasslands contribute most to the fire problem.

Several fires have occurred on Army installations within the last few months that reinforce the fact that full control of fires is not possible, even with precautions and restrictions in place. The latest fire at Makua (July 2003) was a prescribed burn that got out of prescription and ended up burning over 850.2 ha (2100 ac) including 60.7 ha (150 ac) of native habitat and several listed plant species. In addition, there have been two recent fires at SBMR (July and Aug 2003) and KTA (June 2003) that impacted critical habitat for elepaio, consumed additional native habitat which leads the Service to refute the fire risk as stated in the Biological Assessment, and therefore, the Service believes the risk to all species is higher than the Army has indicated.

A surface danger zone is a segment of a training range endangered by the firing of a particular type of weapon. A surface danger zone consists of the target area, impact area, ricochet area, secondary danger areas on all sides of the primary danger area, and other associated areas. Surface danger zones for ranges at SBMR terminate in a common impact area. The impact area is the primary danger area for all indirect fired weapon rounds. When applied to direct fire weapons, the impact area is the area located between established range limits in the approved surface danger zone. The impact area is off-limits to unauthorized personnel due to fired munitions hazards. The portion of the impact area where high explosive rounds have landed but did not detonate (duds) is termed a dedicated, or dudded, impact area (U.S. Army 2003a).

Non-Native or Invasive Plant Species

The ongoing threat from increased non-native plant invasion is always prevalent within, and adjacent to, high disturbance areas such as military training facilities. There are several potential sources of non-native plant introduction into Army installations including: mounted maneuvers, dismounted maneuvers, movement of equipment, vehicles, troops between installations and between islands, construction of buildings and roads, especially post fire. In addition, movements of troops into Hawaii from other states and countries and movements between installations in Hawaii increase the likelihood of habitat-altering weeds being introduced into installations and spreading into native habitats that support listed species. Some non-native invasive plants can also spread into undisturbed areas once they have become established in disturbed area. These alien plant species compete with native plants for light, nutrients, and space, and impact many of the endangered species both directly through competition and indirectly through alteration of the habitats these listed species require to survive (Cuddihy and Stone 1990).

Lower elevation plant communities have a higher threat level of invasion from non-native plants due to dry microclimates and proximity to potential seed sources from training activities. Non-

native or weedy plant invasives tend to be grassy or shrubby species which prefer the drier, lower elevations areas and can readily take hold. The mesic forest habitats have a moderate threat level of being invaded by non-native plants since invasive plants are compromised in the wetter conditions and the areas are somewhat more removed from training and activity areas. The wet forest species have the lowest threat level of being impacted from non-natives since the extremely mesic conditions preclude establishment of the xeric invasive species.

Minimization measures to reduce the likelihood of seed transport from Army actions are included in the project description and will be further addressed specifically for each installation in the Implementation Plan to be developed for the Oahu Army training installations. Those relevant measures contained in the Implementation Plan prepared for MMR will also be in the Oahu IP, and will include: preventing secondary weed spread from fire by monitoring and rapidly eradicating newly dispersed alien invasive plant species; implementing all actions described in the project description for this threat; and detailed methods for the monitoring and eradication of non-native plants. In addition, if a fire does occur and native habitat is lost, the Army will work with the Service regarding their restoration of the damaged area.

Ungulates

Two species of feral ungulates, pigs (*Sus scrofa*) and goats (*Capra hircus*), are found in all of the Army installations. Feral pigs are found in the moister sections of the valley, while feral goats are typically found in the drier, steeper areas. Feral goats and pigs have degraded extensive tracts of native vegetation through grazing and trampling, affecting habitats of listed species as well as occasionally having direct impacts to the species themselves. Goats contribute to a serious erosion problems in Ohikilolo Ridge. Signs of pig activity (rooting, tracks, and scat) are evident in some of the mesic areas of SBMR and SRAA. Both pigs and goats may increase the spread of alien species into native habitat by carrying such species in their feces and fur, and by creating areas of bare soil and open canopy for alien plant species to establish and spread (Cuddihy and Stone 1990). Feral ungulates are found throughout the installations which is a continued additional pressure for listed plant species. Pigs are particularly destructive as they trample, root and eat native vegetation and can introduce invasive species through fecal matter. These rooting sites are another avenue for establishment of invasive plants plant species.

Other Invasive Species

Several species of small mammals are found in the Army installations, including rats (*Rattus* spp.), mice (*Mus domesticus*), feral cats (*Felix catus*), and mongoose (*Herpestes auropunctatus*). All of these species are known to prey upon native snails, birds and their eggs. Rodents have also been shown to eat plants and the fruit/seeds of native plant species, especially plants in the lobelia, palm, and African violet families (Cuddihy and Stone 1990).

Invertebrate pests include slugs (such as *Milax gagates*), black twig borer (*Xylosandrus compactus*), two-spotted leafhopper (*Sophonia rufofascia*), carnivorous snail (*Euglandina rosea*), and mosquitoes (*Culex quinquefasciatus*). In addition to possibly being an attractant to pigs, slugs are widespread in Hawaii and a serious threat to many native plant taxa (Howarth

1985). Slugs feed preferentially on plants with fleshy leaves, stems, and fruits, including all taxa in the lobelia family in Hawaii (L. Mehrhoff, *in litt.* 1995).

The black twig borer is known to infest a wide variety of common plant taxa (Davis 1970). The black twig borer burrows into branches, introduces a pathogenic fungus as food for its larvae, and lays its eggs. Twigs, branches, and even entire plants can be killed from an infestation. In the Hawaiian Islands, the black twig borer has many hosts, disperses easily, and is probably present at most elevations up to 670 m (2,500 ft) (Howarth 1985). Black twig borer is a major threat to *Flueggea neowawraea* and *Alectryon macrococcus* var. *macrococcus* (mahoe) (Service 1998a).

The two-spotted leafhopper is a recently introduced insect that causes feeding damage on leaves, typically in the form of stippling and yellowing. In addition to mechanical feeding damage, this insect may introduce a plant virus. It is suspected of causing severe dieback of the native fern *Dicranopteris linearis* and economic damage to crops and ornamental plants in Hawaii (U.S. Army 2003a).

The carnivorous snail, *Euglandina rosea*, is a significant threat to native land snails (Hadfield 1986) and has been observed eating native land snails (S. Miller, pers. comm. 1988). Mosquitoes carry avian malaria (*Plasmodium rilictum*) and avian pox (*Avipox* sp.) that impact the endangered Oahu elepaio (U.S. Army 1998b). The Army's activities are unlikely to increase the spread of any of these invertebrate pests and diseases other than through activities that may weaken or stress individuals through alteration of habitat, which increases their susceptibility to pests.

Trampling

Trampling can directly and indirectly impact listed plant and snail species. Soldiers can directly crush a plant or snail in the course of their reconnaissance or dismounted training activities, their footfall can compact soil and degrade the micro-climate for listed plants. Trails may inadvertently be made by troop activity which has the potential to increase ungulate use and open up an otherwise closed canopy habitat. Wind and water erosion may further degrade the habitat when a trail is not properly constructed but only created by cross-country activity. Measures to minimize trampling are outlined in the conservation measures section of this biological opinion.

Integrated Training Area Management

This program provides land managers and trainers with long-term assessments of changes in the condition of training lands, assesses the training carrying capacity of the land, and prioritizes and evaluates land rehabilitation projects. The Integrated Training Area Manager monitors and mitigates erosion and loss of vegetative cover from training activity and revegetates areas heavily used for training. This may involve the use of a non-native plant species. The workers coordinate these decisions with the Army's Natural Resource staff but there is still the potential to introduce alien plant and animal species while performing their work. Minimization measures for their activities are outlined in the conservation measures section of this biological opinion.

Natural Resource Program

The Natural Resource staff manages rare plants and animals and their habitats so that the Army is in compliance with the Endangered Species Act and other environmental laws and regulations. Their work is beneficial as they strive to improve conditions for listed species by reducing or removing threats for sensitive and listed plants, invertebrates, and vertebrates. Natural Resource workers could inadvertently introduce non-native or invasive species via field vehicles or gear; however, they are knowledgeable and trained to be careful. Minimization measures for this action are outlined in the conservation measures section of this biological opinion.

Kahuku Training Area

Ignition Sources from Legacy Training

KTA areas support up to battalion-level (500 personnel) training that utilize pyrotechnics, blank ammunition, smoke, and simulators. No live-fire training is allowed at KTA. Field activities, or training exercises can involve vehicle movement, maneuvers and convoys, foot maneuvers, bivouacking, limited aviation training, and staff training exercises. Pyrotechnics use occurs anywhere that dismounted (and/or mounted) training occurs in accordance with Range Division Hawaii rules for these training devices. All operations involving significant support activities, tents, field facilities, and vehicles/equipment take place in the lower elevation and flatter areas cleared of vegetation and accessible by road. These activities take place within areas that support off-road vehicle maneuvers. The average use of each training area ranges from 26 to 44 days per year and approximately 1,500 to 4,800 troops per year. Dismounted activities, especially bivouacking, increases the potential for fire due to cooking activities and cigarette smoking.

The KTA contains nine sub-areas (training areas), five open helicopter landing zones, three closed landing zones, and three parachute drop zones (Kanes, Kahuku and X-Strip) also used as landing zones (Figure 6.a of the Biological Assessment). Helicopter training increases the potential for fire due to the risk of helicopter crashes.

There was a fire in 2000 suspected to have been ignited by a flare or a grenade from Marines using KTA. The fire impacted many native trees and shrubs and burned within 400 m (1,360 ft) of a stand of *Eugenia koolauensis* trees (U.S. Army 2003b). On July 9, 2003, a fire started at LZ Duram and burned until July 14, burning a total of 5.5 ha (13.5 ac). Mr. Gayland Enriques, the Army Fire Protection Specialist and Wildland Fire Program Manager, determined that the fire was ignited due to the use of C-4 explosive to clear a new landing zone. The Engineer team clearing the landing area determined the fire was out, but it actually smoldered underground and re-started two days later (G. Enriques, pers. comm. 2003; K. Kawelo, pers. comm. 2003). Proper Standard Operating Procedures were not carried out with either of these fire events which resulted in loss of native habitat and possibly *E. koolauensis* seedlings.

Fire Risk after Transformation

Rules for allowable and prohibited live-fire and pyrotechnics at KTA would be unchanged and would apply to all future Legacy and SBCT training, with the exception of short-range training ammunition (plastic bullets which are considered live-fire) would be used at the Combined Arms

Collective Training Facility urban training facility. As with Legacy training, exercises would continue at the squad (9 soldiers) through company levels (120 soldiers). The use of higher elevation areas including Training Areas A1, A3, C1, C2, D1 and D2 is currently very limited due to the steep terrain and dense vegetation (U.S. Army 2003b) and would continue to be limited for SBCT for the same reasons. Landing zones and drop zones would continue to be used as similar levels as current training. General SBCT training would likely occur between 180 and 242 days per year.

Limited live-fire of special plastic simulations ammunition will be used at the Combined Arms Complex Training Facility site. Legacy units and the transformed brigade would conduct at least one major exercise each year that involves at least two battalion-level attacks on the Military Operations in Urban Terrain site. Each brigade would conduct one field training exercise each year consisting of 2-4 battalion-size operations at the Combined Arms Complex Training Facility. The overall estimate for the proposed KTA Combined Arms Complex Training Facility for 5.56 mm and .50 cal short range training ammunition is 124,000 rounds per year, mainly within the buildings that make up the complex.

Fire Vulnerability Rating

The Biological Assessment defines fire vulnerability as the risk of fire ignition combined with the risk of fire spread as determined by characteristics of the vegetation and climate. KTA has been divided into three fire vulnerability risk categories: moderate, low, and none. Areas included in the moderate fire vulnerability zone includes low elevation sites with large grassy areas or landing zones. Moderate areas have drier climate, fire prone vegetation, and a higher frequency of training. Low fire vulnerability areas include higher elevation sites with an increased moisture regime and reduced training. The areas of no fire vulnerability include high elevation locations that receive approximately 200 inches of rain a year and support less fire prone vegetation. Military training is minimal in these areas (U.S. Army 2003b).

Military Actions to Minimize Fire Impact

The potential for a wildland fire can never be totally eliminated. The risk of fires from training activities can be reduced and the Army has outlined minimization measures for fire prevention from all ignition sources. The most important measure is the implementation of the WFMP, including: 1) implementation of a Fire Danger Rating System that will restrict pyrotechnic training according to weather and fuel conditions and will be monitored daily by range control; 2) range control approval and guidance must be obtained propr to occupying use of the maneuver areas; and 3) a 1,136 cubic meter (300,000 gallon) capacity dip pond will be constructed; and 4) use of water reservoirs during training and major wildfires on Army lands from private landowners in central Oahu. Additional minimization measures for fire from all ignition sources are outlined in the project description and standard operating procedures for KTA (U.S. Army 2003b).

Drum Road

The construction of Drum Road will increase the number of vehicular activities on the road, therefore, increasing mounted and dismounted actions in this area. Units currently use Drum

Road through KLOA to access KTA on a minimal and infrequent basis (very few vehicles – mainly Humvees) due to the poor condition of this one-lane dirt road. The primary route for vehicles going to KTA is via Kamehameha Highway. Future use of Drum Road to access KTA is expected to be approximately 36 trucks (company level) and 41 trucks (battalion level) trips for Legacy vehicles 12 times per year. For SBCT the number will increase to 47 Strykers and trucks (company level) and 217 Strykers and trucks (battalion level) once the road is upgraded.

Army Regulated Hunting

Hunting has the potential to impact threatened and endangered plants due to increased risk of fire (cigarette smoking, catalytic converter ignition from cars driving off-road), trampling by men or dogs, and introduction of non-native or invasive species. There is a maintained hunting program in training areas A-1 and A-3 which allow hunting of wild pigs, game birds and goats. Only one hunting group (two to six individuals) is allowed in either training area at a time and permits are issued by the Provost Marshal.

Kawailoa Training Area

Potential Fire Issues with Legacy Training

KLOA is used primarily for helicopter aviation training, including long-range patrol, helicopter unit tactical training, and command post displacement up to company level (120 soldiers). Live-fire training is not allowed on KLOA nor is the use of pyrotechnics including smoke grenades, simulators, and fog oil. Blank ammunition is used including 5.56 mm, 7.62 mm and .50 caliber. Ignition sources at KLOA include sparks from cook stoves/fires at bivouac sites, smoking, blank ammunition or muzzle flash, and helicopter crashes. Within the training area, it is estimated that there will be one or two operations every month, each of which would be two to five days (up to 10 days for battalion -size and larger groups) in duration. Based upon data compiled for Legacy training for the years 1998-2002, it is estimated that the average number of troops that will use this area will be 17,422 over an average of 137 days per year. Cigarette smoking and cooking/warming fires will be authorized by Range Division Hawaii using the Fire Danger Rating System for KLOA.

KLOA is a desirable location for mountain and jungle warfare training because of its ravines and dense vegetation. The remaining area is considered less desirable for maneuver training activities due to excessively steep slopes and thick vegetation, and is therefore exploited in a very limited fashion. In areas with slopes greater than 20 percent, troop deployment is typically limited to single file, small unit maneuvers along ridgelines and trails. Typical reconnaissance training operations involve small groups, from squad to platoon strength (9 to 35 soldiers). This type of training may take place in all types of terrain but can be constrained by extremely rugged terrain and thick vegetation. The training is conducted between 20 and 40 times per year. The average use of each training area ranges from 100 to 154 days per year and approximately 12,700 to 19,500 troops per year.

There is an increased fire risk from the intensive use of this installation as a helicopter training area. There are seven training areas, 12 open and seven closed landing zones, three landing

zones on private lands west of KLOA, and one drop zone (Puu Kapu Drop Zone). In addition, most troop transport is via helicopter. Current helicopter usage averages approximately 78 flights per day (U.S. Army 2003a). The high use of KLOA for helicopter transport and training increases the potential for fire due to the increased probability of a helicopter accident.

SBCT Training and Fire Risk

KLOA would continue to be used at current levels primarily for helicopter aviation training, including long-range patrol, helicopter unit tactical training, and command post displacement. In areas with slopes greater than 20 percent, troop deployment would typically be limited to single file, small unit maneuvers along ridgelines. Troop transport would be primarily via helicopter, and the same landing zones and drop zones would be used by Legacy units. Typical operations involve small groups, from squad to platoon strength (9 to 35 soldiers). The training is conducted between 20 and 40 times per year, in daytime and at night. Areas used for training are based largely on topographic and maneuverability constraints. Off-limits and restricted areas, impact areas, habitat and species protection areas, identified cultural resource sites, cantonment areas, and recreation areas are not used for reconnaissance training

Fire Vulnerability Rating

The Biological Assessment defines fire vulnerability as the risk of fire ignition combined with the risk of fire spread as determined by characteristics of the vegetation and climate. KLOA has been divided into three fire vulnerability areas; low, very low and none. Areas with a low fire vulnerability include low elevation sites with grass or eucalyptus dominated vegetation. Training in these areas is restricted to maneuver only reducing the chances of ignition. The areas with a fire vulnerability of very low include mid-range elevation areas with a mix of alien and native forests. These areas receive less rainfall than upslope areas and do not support fire prone grasses as found in the lower elevations. The areas of no fire vulnerability include high elevation locations with summit crest vegetation. Rainfall is frequent and heavy, and training is very infrequent in these areas (U.S. Army 2003a).

Military Actions to Minimize Fire Impact

The potential for a wildland fire can never be totally eliminated. The risk of fires from training activities can be reduced and the Army has outlined minimization measures for fire prevention from all ignition sources. The most important measure is the implementation of the WFMP, including: 1) implementation of a Fire Danger Rating System that will restrict training activities according to weather and fuel conditions; 2) the Burning Index will be monitored hourly by Range Control when training is scheduled; 3) Range Control will notify the training unit of any training restrictions being imposed as a result of unfavorable fire danger ratings; 4) Range Control approval and guidance much be obtained prior to use of the maneuver areas; and 5) a 1,136 cubic meter (300,000-gallon) capacity dip pond will be constructed. Additional minimization measures for fire from all ignition sources are outlined in the project description and standard operating procedures for KLOA (U.S. Army 2003a).

Drum Road

One currently unimproved roadway, Drum Road, runs along the western boundary of KLOA providing vehicle access. Legacy units (mainly using Humvees) use Drum Road to access the KLOA training areas (by foot) from the west, occasionally support landing zone/drop zone operations, and as a route to KTA to minimizing the use of Kamehameha Highway. Current use of Drum Road is very limited due to its poor condition. A few small pockets of suitable terrain exist along the Drum Road corridor, and are used by vehicles but are not mapped. Foot trails lead from the Drum Road corridor to higher elevation areas accessible only by foot (U.S. Army 2003a).

The construction of Drum Road will increase the number of vehicular activities on the road, therefore, increasing mounted and dismounted actions in this area. Improvements include approximately 37 km (23 mi) of paving with asphaltic concrete, widening the road to 7.3 m (24 ft) and providing 0.9 m (3 ft) of compacted gravel on each shoulder. Once the road is completed, the road will have the following estimate usage 12 times per year: Legacy 36-41 trucks and SBCT units 47-217 Strykers and trucks.

Maneuver Training

Maneuver also entails the set-up of temporary defensive positions to repel an enemy attack. Defensive positions may consist of soldiers lying in concealed positions and designating fire zones. More complex maneuver defense entails digging individual fighting positions or trenches using hand tools and digging in larger crew-served weapons using excavators. The longer a unit stays in a particular area, the greater the need for digging-in to provide protection from enemy fire given the greater likelihood of detection. All digging must be approved through Range Control and Environmental Division. During extended maneuver training, soldiers may sleep in the field. To avoid detection and allow for quick displacement, tents are not set up during light infantry maneuvers. All of these training activities have the potential to impact occurrences of listed plant species either from trampling, digging, or crushing.

Schofield Barracks Military Reservation to Helemano Military Reservation Vehicle Trail

SBCT use of KLOA would be confined to vehicular use of the military vehicle trail from Schofield Barracks Military Reservation to Helemano Military Reservation, and subsequently north toward KTA via Drum Road. Approximately 15-90 Strykers and 10-90 trucks/Humvees would be using the road approximately 12 times per year for SBCT training. However, the Drum Road upgrade by itself would not change training uses or patterns at KLOA. Some limited dismounted maneuvers may occur but little training is planned for SBCT forces in KLOA.

Non-Military Use within the Action Area

Non-military uses at KLOA that may effect threatened and endangered species include hunting, biking and hiking on approximately 465 ha (1,150 ac) of land leased from the State of Hawaii. There is the potential for trampling of young plants or seedlings from either dogs or humans. The beneficial affect from hunting is the reduction in the number of destructive feral ungulates. The

Ewa Forest Reserve (Wahiawa) State Public Hunting Area (part of unit C) is located in KLOA between Poamoho trail and the Schofield-Waikane trail and allows hunting of pigs and goats.

Public hiking is allowed on the Pupukea summit trail with follows the boundary of KLOA, KTA and SBER. Permission is required to use the trail.

A Cooperative Agreement was signed in 1999 creating the Opaeula Watershed Protection Project which includes a 61 ha (150 ac) fenced area where threats to native habitat and endangered species will be reduced or eliminated. A threat management program has been initiated to control rats, weeds, mongooses, and human disturbance. Monitoring responsibilities were assumed by Natural Resource staff in 2001 (U.S. Army 2003).

Schofield Barracks East Range

Fire Potential with Legacy and Transformation Training

The western maneuver area on East Range is used for rappelling, jungle survival, and patrolling operations. Several open areas are used for Air assault and airborne operations. Small unit maneuvers and combat support training include non-live-fire, mounted maneuver training with Humvees, cargo trucks, trailers, as well as foot training. Field activities, or training exercises can involve vehicle movement, maneuvers and convoys, foot maneuvers, bivouacking, and aviation training. The eastern portion of East Range has extremely rugged terrain and is densely forested. The average use of each training area ranges from 78 to 120 days per year and approximately 5,600 to 20,500 troops per year, and would continue to be used in the future at similar levels by Legacy and SBCT forces. Vehicle maneuvers are constrained by topography and vegetation (and other applicable constraints), whereas foot maneuvers occur anywhere that safety or administrative restrictions permit including the high probability vehicle maneuver areas. Much of the dismounted maneuvers such as land navigation take place at lower elevations. Reconnaissance units may travel along ridgelines in the upper areas of ER-12 and ER-13.

Ignition sources at SBER include sparks from cook stoves/fires at bivouac sites, smoking, blank ammunition or muzzle flash, pyrotechnics, and helicopter crashes. No live-fire is permitted at SBER. However, blank ammunition can be used throughout the area, and pyrotechnics can be used in all areas except training areas 1A, 1B, 2, 3A, and 3B. The use of pyrotechnics and simulators (including demolition effects simulators – DES) requires approval from Range Division Hawaii Range Operations.

Between 1994 and 2002, there have been 14 fires were reported in SBER, impacting approximately 9 ha (23 ac). The most common ignition source was the use of pyrotechnics. Smoke grenades will only be used in areas cleared of debris and grass that might provide fuel to start a fire. Range Division Hawaii may restrict the use of pyrotechnics based on the Fire Danger Rating System for SBER.

Aviation training consists of air assault school training, aviator training missions and air assault operations on a daily basis. Night operations occur approximately eight times per week. In

addition to flight training, fixed wing aircraft and helicopters provide support for drop and landing zone activities, respectively. There is always the risk with aviation training that an accident may occur which can lead to wildlfires.

Summary of Changes in Training Activities as a Result of Transformation

SBCT training will be very similar to current training activities. No live-fire exercises or other activities that significantly increase the risk of fire will occur on East Range. Regulations governing the use of pyrotechnics will remain unchanged. The number of vehicles, days of use, and personnel will likely increase with SBCT training compared to Legacy training; however, similar activities are anticipated to occur in similar areas. Use of 5.56 mm and 7.62 mm blanks is projected to decrease significantly in training areas 1A, 1B, 2, 3A, 3B, 4, 5, 6A, 6B, 11, 12, and 13, and increase significantly in training areas 7, 8, 9, and 10. Use of .50 cal blanks is projected to increase significantly in all training areas.

Fire Vulnerability Rating

The Biological Assessment defines fire vulnerability as the risk of fire ignition combined with the risk of fire spread as determined by characteristics of the vegetation and climate. SBER has been divided into three fire vulnerability areas: moderate, low and none. The moderate fire vulnerability occurs at the lower elevation where the area is used for mounted training and a majority of the dismounted training. This area is drier and supports more fire prone vegetation including large expanses of grass and eucalyptus. Low fire vulnerability occurs at the mid-range elevation where there is a mix of alien and native forest and less fire prone fuels as the lower elevations. No fire vulnerability includes summit crest vegetation with frequent and heavy rainfall. Training is reduced in this area which reduces ignition sources.

Military Actions to Minimize Fire Impact

The potential for a wildland fire can never be totally eliminated. The risk of fires from training activities can be reduced and the Army has outlined minimization measures for fire prevention from all ignition sources. The most important measure is the implementation of the WFMP, including: 1) implementation of a Fire Danger Rating System that will restrict pyrotechnic training according to weather and fuel conditions and will be monitored hourly by range control; 2) construction of a 1,136 cubic meter (300,000 gallon) dip pond at SBMR; and 3) improvement of the existing roads to fuel break standards fuel load reduction as appropriate, and 4) reduction of fuels (Beavers and Burgan 2001). Additional minimization measures for fire from all ignition sources are outlined in the project description and standard operating procedures for SBER. Among the restrictions are no aerial pyrotechnics, and smoke grenades only in areas cleared of debris and grass (U.S. Army 2003b).

Feral Ungulates and Hunting

Three hunting areas are located on SBER and are open during the week when not in use for military training. There is the potential threat to listed species in the eastern portion of hunting Area 3 due to trampling or inadvertent fire ignition. However, the removal of feral pigs benefits the native habitat by reducing foraging and rooting impacts.

Trampling Impacts with Legacy and Transformation Training

All of the threatened and endangered species in SBER occur in training area ER-13. Identified actions in this training area include dismounted maneuvers, foot reconnaissance, bivouac, helicopter aviation training, and air assault. This area also supports a "Malaysian Tracking Course" which is a tracking training course to teach soldiers the art of tracking humans in vegetation while remaining un-noticed. No vehicles are utilized, normal soldier load consists of a ruck sack and personal weapon. Within the training area, it is estimated that there will be one or two operations every month, each of which would be two to five days (10 to 14 days for battalion-size and larger groups) in duration. Based upon data compiled for Legacy training for the years 1998 to 2002, the average number of troops using this area annually was approximately 5,000, with 47 average days of use per year. Foot maneuvers will be focused on and around trails, bivouac activity will be limited in area due to the extreme terrain in the SBER action area, and helicopter and air assault activities will be restricted to open landing and drop zones.

Schofield Barracks Military Range

Potential Fire Issues with Legacy Training

The primary effect to all plant species from ongoing training activities is the risk of fire, particularly due to use of live-fire ammunition at this installation. Live-fire ammunition at SBMR includes highly incendiary weaponry such as mortar rounds, tracer bullets, anti-tank weapons, smoke grenades, white phosphorus, illumination rounds and pyrotechnics. Currently training activities utilize approximately 29,000 rounds of High Explosive ammunition per year. Artillery firing points are located on SBMR and mobile howitzers are towed to a designated point and fired. The range of artillery and mortars varies with the amount of propellant charge used. Artillery firing (105 and 155 mm howitzer cannons) are limited to a charge of three to ensure that the weapon will not overshoot the ridgeline at Schofield Barracks. However, this reduced charge does not limit the ability of the round to land outside of the fire break road.

The most significant cause of ignitions at SBMR has been tracers, which account for 49.4 percent of recorded fires. There is the potential that a fire could start from other sources such as sparks from catalytic converters or cigarette smoking, however, these sources of ignition are more unlikely. According to the Biological Assessment, live-fire training occurs at West range 220 days per year utilizing a variety of incendiary devises and training equipment. The risk to listed plants include fires starting from either an incendiary device landing outside the impact area or the fire starting in the impact area and escaping the fire break road.

A fire history was compiled for SBMR to the extent possible utilizing fire records provided by the U.S. Army Hawaii Range Division and the Federal Fire Department. Unfortunately, there were frequent data gaps in information provided, such as acreage burned and/or the cause of the ignition, but it is known that fire at SBMR has been frequent in the past decade due in large part to the extensive use of live-fire training devices. Review of the available data indicates that the total number of fires per month increase in the summer months although there is also a fairly high incidence in March, April, and May. Over 60 percent of the 429 total records indicated time of ignition was between 11:00 am and 3:00 pm. The median fire size was 0.2 ha (0.5 ac). Only six

percent of the 312 fires that recorded acreage were larger than 4 ha (10 ac) and the largest fire on record was 121 ha (300 ac). However, the paucity of large fire records may be due at least in part to incomplete record keeping. The greatest number of fires have been ignited at MF-2, in the impact area, at KR-5, and at CR-1 (see Figure 7 in the WFMP). These four locations were responsible for 51 percent of all fires.

Transformation Training

Major changes to live-fire activities at SBMR from SBCT forces include the addition of direct gunnery fire which refers to mechanized or tank firing using large caliber guns where the target is in view of the gunner. The Stryker-mounted 105 mm gun would be used in the Battle Action Course on SBMR. There would also be a reduction in 5.56 mm ball and tracer munition use and increases in other small arms ball and munition use. The increase in the use of direct gunnery and mortar ammunition may increase the potential for ammunition to land outside of the current fire break road due to velocity and charge. Therefore, additional use of these weapons particularly Stryker-mounted systems under SBCT may increase the number of rounds that land outside of the fire break road, increasing the risk of fire in the areas where endangered plant species occur (U.S. Army 2003b).

Fire Vulnerability Rating

The Biological Assessment defines fire vulnerability as the risk of fire ignition combined with the risk of fire spread as determined by characteristics of the vegetation and climate. SBMR has been divided into four fire vulnerability areas: very high, moderate, low and very low. The very high fire vulnerability area includes the impact area which is entirely vegetated by alien species and where the intensive training with highly incendiary devices occurs. Moderate areas include south range and other areas used for training with non-native vegetation such as grasslands, eucalyptus, or ironwood dominated plant communities. The low vulnerability areas includes the sites dominated by less flammable vegetation and not typically used for training activities. OP-Halo located just outside the fire break in South Range also falls into the low rating category. A very low fire vulnerability rating includes the westernmost areas of SBMR where training does not occur and over 80 inches of rain falls each year (U.S. Army 2003b).

Fire Risk Reduction

The potential for a wildland fire can never be totally eliminated. However, the risk of fires from training activities can be reduced. The WFMP incorporates minimization measures for fire prevention from all ignition sources. The most important measure includes the implementation of the WFMP, including: 1) implementation of a Fire Danger Rating System that will restrict training according to weather and fuel conditions and will be monitored hourly by range control; 2) construction of a 1,136 cubic meter (300,000 gallon) dip pond in fiscal year 2004; 3) relocating targets that are close to the fire break road further into the impact area to reduce the likelihood of overshot rounds landing outside the fire break; 4) improvement of the fire break road around the McCarthy Flats ranges to the same standards as the existing fire break roads; and 5) managing the fuels on the ridge leading to Puu Pane. Additional restrictions, such as prohibiting smoking on

site, are identified in the Standard Operating Procedures and the Biological Assessment for SBMR (U.S. Army 2003b). Few fires have burned outside of the fire break road indicating that it is a significant barrier to the spread of fire.

Feral Ungulates

Feral ungulates are found throughout the installation which is a continued additional pressure for listed plant species. Pigs are particularly destructive as they trample, root and eat native vegetation and can introduce invasive species through fecal matter. In the past, the Army allowed private hunting parties to enter these areas for the purpose of controlling feral pigs. Due to unexploded ordinance liability issues, the Army has since curtailed public hunting in this area, which has resulted in a drastic increase in pig numbers. Pig control is now solely the responsibility of the Army Natural Resource staff. The lack of hunting, and hence proliferation of pigs, presents a direct and constant threat to all listed plant species within the action area.

Natural Resource Staff Time Allotment

Due to training activities and safety concerns the Army Natural Resource staff has limited access to the upper reaches of the action area where all the threatened and endangered plant species are found. The Army Natural Resource staff can presently only access the area above the impact area less than 24 days per year. This amount of time is not sufficient to implement the conservation measures as outlined in the Makua IP much less the future stabilization measures to be determined in the Oahu IP (K. Kawelo, U.S. Army, pers. comm. 2003). Therefore, the Army has granted a minimum of 45 days per year for access to this area to complete biological studies and work activities and outlined in the MMR and Oahu IPs (J. Godfrey, pers. comm. 2003). If, after the Natural Resource staff begins conservation actions, they determine that this amount of time is not adequate, the Army must reinitiate consultation to determine measures to allow more access time to needed areas.

Direct Impact from Ammunition

There is a risk, albeit low, that an artillery round could land directly on top of a threatened or endangered plant occurrence. During biological surveys within the natural habitat west of the impact area, numerous rounds are visible indicating reaffirming the fact that some ammunition rounds do overshoot the target or impact area. It is possible that one of these misfired rounds could directly impact a plant occurrence.

EFFECTS OF THE ACTION TO PLANT SPECIES

Abutilon sandwicense

All extant *Abutilon sandwicense* are restricted to the Waianae Mountains where between 180 and 246 individuals are found in 11 occurrences. Between 68 and 83 individuals are found as one occurrence in the SBMR action area (see Figure 10b in the Biolocial Assessment). These individuals represent between 28 and 46 percent of the total known individuals of *A. sandwicense* (K. Kawelo, U.S. Army, pers. comm. 2003; J. Lau, HINHP, pers. comm. 2003).

While within the action area, these individuals, found from West Makaleha to Palikea, occur outside of the impact zone. There are no Army actions proposed for the areas where *A. sandwicense* is found within SBMR, as mounted and dismounted maneuvers are restricted by the presence of unexploded ordnance. While most of the high explosive rounds fired during live-fire training at SBMR land within the designated impact area, numerous rounds can be found on the ground above the fire break road which forms the boundary of the impact area. This demonstrates that some rounds either ricochet out of the impact area or exceed their expected range. Fire can also carry from the impact area out of the fire break road into habitat of listed species. Live-fire ammunition includes tracers and various types of high explosive rounds, both of which are highly incendiary. Live-fire training exercises currently occur within the impact area an average of 220 days per year, utilizing over 29,000 rounds of high explosive ammunition. Transformation will result in the reduction in 5.56 mm ball and tracer munition use and increases in other small arms ball and munition use. There will be an increase in the use of grenades and mortar ammunition, which are more likely to land outside of the current fire break road and have been responsible for starting previous fires. Of note is the addition of the mobile gun Stryker-mounted system that shoots 155 mm munition, which behave similarly to mortar rounds. Mortar rounds are currently limited to a charge of three to ensure that they do not land above the upper elevation boundary of SBMR, but this charge does not limit the ability of the round to land outside of the fire break road (U.S. Army 2003a).

One effect to this species in SBMR from ongoing and SBCT training activities is the continued risk of fire, particularly due to use of live-fire ammunition. A fire can start either from a round igniting vegetation within the impact area and the fire jumping the fire break road or from a round that lands outside the impact area and starts a fire outside of the fire break road. Therefore, additional use of these weapons systems under SBCT will increase the risk of fire in the areas where this species occurs. There is also the potential for ignition caused by catalytic converters and construction equipment. *Abutilon sandwicense* occurs in areas of mesic forest with a low risk of fire ignition, at least 1,100 m (3,575 ft) up slope of the fire break road (U.S. Army 2003a). Minimization measures for fire from all ignition sources are outlined in the project description, including implementation of the WFMP. The WFMP includes the following actions for SBMR that will reduce the risk of fire at this installation: implementation of a Fire Danger Rating System that will restrict training according to weather and fuel conditions and will be monitored hourly by range control; construction of a 1,136 cubic meter (300,000 gallon) dip pond in fiscal year 2004; relocating targets that are close to the fire break road further into the impact area to reduce the likelihood of overshot rounds landing outside the fire break; improvement of the fire break road around the McCarthy Flats ranges to the same standards as the existing fire break roads; and managing the fuels on the ridge leading to Puu Pane (U.S. Army 2003b). Additional restrictions, such as prohibiting smoking on site, are identified in the Standard Operating Procedures and the Biological Assessment for SBMR (U.S. Army 2003a). However, the latest fires at SBMR (July and August 2003) indicate that full control of fire is not possible, even with all of these precautions and restrictions in place, and therefore the Service believes the risk to all species is higher than the Army indicates in the Biological Assessment. With these

measures in place the threat from fire to these individuals will be minimized; however, the potential for a wildland fire can never be completely eliminated.

There is a low threat from a round unintentionally landing outside of the impact area and exploding on or near the population of *Abutilon sandwicense* in SBMR under Legacy training. However, there will be an increase in the use of grenades and mortar ammunition, which are more likely to land outside of the current fire break road, and therefore more likely to impact this species (U.S. Army 2003a).

Not only is there the potential for the direct loss of *Abutilon sandwicense* due to fire, but a fire may open up the habitat allowing for the invasion of non-native plant species. The ongoing threat from increased non-native plant invasion is always prevalent within, and adjacent to, high disturbance areas such as military training facilities. There are several additional potential sources of non-native plant introduction in SBMR. Invasive plants could be spread within the installation during dismounted and mounted maneuvers by troops and equipment, range construction and maintenance, and especially after a fire. Some non-native invasive plants can also spread into undisturbed areas once they have become established in a disturbed area. Invasive plant encroachment will also be a possibility after a major disturbance event such as a fire and this threat would have a significant effect should a fire occur in the vicinity of these plants. The non-native plant threat from Army training and SBCT Transformation is low for *A. sandwicense* because the individuals are found outside of the surface danger area where ammunition may land and cause a fire. To further minimize this threat the Army will prevent secondary non-native plant spread from fire by monitoring and eradicating newly dispersed non-native plants; implementing all minimization actions described in the project description for this threat; and supporting development of detailed methods for the monitoring and eradication of non-native invasive plants by the Oahu Implementation Team. In addition, if a fire does occur and native habitat is lost, the Army will work with the Service regarding restoration of the damaged area to prevent the spread of additional invasive plant species (U.S. Army 2003a).

Feral ungulates are found throughout all of the installations and are a continued additional pressure for *Abutilon sandwicense*. Pigs are particularly destructive as they trample, root and eat native vegetation and can introduce invasive species through fecal matter. These rooting sites are another avenue for establishment of invasive plants. In the past in SBMR, the Army allowed private hunting parties to enter these areas for the purpose of controlling feral pigs. Due to unexploded ordinance liability issues, the Army has since curtailed public hunting in SBMR, which has resulted in a drastic increase in pig numbers. Currently, pig control is the sole responsibility of the Army Natural Resource staff. The lack of hunting, and hence proliferation of pigs, presents a direct and constant threat to all *A. sandwicense* occurrences within the action area. Additional measures will be considered by the Oahu implementation team, including fencing in appropriate locations in and out of the action area (U.S. Army 2003a).

In addition to all of the minimization actions described in the effects section, an Implementation Plan will be developed and implemented for the Oahu action areas, which will include a stabilization plan for *Abutilon sandwicense*. The stabilization plan will include those actions listed in the Conservation Needs in the Action Areas section, along with any additional measures identified by the Oahu Implementation Team. While this species did not require stabilization for the MMR biological opinion, since less than one percent occurs within the MMR action area, the stabilization plan for the Oahu biological opinion will likely include actions for the MMR occurrence.

Summary

The risk to *Abutilon sandwicense* from Legacy and Transformation training has been reduced through the restrictions the Army has made to its routine training activities and the development and implementation of its WFMP. This species is not considered stable at this time, but the stabilization actions to be developed for the Oahu IP will benefit the species so that potential impacts associated with military training activities will be minimized in the short-term and the species will be stabilized in the long-term. The Service has final approval of the Oahu IP to assure the Army's minimization and stabilization actions will stabilize the species and increase the environmental baseline of the species. Based on the actions and issues outlined in the Project Description and the Effects of the Action on the Listed Species sections above and the species stabilization actions as described in the Biological Assessment, the Service believes that the risk of the Army's proposed action is outweighed by the long-term benefits from stabilizing this species.

Alectryon macrococcus* var. *macrococcus

All current locations of *Alectryon macrococcus* var. *macrococcus* on Oahu occur in the Waianae Mountains. Of the total number of individuals known, 39 occur within SBMR (see Figure 10b in the Biological Assessment). Four plant occurrences are located above the live-fire impact training area in West Range at Palikea Gulch (2 individuals), south Mohiakea Gulch (17), north Waieli (3), and south Kaluaa (17). They represent 10 percent of the known individuals rangewide. The individuals above the impact area in West Range are between 390 and 1,000 m (1,280 to 3,281 ft) from the edge of the impact area. There are no Army actions proposed for the areas where *A. macrococcus* var. *macrococcus* is found within SBMR, as mounted and dismounted maneuvers are restricted by the presence of unexploded ordnance. While most of the high explosive rounds fired during live-fire training at SBMR land within the designated impact area, numerous rounds can be found on the ground above the fire break road which forms the boundary of the impact area. This demonstrates that some rounds either ricochet out of the impact area or exceed their expected range. Fire can also carry from the impact area out of the fire break road into habitat of listed species. Live-fire ammunition includes tracers and various types of high explosive rounds, both of which are highly incendiary. Live-fire training exercises currently occur within the impact area an average of 220 days per year, utilizing over 29,000 rounds of high explosive ammunition. Transformation will result in the reduction in 5.56 mm ball and tracer munition use and increases in other small arms ball and munition use. There will be an increase in the use of grenades and mortar ammunition, which are more likely to land outside of

the current fire break road and have been responsible for starting previous fires. Of note is the addition of the mobile gun Stryker-mounted system that shoots 155 mm munition, which behave similarly to mortar rounds. Mortar rounds are currently limited to a charge of 3 to ensure that they do not land above the upper elevation boundary of SBMR, but this charge does not limit the ability of the round to land outside of the fire break road (U.S. Army 2003a).

One effect to this species from ongoing and SBCT training activities is the continued risk of fire, particularly due to use of live-fire ammunition. A fire can start either from a round igniting vegetation within the impact area and jumping the fire break road or from a round that lands outside the impact area and ignites the vegetation. Therefore, additional use of these weapons systems under SBCT will increase the risk of fire in the areas where this species occurs. There is also the potential for ignition caused by catalytic converters and construction equipment. *Alectryon macrococcus* var. *macrococcus* individuals that are located in West Range have a minimal threat from a fire, as they occur in mesic forests that have a low fire vulnerability (U.S. Army 2003a). Minimization measures for fire from all ignition sources are outlined in the project description, including implementation of the WFMP. The WFMP includes the following actions for SBMR that will reduce the risk of fire at this installation: implementation of a Fire Danger Rating System that will restrict training according to weather and fuel conditions and will be monitored hourly by range control; construction of a 1,136 cubic meter (300,000 gallon) dip pond in fiscal year 2004; relocating targets that are close to the fire break road further into the impact area to reduce the likelihood of overshot rounds landing outside the fire break; improvement of the fire break road around the McCarthy Flats ranges to the same standards as the existing fire break roads; and managing the fuels on the ridge leading to Puu Pane (U.S. Army 2003b). Additional restrictions, such as prohibiting smoking on site, are identified in the Standard Operating Procedures and the Biological Assessment for SBMR (U.S. Army 2003a). However, the latest fires at SBMR (July and August 2003) indicate that full control of fire is not possible, even with all of these precautions and restrictions in place, and therefore the Service believes the risk to all species is higher than the Army indicates in the Biological Assessment. With these measures in place the threat from fire to these individuals will be minimized; however, the potential for a wildland fire can never be completely eliminated.

There is a low threat from a round unintentionally landing outside of the impact area and exploding on or near the population of *Alectryon macrococcus* var. *macrococcus* in SBMR under Legacy training. One individual of *A. macrococcus* var. *macrococcus* is located within 400 m (1,300 ft) of the fire impact area boundary. This tree grows in an area that has been classified as having a low threat from indirect fire munitions. However, there will be an increase in the use of grenades and mortar ammunition, which are more likely to land outside of the current fire break road, and therefore more likely to impact this species (U.S. Army 2003a).

Not only is there the potential for the direct loss of *Alectryon macrococcus* var. *macrococcus* due to fire, but a fire may open up the habitat allowing for the invasion of non-native plant species. The ongoing threat from increased non-native plant invasion is always prevalent within, and

adjacent to, high disturbance areas such as military training facilities. There are several additional potential sources of non-native plant introductions in SBMR. Invasive plants could be spread within the installation by mounted maneuvers, range construction and maintenance, and especially after a fire. Some non-native invasive plants can also spread into undisturbed areas once they have become established in a disturbed area. Invasive plant encroachment will also be a possibility after a major disturbance event such as a fire and this threat would have a significant effect should a fire occur in the vicinity of these plants. The non-native plant threat from Army training and SBCT Transformation is moderate for *A. macrococcus* var. *macrococcus* found in lowland mesic forests and high for those in alien dominated forests at lower elevations. To minimize this threat the Army will prevent secondary non-native plant spread from fire by monitoring and eradicating newly dispersed non-native plants; implementing all minimization actions described in the project description for this threat; and supporting the development by the Oahu Implementation team of detailed methods for monitoring and eradicating non-native invasive plants. In addition, if a fire does occur and native habitat is lost, the Army will work with the Service regarding restoration of the damaged area to prevent the spread of additional invasive plant species (U.S. Army 2003a).

Feral ungulates are found throughout all of the installations and are a continued additional pressure on *Alectryon macrococcus* var. *macrococcus*. Pigs are particularly destructive as they trample, root and eat native vegetation and can introduce invasive species through fecal matter. These rooting sites are another avenue for establishment of invasive plants. In the past in SBMR, the Army allowed private hunting parties to enter these areas for the purpose of controlling feral pigs. Due to unexploded ordinance liability issues, the Army has since curtailed public hunting in SBMR, which has resulted in a drastic increase in pig numbers. Currently, pig control is the sole responsibility of the Army Natural Resource staff. The lack of hunting, and hence proliferation of pigs, presents a direct and constant threat to all *A. macrococcus* var. *macrococcus* occurrences within the action area. The actions listed in the Makua IP minimize the effects of this by stabilizing the species and its surrounding habitat, and will include fencing in appropriate locations both inside and outside of the impact area. Additional measures will be considered by the Oahu Implementation Team (U.S. Army 2003a).

Military installations with much human activity and food sources may inadvertently provide a source for increased rat populations in the action areas. This in turn adds another pressure to populations with very limited numbers of individuals. With only senescent, poorly reproducing individuals remaining in the wild, every individual is important for the genetic diversity and health of this species. Bait stations will be part of the stabilization efforts if monitoring indicates this measure is necessary to protect *Alectryon macrococcus* var. *macrococcus* from rats. Additional measures will be considered by the Oahu Implementation Team (U.S. Army 2003a).

Alectryon macrococcus var. *macrococcus* is also threatened by the black twig borer. The black twig borer has been cited as an immediate threat to numerous tree species in Hawaii. The black twig borer burrows into the branches and introduces a pathogenic fungus, pruning the host

severely and often killing branches or whole plants. The black twig borer can cause slight to severe defoliation and leads to reduced vigor. There is currently no known control for this non-native insect but tests on biological controls are ongoing.

In addition to all of the minimization actions described here, an Implementation Plan has been developed for Makua which includes a stabilization plan for *Alectryon macrococcus* var. *macrococcus*. This stabilization plan includes those actions as outlined in the Conservation Needs in the Action Areas section of this opinion and in the Biological Assessment. The Oahu Implementation Team shall reassess the current status of the stabilization actions for *A. macrococcus* var. *macrococcus* to assure that conservation needs of this species are being met pursuant to the Makua IP and prior to the completion of the Oahu IP. No additional population units are expected to be identified for management based on the occurrences within the Oahu action areas, as all four occurrences were identified only for collection of propagation material in the Makua IP.

Summary

The risk to *Alectryon macrococcus* var. *macrococcus* from Legacy and Transformation training has been reduced through the restrictions the Army has made to its routine training activities and the development and implementation of its WFMP. This species is not considered stable at this time, but the high priority stabilization actions the Army is currently implementing (see the Ongoing Conservation Actions section and the Ongoing Conservation Actions within the Action Area section) and the stabilization actions developed for the Makua IP will benefit the species so that potential impacts associated with military training activities will be minimized and the species will be stabilized in the long-term. Because *A. macrococcus* var. *macrococcus* occurs in both the MMR and Oahu action areas, the Oahu Implementation Team shall review the ongoing stabilization measures that have been implemented for this species and determine any urgent actions that may be necessary so that conservation needs of this species are not undermined prior to the completion of the Oahu IP. The Service had final approval of the Makua IP and will have final approval of the Oahu IP to assure the Army's minimization and stabilization actions will stabilize the species and increase the environmental baseline of the species. Based on the actions and issues outlined in the Project Description and the Effects of the Action on the Listed Species sections above, and the species stabilization actions as described in the Biological Assessment and the Makua IP, the Service believes that the Army's proposed action is outweighed by the long-term benefits from stabilizing this species.

Alsinidendron trinerve

Approximately 83 percent of all individuals of *Alsinidendron trinerve* occur within the SBMR action area (see Figure 10b in the Biological Assessment). One occurrence is scattered around the summit of Mount Kaala and all individuals are found approximately 1,900 m (6,234 ft) from the impact area. Fifteen to 17 of these individuals occur outside of the action area. The other occurrence is located along the ridgelines approximately 1,100 m (3,609 ft) from the live-fire impact training area in West Range (J. Lau, HINHP, pers. comm. 2003; K. Kawelo, U.S. Army,

pers. comm. 2003). There are no Army actions proposed for the areas where *A. trinerve* is found within SBMR, as mounted and dismounted maneuvers are restricted by the presence of unexploded ordnance. While most of the high explosive rounds fired during live-fire training at SBMR land within the designated impact area, numerous rounds can be found on the ground above the fire break road which forms the boundary of the impact area. This demonstrates that some rounds either ricochet out of the impact area or exceed their expected range. Fire can also carry from the impact area out of the fire break road into habitat of listed species. Live-fire ammunition includes tracers and various types of high explosive rounds, both of which are highly incendiary. Live-fire training exercises currently occur within the impact area an average of 220 days per year, utilizing over 29,000 rounds of high explosive ammunition. Transformation will result in the reduction in 5.56 mm ball and tracer munition use and increases in other small arms ball and munition use. There will be an increase in the use of grenades and mortar ammunition, which are more likely to land outside of the current fire break road and have been responsible for starting previous fires. Of note is the addition of the mobile gun Stryker-mounted system that shoots 155 mm munition, which behave similarly to mortar rounds. Mortar rounds are currently limited to a charge of three to ensure that they do not land above the upper elevation boundary of SBMR, but this charge does not limit the ability of the round to land outside of the fire break road.

The primary effect to this species in SBMR from ongoing and SBCT training activities is the continued risk of fire, particularly due to use of live-fire ammunition. A fire can start either from a round igniting vegetation within the impact area and jumping the fire break road or from a round that lands outside the impact area and ignites the vegetation. Therefore, additional use of these weapons systems under SBCT will increase the risk of fire in the areas where this species occurs. There is also the potential for ignition caused by catalytic converters and construction equipment. The *Alsinidendron trinerve* individuals at Mount Kaala are at a very low risk of fire while those at Puu Kalena are at a low risk. Although both are found in wet forest, the Puu Kalena occurrence is closer to the impact area (U.S. Army 2003a). Minimization measures for fire from all ignition sources are outlined in the project description, including implementation of the WFMP. The WFMP includes the following actions for SBMR that will reduce the risk of fire at this installation: implementation of a Fire Danger Rating System that will restrict training according to weather and fuel conditions and will be monitored hourly by range control; construction of a 1,136 cubic meter (300,000 gallon) dip pond in fiscal year 2004; relocating targets that are close to the fire break road further into the impact area to reduce the likelihood of overshot rounds landing outside the fire break; improvement of the fire break road around the McCarthy Flats ranges to the same standards as the existing fire break roads; and managing the fuels on the ridge leading to Puu Pane (U.S. Army 2003b). Additional restrictions, such as prohibiting smoking on site, are identified in the Standard Operating Procedures and the Biological Assessment for SBMR (U.S. Army 2003a). However, the latest fires at SBMR (July and August 2003) indicate that full control of fire is not possible, even with all of these precautions and restrictions in place, and therefore the Service believes the risk to all species is higher than the Army indicates in the

Biological Assessment. With these measures in place the threat from fire to these individuals will be minimized; however, the potential for a wildland fire can never be completely eliminated.

There is a low threat from a round unintentionally landing outside of the impact area and exploding on or near the population of *Alsinidendron trinerve* in SBMR under Legacy training, since all of the individuals are at the upper elevation of the action area. However, there will be an increase in the use of grenades and mortar ammunition, which are more likely to land outside of the current fire break road, and therefore more likely to impact this species (U.S. Army 2003a).

Not only is there the potential for the direct loss of *Alsinidendron trinerve* due to fire, but a fire could open up the habitat allowing for the invasion of non-native plant species. The ongoing threat from increased non-native plant invasion is always prevalent within, and adjacent to, high disturbance areas such as military training facilities. There are several potential sources of non-native plant introduction in SBMR. Invasive plants could be spread within the installation by mounted maneuvers, range construction and maintenance, and especially after a fire. Some non-native invasive plants can also spread into undisturbed areas once they have become established in a disturbed area. Invasive plant encroachment will also be a possibility after a major disturbance event such as a fire and this threat would have a significant effect should a fire occur in the vicinity of these plants. The non-native plant threat from Army training and SBCT Transformation is low for *A. trinerve* found in wet forest environments at higher elevations. To minimize this threat the Army will prevent secondary non-native plant spread from fire by monitoring and eradicating newly dispersed non-native plants; implementing all minimization actions described in the project description for this threat; and supporting development of detailed methods for the monitoring and eradication of non-native invasive plants by the Oahu Implementation Team. In addition, if a fire does occur and native habitat is lost, the Army will work with the Service regarding restoration of the damaged area to prevent the spread of additional invasive plant species (U.S. Army 2003a).

Feral ungulates are found throughout all of the installations and are a continued additional pressure on *Alsinidendron trinerve*. Pigs are particularly destructive as they trample, root and eat native vegetation and can introduce invasive species through fecal matter. These rooting sites are another avenue for establishment of invasive plants. In the past in SBMR, the Army allowed private hunting parties to enter these areas for the purpose of controlling feral pigs. Due to unexploded ordinance liability issues, the Army has since curtailed public hunting in SBMR, which has resulted in a drastic increase in pig numbers. Currently, pig control is the sole responsibility of the Army Natural Resource staff. The lack of hunting, and hence proliferation of pigs, presents a direct and constant threat to all *A. trinerve* occurrences within the action area. Additional measures will be considered by the Oahu Implementation Team, including fencing in appropriate locations within and outside the action areas (U.S. Army 2003a).

In addition to all of the minimization actions described in this effects section, an Implementation Plan will be developed and implemented for the Oahu action areas, which will include a

stabilization plan for *Alsinidendron trinerve*. The stabilization plan will include those actions listed in the Conservation Needs in the Action Areas section, along with any additional measures identified by the Oahu implementation team.

Summary

The risk to *Alsinidendron trinerve* from Legacy and Transformation training has been reduced through the restrictions the Army has made to its routine training activities and the development and implementation of its WFMP. This species is not considered stable at this time, but the stabilization actions to be developed for the Oahu IP will benefit the species so that potential impacts associated with military training activities will be minimized and the species will be stabilized in the long-term. The Service has final approval of the Oahu IP to assure the Army's minimization and stabilization actions will stabilize the species and increase the environmental baseline of the species. Based on the actions and issues outlined in the Project Description and the Effects of the Action on the Listed Species sections above and the species stabilization actions as described in the Biological Assessment, the Service believes that the risk of the Army's proposed action is outweighed by the long-term benefits from stabilizing this species.

Chamaesyce rockii

All current locations of *Chamaesyce rockii* occur along the summit of the Koolau Mountains. Six occurrences of this species, with a total of approximately 481 individuals, are found in two of the Oahu actions areas: KLOA and SBER (see Figures 7b and 9a in the Biological Assessment). These occurrences represent between 52 and 60 percent of the entire known individuals of *C. rockii*.

KLOA

Five occurrences with a total of 456 individuals (between 52 and 60 percent of the species) occur within KLOA at the following locations: Puu Kainapuaa (100 individuals), Kawaiiki and Opaeula (54), Helemano-Opaeula (300), north Kaukonahua-Kahana summit Ridge (1) and north Kaukonahua Gulch (1) (K. Kawelo, U.S. Army, pers. com. 2003; J. Lau, HINHP, pers. com. 2003, U.S. Army 2003a). All of the occurrences are located in areas characterized by the Army as low use areas. Identified actions in these areas include dismounted maneuvers, foot reconnaissance, bivouac, helicopter aviation training, and air assault. These operations take place one to two times per month for an average of two to five days at a time at company level (120 soldiers) size. These operations have the potential of lasting up to 10 days in length. The companies move through the area in squad (9 soldiers) or platoon (35 soldiers) units. Based upon data compiled for Legacy training for the years 1998-2002, it is estimated that the average number of troops that will use this area will be 17,422 over an average of 137 days per year. Mounted (vehicle) maneuvers will be restricted to existing roads, most of which are far from any existing endangered species occurrences; foot maneuvers will be focused on and around trails; bivouac activity will be limited in area due to the extreme terrain found in much of the KLOA action area; and helicopter and air assault activities will be restricted to open landing and drop

zones. Blank ammunition and ground pyrotechnics are used in this area during foot maneuvers (U.S. Army 2003a).

One of the effects to this species from ongoing and SBCT training activities is the continued risk of fire particularly due to pyrotechnic exercises, blank training exercises, cigarette smoking, cookstoves/fires at bivouac sites, and other accidental or unforseen ignition sources. However, the *Chamaesyce rockii* individuals that are located in KLOA have a minimal threat of direct impact from a fire because the plants are found in lowland wet forest and shrub habitat and occur in areas that have very low fire vulnerability rating. However, the majority of the occurrences occur along side trails that are used for training and could be directly impacted should a fire start on a trail. One fire occurred in 2000, burning 125.5 ha (310 ac), and is believed to have been started by blank ammunition or a muzzle flash. Minimization measures for fire from all ignition sources are outlined in the project description, including implementation of the WFMP. The WFMP includes the following actions for KLOA that will reduce the risk of fire at this installation: implementing a Fire Danger Rating System that will restrict training according to weather and fuel conditions and will be monitored hourly by range control; fuel load reduction as appropriate; use of the dip pond at DMR; maintaining roads to fuel break standards, and reinitiating this consultation should a fire escape the installation boundary, or starts or spreads within 521 m (1,771 ft) of a listed species (U.S. Army 2003b). However, the latest fires at SBMR (July and August 2003) indicate that full control of fire is not possible, even with all of these precautions and restrictions in place, and therefore the Service believes the risk to all species is higher than the Army indicates in the Biological Assessment. Additional restrictions, such as prohibiting smoking on site, are identified in the Standard Operating Procedures and the Biological Assessment for KLOA (U.S. Army 2003a). With these measures in place, the threat from fire to individuals of *C. rockii* will be minimized; however, the potential for a wildland fire can never be completely eliminated.

The ongoing threat from increased non-native plant invasion is always prevalent within, and adjacent to, high disturbance areas such as military training facilities. There are several potential sources of non-native plant introduction in KLOA. Invasive plants could be spread within the installation by dismounted and mounted maneuvers, range construction and maintenance, and especially after a fire. Some non-native invasive plants can also spread into undisturbed areas once they have become established in a disturbed area. Invasive plant encroachment will also be a possibility after a major disturbance event such as a fire and this threat would have a significant effect should a fire occur in the vicinity of these plants. The non-native plant threat from Army training and SBCT Transformation is low for the occurrence of *Chamaesyce rockii* that is more than 300 m (975 ft) from trails or landing zones and moderate for the 4 occurrences that are closer to trails or landing zones, because of the wet microclimate where the individuals are found. To minimize this threat the Army will prevent secondary non-native plant spread from fire by monitoring and eradicating newly dispersed non-native plants; implementing all minimization actions described in the project description for this threat; and supporting development of detailed methods for the monitoring and eradication of non-native invasive plants by the Oahu

Implementation Team. In addition, if a fire does occur and native habitat is lost, the Army will work with the Service regarding restoration of the damaged area to prevent the spread of additional invasive plant species (U.S. Army 2003a).

The threat of trampling from foot traffic is very low or non-existent for trees and shrubs, unless the plants are in the seedling stage or the trampling occurs close to the root system, causing compaction of the soil and decreasing the plant's ability to take up water and nutrients. The use of the training area is low; however, since four of the five occurrences of *C. rockii* grow within 300 m (975 ft) of a main trail or landing zone, the threat from trampling is low to high. To minimize the threat to seedlings the Army will educate each set of new soldiers on avoidance of trampling of endangered species; fence the occurrences near trails; establish long-term conservation trend analysis (ITAM) plots to monitor impact of foot traffic trampling by infantry soldiers; and establish signage to identify areas that are off limits due to the presence of federally listed species. Additional measures will be considered by the Oahu implementation team (U.S. Army 2003a).

SBER

One occurrence with a total of 25 individuals (approximately 3 percent of the species) occurs within SBER at south Kaukonahua. These individuals are located in an area characterized by the Army as low use, which includes the following: dismounted maneuvers, foot reconnaissance, bivouac, helicopter aviation training, and air assault. Within the training area, it is estimated that there will be one to two operations a month of company size moving through the area in squad (9 soldiers) or platoon (35 soldiers) units for a duration of two to five days, but for battalion-size (500 soldiers) and larger operations, the duration may be 10 to 14 days. Based upon data compiled for Legacy training for the years 1998-2002, the average number of troops using this area annually was 5,067 with the average days of use per year being 47. Foot maneuvers will be focused on and around trails, bivouac activity will be limited in area due to the extreme terrain in the SBER action area, and helicopter and air assault activities will be restricted to open landing and drop zones. Blank ammunition and ground pyrotechnics are used in this area during foot maneuvers (U.S. Army 2003a).

One of the effects to this species from ongoing and SBCT training activities is the continued risk of fire particularly due to pyrotechnic exercises, blank training exercises, cigarette smoking, cookstoves/fires at bivouac sites, and other accidental or unforseen ignition sources. However, the fire threat is very low for *Chamaesyce rockii* individuals that are located in SBER because the plants grow in lowland wet forest shrubland. The majority of the occurrences of these plants are found along side trails that are used for training and could be directly impacted should a fire start on a trail. Therefore, despite the very low vulnerability of the fuels to fire, the relatively heavy training load of SBER justifies a low vulnerability, rather than very low, to fire for this species. In the periods 1994 to 1998 and 2000 to 2002, a total of 14 fires were reported in SBER, impacting approximately 9 ha (23 ac). The most common cause was pyrotechnics of various types (U.S. Army 2003a). Minimization measures for fire from all ignition sources are outlined in the project description, including implementation of the WFMP. The WFMP includes

the following actions for SBER that will reduce the risk of fire at this installation: implementing a Fire Danger Rating System that will restrict training according to weather and fuel conditions and will be monitored hourly by range control; fuel load reduction as appropriate, use of the dip pond at DMR; maintaining roads to fuel break standards, and reinitiating this consultation should a fire escape the installation boundary, or starts or spreads within 521 m (1,771 ft) of a listed species (U.S. Army 2003b). However, the latest fires at SBMR (July and August 2003) indicate that full control of fire is not possible, even with all of these precautions and restrictions in place, and therefore the Service believes the risk to all species is higher than the Army indicates in the Biological Assessment. Additional restrictions, such as prohibiting smoking on site, are identified in the Standard Operating Procedures and the Biological Assessment for SBER. With these measures in place the threat from fire to these individuals will be minimized; however, the potential for a wildland fire can never be completely eliminated.

The ongoing threat from increased non-native plant invasion is always prevalent within and adjacent to training facilities. There are several potential sources of non-native plant introductions into SBER, as mentioned above for KLOA. The non-native plant threat from Army training and SBCT Transformation is moderate for the occurrence of *Chamaesyce rockii* in SBER, because it is found within 30 m (100 ft) of a main trail. The minimization measures for *C. rockii* in SBER are the same as described above for individuals in the KLOA action area, and will reduce the threat from non-native plants to very low.

The threat of trampling from foot traffic is moderate for the *Chamaesyce rockii* within SBER as it is found near a main trail. The minimization measures for *C. rockii* in SBER are the same as described above for individuals in KLOA action area, and will reduce the threat from trampling to low.

All Installations

Feral ungulates are found throughout all of the installations and are a continued additional pressure on *Chamaesyce rockii*. Pigs are particularly destructive as they trample, root and eat native vegetation and can introduce invasive species through fecal matter. These rooting sites are another avenue for establishment of invasive plants plant species. However, the fencing that will occur to avoid trampling from foot maneuvers will also protect the occurrences within the action area from ungulates. Additional measures will be considered by the Oahu Implementation Team (U.S. Army 2003a).

In addition to all of the minimization actions described in the effects section, an Implementation Plan will be developed and implemented for the Oahu action areas, which will include a stabilization plan for *Chamaesyce rockii*. The stabilization plan will include those actions listed in the Conservation Needs in the Action Areas section, along with any additional measures identified by the Oahu Implementation Team.

Summary

The risk to *Chamaesyce rockii* from Legacy and Transformation training has been reduced through the restrictions the Army has made to its routine training activities and the development and implementation of its WFMP. This species is not considered stable at this time, but the stabilization actions to be developed for the Oahu IP will benefit the species so that potential impacts associated with military training activities will be minimized and the species will be stabilized in the long-term. The Service has final approval of the Oahu IP to assure the Army's minimization and stabilization actions will stabilize the species and increase the environmental baseline of the species. Based on the actions and issues outlined in the Project Description and the Effects of the Action on the Listed Species sections above and the species stabilization actions as described in the Biological Assessment, the Service believes that the risk of the Army's proposed action is outweighed by the long-term benefits from stabilizing this species.

Cyanea acuminata

Currently, *Cyanea acuminata* is known from 18 occurrences in both the Koolau and Waianae Mountains. Six occurrences of this species, with 63 to 68 individuals total, are found in three of the Oahu installations: KLOA, SBER, and SBMR (see Figures 7b, 9c, and 10b, respectively, in the Biological Assessment). These occurrences represent approximately 37 percent of the entire known individuals of *C. acuminata*.

KLOA

Four known occurrences of *Cyanea acuminata* with a total of 20 to 25 individuals are found at KLOA. They represent 12 percent of the total number of known individuals. Within KLOA, the plant occurrences are scattered along the southern half of the of the Koolau summit. Individuals with the closest proximity to the summit trail are located between 11 and 22 m (36 and 72 ft) at Helemano. Other occurrences are located at greater distances from 38 to 820 m (125 to 2,690 ft) from trails. All of the occurrences are located in areas characterized by the Army as low use areas. Identified actions in these areas include dismounted maneuvers, foot reconnaissance, bivouac, helicopter aviation training, and air assault. These operations take place one to two times per month for an average of two to five days at a time at company level (120 soldiers) size. These operations have the potential of lasting up to 10 days in length. The companies move through the area in squad (9 soldier) or platoon (35 soldier) units. Based upon data compiled for Legacy training for the years 1998-2002, it is estimated that the average number of troops that will use this area will be 17,422 over an average of 137 days per year. Mounted (vehicle) maneuvers will be restricted to existing roads, most of which are far from any existing endangered species occurrences; foot maneuvers will be focused on and around trails; bivouac activity will be limited in area due to the extreme terrain found in much of the KLOA action area; and helicopter and air assault activities will be restricted to open landing and drop zones. Blank ammunition and ground pyrotechnics are used in this area during foot maneuvers (U.S. Army 2003a).

One of the effects to this species from ongoing and SBCT training activities is the continued risk of fire particularly due to pyrotechnic exercises, blank training exercises, cigarette smoking, cookstoves/fires at bivouac sites, and other accidental or unforseen ignition sources. The *Cyanea acuminata* individuals that are located in KLOA have a minimal threat of direct impact from a fire because the plants grow in lowland wet forest and shrub habitat and occur in areas that have very low fire vulnerability rating. However, the majority of the occurrences along side trails that are used for training could be impacted should a fire start on a trail. One fire occurred in 2000, burning 125.5 ha (310 ac), and is believed to have been started by blank ammunition or a muzzle flash. Minimization measures for fire from all ignition sources are outlined in the project description, including implementation of the WFMP. The WFMP includes the following actions for KLOA that will reduce the risk of fire at this installation: implementing a Fire Danger Rating System that will restrict training according to weather and fuel conditions and will be monitored hourly by range control; fuel load reduction as appropriate; use of the dip pond at DMR; maintaining roads to fuel break standards, and reinitiating this consultation should a fire escape the installation boundary, or starts or spreads within 521 m (1,771 ft) of a listed species (U.S. Army 2003b). However, the latest fires at SBMR (July and August 2003) indicate that full control of fire is not possible, even with all of these precautions and restrictions in place, and therefore the Service believes the risk to all species is higher than the Army indicates in the Biological Assessment. Additional restrictions, such as prohibiting smoking on site, are identified in the Standard Operating Procedures and the Biological Assessment for KLOA (U.S. Army 2003a). With these measures in place the threat from fire to these individuals will be minimized; however, the potential for a wildland fire can never be totally eliminated.

The ongoing threat from increased non-native plant invasion is always prevalent within, and adjacent to, high disturbance areas such as military training facilities. There are several potential sources of non-native plant introduction in KLOA. Invasive plants could be spread within the installation by dismounted and mounted maneuvers, range construction and maintenance, and especially after a fire. Some non-native invasive plants can also spread into undisturbed areas once they have become established in a disturbed area. Invasive plant encroachment will also be a possibility after a major disturbance event such as a fire and this threat would have a significant effect should a fire occur in the vicinity of these plants. The non-native plant threat from Army training and SBCT Transformation is low to moderate for *Cyanea acuminata* because of the wet microclimate where the individuals are found and the low frequency of use of the area. To minimize this threat the Army will prevent secondary non-native plant spread from fire by monitoring and eradicating newly dispersed non-native plants; implementing all minimization actions described in the project description for this threat; and supporting development of detailed methods for the monitoring and eradication of non-native invasive plants by the Oahu Implementation Team. In addition, if a fire does occur and native habitat is lost, the Army will work with the Service regarding their restoration of the damaged area to prevent the spread of additional invasive plant species (U.S. Army 2003a).

The threat of trampling from foot traffic is very low or non-existent for trees and shrubs, unless the plants are in the seedling stage or the trampling occurs close to the root system, causing compaction of the soil and decreasing the plant's ability to take up water and nutrients. As described above, some individuals of *Cyanea acuminata* are fairly close to trails, however, because of the frequency of use and the steepness of the terrain where the plants occur, the threat of trampling to the species is low. To minimize the threat to seedlings the Army will educate each set of new soldiers on avoidance of trampling of endangered species, establish long-term conservation trend analysis (ITAM) plots to monitor impact of foot traffic trampling by infantry soldiers; and establish signage to identify areas that are off limits due to the presence of federally listed species. Additional measures, such as fencing of those occurrences most in danger of trampling, will be considered by the Oahu Implementation Team (U.S. Army 2003a).

SBER

One occurrence of *Cyanea acuminata* with a total of 25 individuals (approximately 15 percent of the species) occurs within SBER. The plants are located on a ridge above south Kaukonahua Stream approximately 764 m (2,507 ft) from the Koolau summit trail. These individuals are located in an area characterized by the Army as low use, which includes the following: dismounted maneuvers, foot reconnaissance, bivouac, helicopter aviation training, and air assault. Within the training area, it is estimated that there will be one to two operations a month of company size moving through the area in squad (9 soldiers) or platoon (35 soldiers) units for a duration of two to five days, but for battalion-size (500 soldiers) and larger operations, the duration may be 10 to 14 days. Based upon data compiled for Legacy training for the years 1998-2002, the average number of troops using this area annually was 5,067 with the average days of use per year being 47. Foot maneuvers will be focused on and around trails, bivouac activity will be limited in area due to the extreme terrain in the SBER action area, and helicopter and air assault activities will be restricted to open landing and drop zones. Blank ammunition and ground pyrotechnics are used in this area during foot maneuvers (U.S. Army 2003a).

One of the effects to this species from ongoing and SBCT training activities is the continued risk of fire particularly due to pyrotechnic exercises, blank training exercises, cigarette smoking, cookstoves/fires at bivouac sites, and other accidental or unforseen ignition sources. The fire threat is very low for the *C. acuminata* individuals that are located in SBER because the plants grow in lowland wet forest shrubland. Despite the very low vulnerability of the fuels to fire, the relatively heavy training load of SBER justifies a low vulnerability to fire for this species rather than a very low rating. As previously mentioned, from 1994 to 1998 and from 2000 to 2002, a total of 14 fires were reported in SBER, impacting approximately 9 ha (23 ac). The most common cause was pyrotechnics of various types (U.S. Army 2003a). Minimization measures for fire from all ignition sources are outlined in the project description, including implementation of the WFMP. The WFMP includes the following actions for SBER that will reduce the risk of fire at this installation: implementing a Fire Danger Rating System that will restrict training according to weather and fuel conditions and will be monitored hourly by range control; fuel load reduction

as appropriate, use of the dip pond at DMR; maintaining road to fuel break standards, and reinitiating this consultation should a fire escape the installation boundary, or starts or spreads within 521 m (1,771 ft) of a listed species (U.S. Army 2003b). However, the latest fires at SBMR (July and August 2003) indicate that full control of fire is not possible, even with all of these precautions and restrictions in place, and therefore the Service believes the risk to all species is higher than the Army indicates in the Biological Assessment. Additional restrictions, such as prohibiting smoking on site, are identified in the Standard Operating Procedures and the Biological Assessment for SBER. With these measures in place the threat from fire to these individuals will be minimized; however, the potential for a wildland fire can never be totally eliminated.

The threat of trampling is very low for the *Cyanea acuminata* in SBER, as it is not found along a main trail, but is 764 m (2,507 ft) from the Koolau summit trail, in very rugged terrain. The minimization measures for *C. acuminata* in SBER are the same as described above for individuals in KLOA action area.

SBMR

One occurrence with a total of 18 individuals occurs within SBMR. The individuals are located just below Kaala summit. The occurrence is particularly important because it is the largest of only two occurrences that occur within the Waianae Mountains. There are no Army actions proposed for the areas where *Cyanea acuminata* is found within SBMR, as mounted and dismounted maneuvers are restricted by the presence of unexploded ordnance. While most of the high explosive rounds fired during live-fire training at SBMR land within the designated impact area, numerous rounds can be found on the ground above the fire break road which forms the boundary of the impact area. This demonstrates that some rounds either ricochet out of the impact area or exceed their expected range. Fire can also carry from the impact area out of the fire break road into habitat of listed species. Live-fire ammunition includes tracers and various types of high explosive rounds, both of which are highly incendiary. Live-fire training exercises currently occur within the impact area an average of 220 days per year, utilizing over 29,000 rounds of high explosive ammunition. Transformation will result in the reduction in 5.56 mm ball and tracer munition use and increases in other small arms ball and munition use. There will be an increase in the use of grenades and mortar ammunition, which are more likely to land outside of the current fire break road and have been responsible for starting previous fires. Of note is the addition of the mobile gun Stryker-mounted system that shoots 155 mm munition, which behave similarly to mortar rounds. Mortar rounds are currently limited to a charge of three to ensure that they do not land above the upper elevation boundary of SBMR, but this charge does not limit the ability of the round to land outside of the fire break road (U.S. Army 2003a).

One effect to this species in SBMR from ongoing and SBCT training activities is the continued risk of fire, particularly due to use of live-fire ammunition. A fire can start either from a round igniting vegetation within the impact area and the fire jumping the fire break road or a round that

lands outside the impact area and starts a fire outside the fire break road. Therefore, additional use of these weapons systems under SBCT will increase the risk of fire in the areas where this species occurs. There is also the potential for ignition caused by catalytic converters and construction equipment. The *Cyanea acuminata* individuals that are located in West Range have a minimal threat of direct impact from a fire because they occur approximately 2,190 m (7,185 ft) from the impact area in wet forest. However, because the largest of just two occurrences in the Waianae Mountains occur within the action area (10 percent of the total number of individuals), there would be a significant impact to the genetic diversity and range of the species should any of these individuals be lost to a fire (U.S. Army 2003a). Minimization measures for fire from all ignition sources are outlined in the project description, including implementation of the WFMP. The WFMP includes the following actions for SBMR that will reduce the risk of fire at this installation: implementation of a Fire Danger Rating System that will restrict training according to weather and fuel conditions and will be monitored hourly by range control; construction of a 1,136 cubic meter (300,000 gallon) dip pond in fiscal year 2004; relocating targets that are close to the fire break road further into the impact area to reduce the likelihood of overshot rounds landing outside the fire break; improvement of the fire break road around the McCarthy Flats ranges to the same standards as the existing fire break roads; and managing the fuels on the ridge leading to Puu Pane (U.S. Army 2003b). Additional restrictions, such as prohibiting smoking on site, are identified in the Standard Operating Procedures and the Biological Assessment for SBMR (U.S. Army 2003a). However, the latest fires at SBMR (July and August 2003) indicate that full control of fire is not possible, even with all of these precautions and restrictions in place, and therefore the Service believes the risk to all species is higher than the Army indicates in the Biological Assessment. With these measures in place the threat from fire to these individuals will be minimized; however, the potential for a wildland fire can never be totally eliminated.

There is a low threat from a round unintentionally landing outside of the impact area and exploding on or near the population of *Cyanea acuminata* in SBMR under Legacy training, since all of the individuals are at the upper elevation of the action area. However, there will be an increase in the use of grenades and mortar ammunition, which are more likely to land outside of the current fire break road, and therefore more likely to impact this species (U.S. Army 2003a).

Not only is there the potential for the direct loss of *Cyanea acuminata* due to fire, but a fire may open up the habitat allowing for the invasion of non-native plant species. The non-native plant threat from Army training and SBCT Transformation is low to moderate for the *C. acuminata* on wet cliffs and moderate for the occurrence in lowland mesic forest and shrubland vegetation. The minimization measures for *C. acuminata* in SBMR are the same as described above for individuals in KLOA action area.

All Installations

Feral ungulates are found throughout all of the installations and are a continued additional pressure for *Cyanea acuminata*. Pigs are particularly destructive as they trample, root and eat native

vegetation and can introduce invasive species through fecal matter. These rooting sites are another avenue for establishment of invasive plants. The fencing that will occur to avoid trampling from foot maneuvers will also protect the occurrences within the action area from ungulates. This species is also threatened by destruction of habitat and trampling by feral pigs and encroachment by non-native plants. In the past in SBMR, the Army allowed private hunting parties to enter these areas for the purpose of controlling feral pigs. Due to unexploded ordinance liability issues, the Army has since curtailed public hunting in SBMR, which has resulted in a drastic increase in pig numbers. Currently, pig control is the sole responsibility of the Army Natural Resource staff. The lack of hunting, and hence proliferation of pigs, presents a direct and constant threat to all *C. acuminata* occurrences within the action area. Additional measures will be considered by the Oahu Implementation Team, including fencing in appropriate locations in and out of the action areas (U.S. Army 2003a).

Military installations with much human activity and food sources may inadvertently provide a source for increased rat populations in the action area. This in turn adds another pressure to populations with very limited numbers of individuals. With only 172 to 208 plants remaining in the wild, the loss of the fruit of any of the plants within the action areas could prove devastating for the genetic diversity and health of this species. Bait stations will be part of the stabilization efforts if monitoring indicates this measure is necessary to protect *Cyanea acuminata* from rats. Slugs impact *C. acuminata* by browsing on seedlings and young vegetation. The Army will support research to control slugs to minimize impacts from this threat and implement the most efficient method for slug control (U.S. Army 2003a).

In addition to all of the minimization actions described in the effects section, an Implementation Plan will be developed and implemented for the Oahu action areas, which will include a stabilization plan for *Cyanea acuminata*. The stabilization plan will include those actions listed in the Conservation Needs in the Action Areas section, along with any additional measures identified by the Oahu Implementation Team.

Summary

The risk to *Cyanea acuminata* from Legacy and Transformation training has been reduced through the restrictions the Army has made to its routine training activities and the development and implementation of its WFMP. This species is not considered stable at this time, but the stabilization actions to be developed for the Oahu IP will benefit the species so that potential impacts associated with military training activities will be minimized in the short-term and the species will be stabilized in the long-term. The Service has final approval of the Oahu IP to assure the Army's minimization and stabilization actions will stabilize the species and increase the environmental baseline of the species. Based on the actions and issues outlined in the Project Description and the Effects of the Action on the Listed Species sections above and the species stabilization actions as described in the Biological Assessment, the Service believes that the risk of the Army's proposed action is outweighed by the long-term benefits from stabilizing this species.

Cyanea crispa

All current occurrences of *Cyanea crispa* are found along the Koolau Mountains. There is one known occurrence of five individuals at KLOA (see Figure 7b in the Biological Assessment) action area at upper Kawaiiki, which represents approximately eight percent of the current individuals. It is found along the summit of the mountain range approximately 63 m (208 ft) from the Koolau summit trail. Identified actions in these areas include dismounted maneuvers, foot reconnaissance, bivouac, helicopter aviation training, and air assault. These operations take place one to two times per month for an average of two to five days at a time at company level (120 soldiers) size. These operations have the potential of lasting up to 10 days in length. The companies move through the area in squad (9 soldiers) or platoon (35 soldiers) units. Based upon data compiled for Legacy training for the years 1998-2002, it is estimated that the average number of troops that will use this area will be 17,422 over an average of 137 days per year. Mounted (vehicle) maneuvers will be restricted to existing roads, most of which are far from any existing endangered species occurrences; foot maneuvers will be focused on and around trails; bivouac activity will be limited in area due to the extreme terrain found in much of the KLOA action area; and helicopter and air assault activities will be restricted to open landing and drop zones. Blank ammunition and ground pyrotechnics are used in this area during foot maneuvers (U.S. Army 2003a).

One of the effects to this species from ongoing and SBCT training activities is the continued risk of fire particularly due to pyrotechnic exercises, blank training exercises, cigarette smoking, cookstoves/fires at bivouac sites, and other accidental or unforseen ignition sources. The *Cyanea crispa* individuals that are located in KLOA have a minimal threat of direct impact from a fire because they are found in lowland wet forest and shrub habitat that have a very low fire vulnerability rating. One fire occurred in 2000, burning 125.5 ha (310 ac), and is believed to have been started by blank ammunition or a muzzle flash (U.S. Army 2003a). Minimization measures for fire from all ignition sources are outlined in the project description, including implementation of the WFMP. The WFMP includes the following actions for KLOA that will reduce the risk of fire at this installation: implementing a Fire Danger Rating System that will restrict training according to weather and fuel conditions and will be monitored hourly by range control; fuel load reduction as appropriate; use of the dip pond at DMR; maintaining roads to fuel break standards, and reinitiating this consultation should a fire escape the installation boundary, or starts or spreads within 521 m (1,771 ft) of a listed species (U.S. Army 2003b). However, the latest fires at SBMR (July and August 2003) indicate that full control of fire is not possible, even with all of these precautions and restrictions in place, and therefore the Service believes the risk to all species is higher than the Army indicates in the Biological Assessment. Additional restrictions, such as prohibiting smoking on site, are identified in the Standard Operating Procedures and the Biological Assessment for KLOA (U.S. Army 2003a). With these measures in place the threat from fire to these individuals will be minimized; however, the potential for a wildland fire can never be totally eliminated.

The ongoing threat from increased non-native plant invasion is always prevalent within, and adjacent to, high disturbance areas such as military training facilities. There are several potential sources of non-native plant introduction in KLOA. Invasive plants could be spread within the installation by dismounted and mounted maneuvers, helicopter maneuvers, range construction and maintenance, and especially after a fire. Some non-native invasive plants can also spread into undisturbed areas once they have become established in a disturbed area. Invasive plant encroachment will also be a possibility after a major disturbance event such as a fire and this threat would have a significant effect should a fire occur in the vicinity of these plants. The non-native plant threat from SBCT Transformation is low to moderate for *Cyanea crispa* because of the wet microclimate where the individuals are found and the low frequency of military use. To minimize this threat the Army will prevent secondary non-native plant spread from fire by monitoring and eradicating newly dispersed non-native plants; implementing all minimization actions described in the project description for this threat; and supporting development of detailed methods for the monitoring and eradication of non-native invasive plants by the Oahu Implementation Team. In addition, if a fire does occur and native habitat is lost, the Army will work with the Service regarding their restoration of the damaged area to prevent the spread of additional invasive plant species (U.S. Army 2003a).

The threat of trampling from foot traffic is very low or non-existent for trees and shrubs, unless the plants are in the seedling stage or the trampling occurs close to the root system, causing compaction of the soil and decreasing the plant's ability to take up water and nutrients. One occurrence of *Cyanea crispa* in KLOA is found approximately 63 m (208 ft) from a main trail, which makes these plants vulnerable to trampling. With only 65 plants left in the wild, any loss of seedlings at this point could have a lasting effect of the species ability to survive long-term because of the already limited genetic variability. Therefore, there is a potential for trampling impacts to effect this occurrence. The remaining plants are found in extremely steep terrain which minimizes or even eliminates the potential for foot traffic. In addition, the Army will educate each set of new soldiers on avoidance of trampling of endangered species, establish long-term conservation trend analysis (ITAM) plots to monitor impact of foot traffic trampling by infantry soldiers; and establish signage to identify areas that are off limits due to the presence of federally listed species. Additional measures will be considered by the Oahu Implementation Team (U.S. Army 2003a).

Feral ungulates are found throughout all of the installations and are a continued additional pressure for *Cyanea crispa*. Pigs are particularly destructive as they trample, root and eat native vegetation and can introduce invasive species through fecal matter. These rooting sites are another avenue for establishment of invasive plants. However, the fencing that will occur to avoid trampling from foot maneuvers will also protect the occurrences within the action area from ungulates. Additional measures will be considered by the Oahu Implementation Team (U.S. Army 2003a).

Military installations with much human activity and food sources may inadvertently provide a source for increased rat populations in the action areas. This in turn adds another pressure to

populations with very limited numbers of individuals. With only 65 plants remaining in the wild, every individual is important for the genetic diversity and health of this species. Bait stations will be part of the stabilization efforts if monitoring indicates this measure is necessary to protect *Cyanea crispa* from rats. Additional measures will be considered by the Oahu Implementation Team (U.S. Army 2003a).

In addition to all of the minimization actions described in the effects section, an Implementation Plan will be developed and implemented for the Oahu action areas, which will include a stabilization plan for *Cyanea crispa*. The stabilization plan will include those actions listed in the Conservation Needs in the Action Areas section, along with any additional measures identified by the Oahu Implementation Team.

Summary

The risk to *Cyanea crispa* from Legacy and Transformation training has been reduced through the restrictions the Army has made to its routine training activities and the development and implementation of its WFMP. This species is not considered stable at this time, but the stabilization actions to be developed for the Oahu IP will benefit the species so that potential impacts associated with military training activities will be minimized and the species will be stabilized in the long-term. The Service has final approval of the Oahu IP to assure the Army's minimization and stabilization actions will stabilize the species and increase the environmental baseline of the species. Based on the actions and issues outlined in the Project Description and the Effects of the Action on the Listed Species sections above and the species stabilization actions as described in the Biological Assessment, the Service believes that the risk of the Army's proposed action is outweighed by the long-term benefits from stabilizing this species.

Cyanea grimesiana* ssp. *obatae

Cyanea grimesiana ssp. *obatae* currently occurs along the Waianae Mountains. One individual occurs within SBMR (see Figure 10b in the Biological Assessment) which constitutes two percent of the total individuals currently known. The plant is located midway between the fire break road and Kaala summit, approximately 993 m (3,258 ft) above the live-fire impact training area in West Range (K. Kawelo, U.S. Army, pers. comm. 2003; J. Lau, HINHP, pers. comm. 2003). There are no Army actions proposed for the areas where *Cyanea grimesiana* spp. *obatae* is found within SBMR, as mounted and dismounted maneuvers are restricted by the presence of unexploded ordnance. While most of the high explosive rounds fired during live-fire training at SBMR land within the designated impact area, numerous rounds can be found on the ground above the fire break road which forms the boundary of the impact area. This demonstrates that some rounds either ricochet out of the impact area or exceed their expected range. Fire can also carry from the impact area out of the fire break road into habitat of listed species. Live-fire ammunition includes tracers and various types of high explosive rounds, both of which are highly incendiary. Live-fire training exercises currently occur within the impact area an average of 220 days per year, utilizing over 29,000 rounds of high explosive ammunition. Transformation will result in the reduction in 5.56 mm ball and tracer munition use and increases in other small arms

ball and munition use. There will be an increase in the use of grenades and mortar ammunition, which are more likely to land outside of the current fire break road and have been responsible for starting previous fires. Of note is the addition of the mobile gun Stryker-mounted system that shoots 155 mm munition, which behave similarly to mortar rounds. Mortar rounds are currently limited to a charge of three to ensure that they do not land above the upper elevation boundary of SBMR, but this charge does not limit the ability of the round to land outside of the fire break road (U.S. Army 2003a).

One effect to this species in SBMR from ongoing and SBCT training activities is the continued risk of fire, particularly due to use of live-fire ammunition. A fire can start either from a round igniting vegetation within the impact area and the fire jumping the fire break road or a round that lands outside the impact area and starts a fire outside the fire break road. Therefore, additional use of these weapons systems under SBCT will increase the risk of fire in the areas where this species occurs. There is also the potential for ignition caused by catalytic converters and construction equipment. *Cyanea grimesiana ssp. obatae* occurs in the lowland mesic forest and shrub community of the northern part of the action area where the fire threat is low. However, because of the low numbers of known individuals there would be a significant impact to the species should any of these individuals be lost to a fire (U.S. Army 2003a). Minimization measures for fire from all ignition sources are outlined in the project description, including implementation of the WFMP. The WFMP includes the following actions for SBMR that will reduce the risk of fire at this installation: implementation of a Fire Danger Rating System that will restrict training according to weather and fuel conditions and will be monitored hourly by range control; construction of a 1,136 cubic meter (300,000 gallon) dip pond in fiscal year 2004; relocating targets that are close to the fire break road further into the impact area to reduce the likelihood of overshot rounds landing outside the fire break; improvement of the fire break road around the McCarthy Flats ranges to the same standards as the existing fire break roads; and managing the fuels on the ridge leading to Puu Pane (U.S. Army 2003b). Additional restrictions, such as prohibiting smoking on site, are identified in the Standard Operating Procedures and the Biological Assessment for SBMR (U.S. Army 2003a). However, the latest fires at SBMR (July and August 2003) indicate that full control of fire is not possible, even with all of these precautions and restrictions in place, and therefore the Service believes the risk to all species is higher than the Army indicates in the Biological Assessment. With these measures in place the threat from fire to these individuals will be minimized; however, the potential for a wildland fire can never be totally eliminated.

There is a low threat from a round unintentionally landing outside of the impact area and exploding on or near the population of *Cyanea grimesiana* ssp. *obatae* in SBMR under Legacy training. One individual of *C. grimesiana ssp. obatae* is located within 400 m (1,300 ft) from the fire impact area boundary. However, there will be an increase in the use of grenades and mortar ammunition, which are more likely to land outside of the current fire break road, and therefore more likely to impact this species (U.S. Army 2003a).

Not only is there the potential for the direct loss of *Cyanea grimesiana* ssp. *obatae* due to fire, but a fire may open up the habitat allowing for the invasion of weedy plant species. The ongoing threat from increased non-native plant invasion is always prevalent within, and adjacent to, high disturbance areas such as military training facilities. There are several additional potential sources of non-native plant introduction in SBMR. Invasive plants could be spread within the installation by mounted maneuvers, range construction and maintenance, and especially after a fire. Some non-native invasive plants can also spread into undisturbed areas once they have become established in a disturbed area. Invasive plant encroachment will also be a possibility after a major disturbance event such as a fire and this threat would have a significant effect should a fire occur in the vicinity of these plants. The non-native plant threat from Army training and SBCT Transformation is moderate for the *C. grimesiana* ssp. *obatae* found in lowland mesic forests in Palikea Gulch. To minimize this threat the Army will prevent secondary non-native plant spread from fire by monitoring and eradicating newly dispersed non-native plants; implementing all minimization actions described in the project description for this threat; and supporting development of detailed methods for the monitoring and eradication of non-native invasive plants by the Oahu Implementation Team. In addition, if a fire does occur and native habitat is lost, the Army will work with the Service regarding their restoration of the damaged area to prevent the spread of additional invasive plant species (U.S. Army 2003a).

Feral ungulates are found throughout all of the installations and are a continued additional pressure for *Cyanea grimesiana* ssp. *obatae*. Pigs are particularly destructive as they trample, root and eat native vegetation and can introduce invasive species through fecal matter. These rooting sites are another avenue for establishment of invasive plants. In the past in SBMR, the Army allowed private hunting parties to enter these areas for the purpose of controlling feral pigs. Due to unexploded ordinance liability issues, the Army has since curtailed public hunting in SBMR, which has resulted in a drastic increase in pig numbers. Currently, pig control is the sole responsibility of the Army Natural Resource staff. The lack of hunting, and hence proliferation of pigs, presents a direct and constant threat to all *C. grimesiana* ssp. *obatae* occurrences within the action area. The actions listed in the Makua IP minimize the effects of this by stabilizing the species and its surrounding habitat, which will include fencing in appropriate locations both inside and outside of the impact area. Additional measures will be considered by the Oahu Implementation Team (U.S. Army 2003a).

Military installations with much human activity and food sources may inadvertently provide a source for increased rat populations in the action areas. This in turn adds another pressure to populations with very limited numbers of individuals. With only 42 individuals remaining in the wild, every individual is important for the genetic diversity and health of this species. Bait stations will be part of the stabilization efforts if monitoring indicates this measure is necessary to protect *Cyanea grimesiana* ssp. *obatae* from rats. Additional measures will be considered by the Oahu Implementation Team (U.S. Army 2003a).

Cyanea grimesiana ssp. *obatae* is also threatened by slugs. Slugs have been cited as immediate threats to numerous plant species in Hawaii. Slugs can completely denude a plant of its leaves,

often killing branches or whole plants. There is currently no known control for this non-native invertebrate, but tests on biological controls are ongoing.

In addition to all of the minimization actions described in this effects section, the Makua IP has been finalized which includes stabilization actions for *Cyanea grimesiana* ssp. *obatae*. These stabilization actions are discussed in the Conservation Needs in the Action Areas section of this opinion. The Oahu Implementation Team shall reassess the current status of the stabilization actions for *C. grimesiana* ssp. *obatae* to assure that conservation needs of this species are being met pursuant to the Makua IP and prior to the completion of the Oahu IP. They will also consider additional sites for reintroduction, since the Palikea Gulch population unit was not considered part of the action area in the Makua IP.

Summary

The risk to *Cyanea grimesiana* ssp. *obatae* from Legacy and Transformation training has been reduced through the restrictions the Army has made to its routine training activities and the development and implementation of its WFMP. This species is not considered stable at this time, but the high priority stabilization actions the Army is currently implementing (see the Ongoing Conservation Actions section and the Ongoing Conservation Actions within the Action Area section) and the stabilization actions developed for the Makua IP will benefit the species so that potential impacts associated with military training activities will be minimized in the short-term and the species will be stabilized in the long-term. Because *C. grimesiana* ssp. *obatae* occurs within both MMR and Oahu action areas, the Oahu Implementation Team shall consider this species a high priority and assess any urgent actions that should be implemented to assure the conservation needs of this species are not undermined prior to the completion of the Oahu IP. The Service had final approval of the Makua IP and will have final approval on the Oahu IP to assure the Army's minimization and stabilization actions will stabilize its environmental baseline. Based on the actions and issues outlined in the Project Description and the Effects of the Action on the Listed Species sections above and the species stabilization actions as described in the Biological Assessment and the Makua IP, the Service believes that the Army's proposed action is outweighed by the long-term benefits from stabilizing this species.

Cyanea humboldtiana

Cyanea humboldtiana currently occurs within the Koolau Mountains on Oahu. Two individuals from two occurrences occur within KLOA (see Figure 7b in the Biological Assessment), representing less than one percent of the total number of individuals currently known. Within KLOA, the plant occurrences are located along Opaeula midreach and Poamoho trail. The Opaeula midreach occurrence is 230 m (755 ft) from a trail while the Poamoho occurrence is located less than a meter (less than three ft) from the trail. Identified actions in these areas include dismounted maneuvers, foot reconnaissance, bivouac, helicopter aviation training, and air assault. These operations take place one to two times per month for an average of two to five days at a time at company level (120 soldiers) size. These operations have the potential of lasting up to 10 days in length. The companies move through the area in squad (9 soldiers) or platoon (35 soldiers) units. Based upon data compiled for Legacy training for the years 1998-2002, it is

estimated that the average number of troops that will use this area will be 17,422 over an average of 137 days per year. Mounted (vehicle) maneuvers will be restricted to existing roads, most of which are far from any existing endangered species occurrences; foot maneuvers will be focused on and around trails; bivouac activity will be limited in area due to the extreme terrain found in much of the KLOA action area; and helicopter and air assault activities will be restricted to open landing and drop zones. Blank ammunition and ground pyrotechnics are used in this area during foot maneuvers (U.S. Army 2003a).

One of the effects to this species from ongoing and SBCT training activities is the continued risk of fire particularly due to pyrotechnic exercises, blank training exercises, cigarette smoking, cookstoves/fires at bivouac sites, and other accidental or unforseen ignition sources. The *Cyanea humboldtiana* individuals that are located in KLOA have a very low threat from fire because the plants grow in lowland wet forest and shrub habitat and occur in areas of very low fire vulnerability rating. However, because *C. humboldtiana* occurs directly along a trail, the probability of a fire impacting these plants is higher than if they occurred elsewhere in this type of habitat. One fire occurred in 2000, burning 125.5 ha (310 ac), and is believed to have been started blank ammunition or a muzzle flash (U.S. Army 2003a). Minimization measures for fire from all ignition sources are outlined in the project description, including implementation of the WFMP. The WFMP includes the following actions for KLOA that will reduce the risk of fire at this installation: implementing a Fire Danger Rating System that will restrict training according to weather and fuel conditions and will be monitored hourly by range control; fuel load reduction as appropriate; use of the dip pond at DMR; maintaining roads to fuel break standards, and reinitiating this consultation should a fire escape the installation boundary, or starts or spreads within 521 m (1,771 ft) of a listed species (U.S. Army 2003b). However, the latest fires at SBMR (July and August 2003) indicate that full control of fire is not possible, even with all of these precautions and restrictions in place, and therefore the Service believes the risk to all species is higher than the Army indicates in the Biological Assessment. Additional restrictions, such as prohibiting smoking on site, are identified in the Standard Operating Procedures and the Biological Assessment for KLOA (U.S. Army 2003a). With these measures in place the threat from fire to these individuals will be minimized; however, the potential for a wildland fire can never be totally eliminated.

The ongoing threat from increased non-native plant invasion is always prevalent within, and adjacent to, high disturbance areas such as military training facilities. There are several potential sources of non-native plant introduction in KLOA. Invasive plants could be spread within the installation by dismounted and mounted maneuvers, range construction and maintenance, and especially after a fire. Some non-native invasive plants can also spread into undisturbed areas once they have become established in a disturbed area. Invasive plant encroachment will also be a possibility after a major disturbance event such as a fire and this threat would have a significant effect should a fire occur in the vicinity of these plants. The non-native plant threat from Army training and SBCT Transformation is low to moderate for *Cyanea humboldtiana* found in KLOA away from trails and moderate for the one individual of *C. humboldtiana* that grows directly along side a main trail. To minimize this threat the Army will prevent secondary non-

native plant spread from fire by monitoring and eradicating newly dispersed non-native plants; implementing all minimization actions described in the project description for this threat; and supporting development of detailed methods for the monitoring and eradication of non-native invasive plants by the Oahu Implementation Team. In addition, if a fire does occur and native habitat is lost, the Army will work with the Service regarding their restoration of the damaged area to prevent the spread of additional invasive plant species (U.S. Army 2003a).

The threat of trampling from foot traffic is very low or non-existent for trees and shrubs, unless the plants are in the seedling stage or the trampling occurs close to the root system, causing compaction of the soil and decreasing the plant's ability to take up water and nutrients. The use of the training area is low; however, the one individual of *Cyanea humboldtiana* and its seedling which grow directly along side a main trail within KLOA are vulnerable to trampling. This species has a low total number of individuals, with only 184 to 334 in existence, which makes it susceptible to extinction. To minimize the threat of trampling the Army will educate each set of new soldiers on avoidance trampling endangered species; fence the occurrences near trails; establish long-term conservation trend analysis (ITAM) plots to monitor impact of foot traffic trampling by infantry soldiers; and establish signage to identify areas that are off limits due to the presence of federally listed species. Additional measures will be considered by the Oahu Implementation Team (U.S. Army 2003a).

Feral ungulates are found throughout all of the installations and are a continued additional pressure for *Cyanea humboldtiana*. Pigs are particularly destructive as they trample, root and eat native vegetation and can introduce invasive species through fecal matter. These rooting sites are another avenue for establishment of invasive plants. However, the fencing that will occur to avoid trampling from foot maneuvers will also protect the occurrences within the action area from ungulates. Additional measures will be considered by the Oahu Implementation Team (U.S. Army 2003a).

Military installations with much human activity and food sources may inadvertently provide a source for increased rat populations in the action areas. Bait stations will be part of the stabilization efforts if monitoring indicates it's necessary to protect *Cyanea humboldtiana* from rats. Additional measures will be considered by the Oahu Implementation Team (U.S. Army 2003a).

Cyanea humboldtiana does not require stabilization because fifty percent of the known individuals do not occur in the Army action areas, and there are at least three stable population units of greater than 50 mature, reproducing individuals outside of the Army action areas. However, the Oahu IP will consider species-specific management actions such as collection for genetic storage.

Summary

The risk to *Cyanea humboldtiana* from Legacy and Transformation training has been reduced through the restrictions the Army has made to its routine training activities and the development

and implementation of its WFMP. This species is considered stable at this time and the stabilization actions developed for other species in the Makua IP will benefit the species so that potential impacts associated with military training activities will be minimized in the short-term. Based on the actions and issues outlined in the Project Description and the Effects of the Action on the Listed Species sections above and the benefit to this species from the species stabilization actions of other species within SBMR as described in the Biological Assessment and the Makua IP, the Service believes that the risk of the Army's proposed action is outweighed by the long-term benefits to this species.

Cyanea koolauensis

All current occurrences of *Cyanea koolauensis* are found along the summit of the Koolau Mountains. Nine occurrences of this species, with about 75 individuals total, are found in three of the Oahu actions areas: KTA, KLOA, and SBER (see Figures6b, 7b, and 9c, respectively, in the Biological Assessment). These occurrences represent approximately 75 percent of the entire known individuals of *C. koolauensis*.

KTA

One to two individuals from the Waimea-Malaeakahana summit Ridge are found in the D2 training area along the boundary between the KLOA and KTA (approximately one percent of the entire species). Identified actions in these areas include dismounted maneuvers, foot reconnaissance, bivouac, helicopter aviation training, and air assault. Three training operations are conducted of squad (9 soldiers) or platoon (35 soldiers) units, scouts and infantry companies, in long range surveillance detachment operations, per month in the D2 training area. Non-live-fire training exercises occur within the action area an average of 44 days per year. Data compiled for Legacy training for the years 1998-2002 does not include training frequency for D2 training area. Pyrotechnics use can occur anywhere that dismounted and mounted training occur, with the following restrictions: approval from range operations, is restricted based on the Fire Danger Rating System, and smoke grenades will only be used in areas devoid of vegetation. Blank ammunition is used throughout the action area. Transformation will include the use of live-fire low-velocity plastic bullets associated with short-range training (U.S. Army 2003a).

One effect to this species from ongoing and SBCT training activities is the continued risk of fire. At KTA, sources of ignition include use of pyrotechnics and blanks, smoking, cooking as part of bivouac activities, sparks from construction activities and equipment, low-velocity plastic bullets associated with short-range training, and heat generated by catalytic converters. While the use of plastic bullets with short-range training is considered to be live-fire, it is not considered to constitute an additional fire risk as these activities will be conducted as part of Combined Arms Collective Training Facility. The Combined Arms Collective Training Facility is located in a highly-altered environment and over 1.6 km (1 mi) from known locations of *Cyanea koolauensis*. Non-live-fire training and pyrotechnics are the most likely source of ignition, but are unlikely to be used in the heavily forested areas where *C. koolauensis* is found. The *C. koolauensis* individuals in KTA have no threat of direct impact from a fire because the plants are found in lowland wet forest or shrub habitat which has a very low fire vulnerability rating, has low

levels of military activity, and the WFMP will be implemented to minimize the risk of fire spreading from more highly fire-prone areas. Minimization measures for fire from all ignition sources are outlined in the project description, including implementation of the WFMP. The WFMP includes the following actions for KTA that will reduce the risk of fire at this installation: implementing a Fire Danger Rating System that will restrict training according to weather and fuel conditions and will be monitored hourly by range control; fuel load reduction as appropriate; construction of a dip pond in fiscal year 2004; maintaining roads to fuel break standards and construction of fire breaks; aerial and ground firefighting resources stationed on site during training; and reinitiating this consultation should a fire escape the installation boundary or start or spread within 521 m (1,771 ft) of a listed species (U.S. Army 2003b). However, the latest fires at SBMR (July and August 2003) indicate that full control of fire is not possible, even with all of these precautions and restrictions in place, and therefore the Service believes the risk to all species is higher than the Army indicates in the Biological Assessment. Additional restrictions, such as prohibiting smoking on site, are identified in the Standard Operating Procedures and the Biological Assessment for KTA (U.S. Army 2003a; G. Enriques, U.S. Army, pers. comm., 2003; K. Kawelo, U.S. Army, pers. comm., 2003). With these measures in place the threat from fire to these individuals will be minimized; however, the potential for a wildland fire can never be totally eliminated.

The ongoing threat from increased non-native plant invasion is always prevalent within, and adjacent to, high disturbance areas such as military training facilities. The non-native plant threat from Army training and SBCT Transformation is low to moderate for *Cyanea koolauensis* because of the wet microclimate where the individuals are found. To minimize this threat the Army will prevent secondary non-native plant spread from fire by monitoring and eradicating newly dispersed non-native plants; implementing all minimization actions described in the project description for this threat; and supporting development of detailed methods for the monitoring and eradication of non-native invasive plants by the Oahu Implementation Team. In addition, if a fire does occur and native habitat is lost, the Army will work with the Service regarding their restoration of the damaged area to prevent the spread of additional invasive plant species (U.S. Army 2003a).

The threat of trampling from foot traffic is very low or non-existent for trees and shrubs, unless the plants are in the seedling stage or the trampling occurs close to the root system, causing compaction of the soil and decreasing the plant's ability to take up water and nutrients. Both of the known individuals of *Cyanea koolauensis* in KTA are found along side a main trail, which make them vulnerable to trampling. Use of training area D2 is low where this occurrence of *C. koolauensis* is found. This occurrence would be especially vulnerable to damage from foot trampling and will be fenced as an urgent action. There are only about 100 plants left in the wild. Any loss of seedlings at this point could have a lasting effect of the species ability to survive long-term because of the already limited genetic variability. To minimize the threat of trampling, the Army will educate each set of new soldiers on avoidance of trampling of endangered species, establish long-term conservation trend analysis (ITAM) plots to monitor impact of foot traffic trampling by infantry soldiers, fence the *C. koolauensis* occurrence, and establish signage to

identify areas that are off limits due to the presence of federally listed species. Additional measures will be considered by the Oahu Implementation Team (U.S. Army 2003a).

KLOA

There are seven occurrences with a total of 65 individuals in KLOA (approximately 65 percent of the species). The plant occurrences are distributed primarily along the summit of the Koolau Mountains and are located at Kawainui-Kaipapau-Kawailoa (35 individuals), upper Helemano-Opaeula (7), lower Helemano-Opaeula (4), Poamoho (4), Kawaiiki-Kawainui (4), Kawailoa trail (10) and Kaukonahua (1). The distance from trails range from directly along side a main trail to 664 m (2,178 ft) away, with three occurrences (Kawainui-Kaipapau-Kawailoa, Kawaiiki-Kawainui, and lower Helemano-Opaeula) found directly on trails. Identified actions in these areas include dismounted maneuvers, foot reconnaissance, bivouac, helicopter aviation training, and air assault. These operations take place one to two times per month for an average of two to five days at a time at company level (120 soldiers) size. These operations have the potential of lasting up to 10 days in length. The companies move through the area in squad (9 soldiers) or (35 soldiers) units. Based upon data compiled for Legacy training for the years 1998-2002, it is estimated that the average number of troops that will use this area will be 17,422 over an average of 137 days per year. Mounted (vehicle) maneuvers will be restricted to existing roads, most of which are far from any existing endangered species occurrences; foot maneuvers will be focused on and around trails; bivouac activity will be limited in area due to the extreme terrain found in much of the KLOA action area; and helicopter and air assault activities will be restricted to open landing and drop zones. Blank ammunition and ground pyrotechnics are used in this area during foot maneuvers (U.S. Army 2003a).

One of the effects to this species from ongoing and SBCT training activities is the continued risk of fire particularly due to pyrotechnic exercises, blank training exercises, cigarette smoking, cookstoves/fires at bivouac sites, and other accidental or unforseen ignition sources. The Kawailoa trail occurrence of ten individuals is 382 m (1,253 ft) from an open landing zone, which is an area from which fires can normally spread. Therefore, the Service considers the risk of fire to be low for most occurrences and moderate for the Kawailoa trail occurrence near the landing zone. One fire occurred in 2000, burning 125.5 ha (310 ac), and is believed to have been started by blank ammunition or a muzzle flash (U.S. Army 2003a). Minimization measures for fire from all ignition sources are outlined in the project description, including implementation of the WFMP. The WFMP includes the following actions for KLOA that will reduce the risk of fire at this installation: implementing a Fire Danger Rating System that will restrict training according to weather and fuel conditions and will be monitored hourly by range control; fuel load reduction as appropriate; use of the dip pond at DMR; maintaining roads to fuel break standards, and reinitiating this consultation should a fire escape the installation boundary, or starts or spreads within 521 m (1,771 ft) of a listed species (U.S. Army 2003b). However, the latest fires at SBMR (July and August 2003) indicate that full control of fire is not possible, even with all of these precautions and restrictions in place, and therefore the Service believes the risk to all species is higher than the Army indicates in the Biological Assessment. Additional restrictions, such as prohibiting smoking on site, are identified in the Standard Operating Procedures and the

Biological Assessment for KLOA (U.S. Army 2003a). With these measures in place the threat from fire to these individuals will be minimized; however, the potential for a wildland fire can never be totally eliminated.

The ongoing threat from increased non-native plant invasion is always prevalent within and adjacent to training facilities. There are several potential sources of non-native plant introduction into KLOA, as mentioned above for KTA. Non-native plants could be spread within the installation indirectly by fire caused by the above discussed ignition sources, dismounted maneuvers, the construction of Drum Road, mounted maneuvers, and range construction and maintenance. The non-native plant threat from Army training and SBCT Transformation is low for the 3 occurrences more than 20 m (65 ft) from trails to moderate for the occurrences closer to trails or landing zones in the lowland wet forest and shrub vegetation where *Cyanea koolauensis* is found. The minimization measures for *C. koolauensis* in KLOA are the same as described above for individuals in KTA action area, and will reduce the threat from non-native plants to low.

The threat from trampling for the majority of the *Cyanea koolauensis* individuals is low or moderate. There are, however, at least 14 plants located around the trails, which are characterized as high probability foot traffic areas. As mentioned in KTA, any loss of seedlings at this point could have a lasting effect of the species ability to survive long-term because of the already limited genetic variability. The minimization measures for *C. koolauensis* in KLOA are the same as described above for individuals in KTA action area, and will reduce the threat from trampling to low.

SBER

One occurrence with a total of 9 individuals (approximately nine percent of the species) is found in SBER action area. The plants are located near south Kaukonahua Stream and are approximately 314 to 338 m (1,030 to 1,109) from a main trail (K. Kawelo, U.S. Army, pers. comm. 2003; J. Lau, HINHP, pers. comm. 2003). These individuals are located in an area characterized by the Army as low use, which includes the following: dismounted maneuvers, foot reconnaissance, bivouac, helicopter aviation training, and air assault. Within the training area, it is estimated that there will be one to two operations a month of company size moving through the area in squad (9 soldiers) or platoon (35 soldiers) units for a duration of two to five days, but for battalion-size (500 soldiers) and larger operations, the duration may be 10 to 14 days. Based upon data compiled for Legacy training for the years 1998-2002, the average number of troops using this area annually was 5,067 with the average days of use per year being 47. Foot maneuvers will be focused on and around trails, bivouac activity will be limited in area due to the extreme terrain in the SBER action area, and helicopter and air assault activities will be restricted to open landing and drop zones. Blank ammunition and ground pyrotechnics are used in this area during foot maneuvers (U.S. Army 2003a).

One of the effects to this species from ongoing and SBCT training activities is the continued risk of fire particularly due to pyrotechnic exercises, blank training exercises, cigarette smoking, cookstoves/fires at bivouac sites, and other accidental or unforseen ignition sources. Although the

fire threat is very low for the *Cyanea koolauensis* individuals that are located in SBER because the plants grow in lowland wet forest shrubland that is unlikely to burn, the relatively heavy training load of SBER justifies a low rather than a very low fire vulnerability rating for this species. In the periods 1994 to 1998 and 2000 to 2002, a total of 14 fires were reported in SBER, impacting approximately 9 ha (23 ac). The most common cause was pyrotechnics of various types (U.S. Army 2003a). Minimization measures for fire from all ignition sources are outlined in the project description, including implementation of the WFMP. The WFMP includes the following actions for SBER that will reduce the risk of fire at this installation: implementing a Fire Danger Rating System that will restrict training according to weather and fuel conditions and will be monitored hourly by range control; fuel load reduction as appropriate, use of the dip pond at DMR; maintaining road to fuel break standards, and reinitiating this consultation should a fire escape the installation boundary or starts or spreads within 521 m (1,771 ft) of a listed species (U.S. Army 2003b). With these measures in place the threat from fire to these individuals will be minimized; however, the potential for a wildland fire can never be totally eliminated. In addition, the Army will implement any additional minimization actions determined necessary by the Oahu Implementation Team (U.S. Army 2003a).

The ongoing threat from increased non-native plant invasion is always prevalent within and adjacent to training facilities. Because the frequency of use of the area where *Cyanea koolauensis* is found in SBER is low, the terrain is steep, and the plants are not located near trails or open landing zones, the threat of non-native plant invasion from Army training and SBCT Transformation is low to moderate. The minimization measures for *C. koolauensis* in SBER are the same as described above for individuals in KTA action area, and will reduce the threat from non-native plants to low.

The threat of trampling to the *Cyanea koolauensis* in SBER is very low, as they are located in inaccessible areas away from trails or landing zones. The minimization measures for *C. koolauensis* in SBER are the same as described above for individuals in KTA action area, and will reduce the threat from trampling.

All Installations

Feral ungulates are found throughout all of the installations and are a continued additional pressure for *Cyanea koolauensis*. However, the fencing that will occur to avoid trampling from foot maneuvers will also protect the occurrences within the action area from ungulates. Additional measures will be considered by the Oahu Implementation Team (U.S. Army 2003a).

Military installations with much human activity and food sources may inadvertently provide a source for increased rat populations in the action areas. This in turn adds another pressure to populations with very limited numbers of individuals. With only 101 to 104 plants remaining in the wild, every individual is important for the genetic diversity and health of this species. Bait stations will be part of the stabilization efforts if monitoring indicates this measure is necessary to protect *Cyanea koolauensis* from rats. Additional measures will be considered by the Oahu Implementation Team (U.S. Army 2003a).

In addition to all of the minimization actions described in the effects section, an Implementation Plan will be developed and implemented for the Oahu action areas, which will include a stabilization plan for *Cyanea koolauensis*. The stabilization plan will include those actions listed in the Conservation Needs in the Action Areas section, along with any additional measures identified by the Oahu Implementation Team. The Army has agreed to implement the following actions immediately to avoid loss of any additional plants: fence the *C. koolauensis* occurrence along the trails.

Summary

The risk to *Cyanea koolauensis* from Legacy and Transformation training has been reduced through the restrictions the Army has made to its routine training activities and the development and implementation of its WFMP. This species is not considered stable at this time, but the stabilization actions to be developed for the Oahu IP will benefit the species so that potential impacts associated with military training activities will be minimized in the short-term and the species will be stabilized in the long-term. The Service has final approval of the Oahu IP to assure the Army's minimization and stabilization actions will stabilize the species and increase the environmental baseline of the species. Based on the actions and issues outlined in the Project Description and the Effects of the Action on the Listed Species sections above and the species stabilization actions as described in the Biological Assessment, the Service believes that the risk of the Army's proposed action is outweighed by the long-term benefits from stabilizing this species.

Cyanea st.-johnii

All current locations of *Cyanea st.-johnii* occur along the Koolau Mountains on Oahu. There are two occurrences with a total of four individuals in the KLOA (see Figure 7b in the Biological Assessment), representing approximately six percent of the species. The plant occurrences are located near the headwaters of the Helamano Stream (three individuals) and at Poamoho-Punaluu summit ridge (one individual). The individuals at Helemano are approximately 280 m (919 ft) from a main trail, while the individuals at Poamoho-Punaluu summit ridge are located approximately 23 m (75 ft) from the Koolau summit trail. Identified actions in these areas include dismounted maneuvers, foot reconnaissance, bivouac, helicopter aviation training, and air assault. These operations take place one to two times per month for an average of two to five days at a time at company level (120 soldiers) size. These operations have the potential of lasting up to 10 days in length. The companies move through the area in squad (9 soldier) or platoon (35 soldier) units. Based upon data compiled for Legacy training for the years 1998-2002, it is estimated that the average number of troops that will use this area will be 17,422 over an average of 137 days per year. Mounted (vehicle) maneuvers will be restricted to existing roads, most of which are far from any existing endangered species occurrences; foot maneuvers will be focused on and around trails; bivouac activity will be limited in area due to the extreme terrain found in much of the KLOA action area; and helicopter and air assault activities will be restricted to open landing and drop zones. Blank ammunition and ground pyrotechnics are used in this area during foot maneuvers (U.S. Army 2003a).

One of the effects to this species from ongoing and SBCT training activities is the continued risk of fire particularly due to pyrotechnic exercises, blank training exercises, cigarette smoking, cookstoves/fires at bivouac sites, and other accidental or unforseen ignition sources. The *Cyanea st.-johnii* individuals that are located in KLOA have very low threat from fire because the plants are found in lowland wet forest and shrub habitat (U.S. Army 2003a). Measures to minimize measures for fire from all ignition sources are outlined in the project description, including implementation of the WFMP. The WFMP includes the following actions for KLOA that will reduce the risk of fire at this installation: implementing a Fire Danger Rating System that will restrict training according to weather and fuel conditions and will be monitored hourly by range control; fuel load reduction as appropriate; use of the dip pond at DMR; maintaining roads to fuel break standards, and reinitiating this consultation should a fire escape the installation boundary or starts or spreads within 521 m (1,771 ft) of a listed species (U.S. Army 2003b). Additional restrictions, such as prohibiting smoking on site, are identified in the Standard Operating Procedures and the Biological Assessment for KLOA (U.S. Army 2003a). With these measures in place the threat from fire to these individuals will be minimized; however, the potential for a wildland fire can never be totally eliminated.

The ongoing threat from increased non-native plant invasion is always prevalent within, and adjacent to, high disturbance areas such as military training facilities. There are several potential sources of non-native plant introduction in KLOA. Invasive plants could be spread within the installation by dismounted and mounted maneuvers, helicopter maneuvers, range construction and maintenance, and especially after a fire. Some non-native invasive plants can also spread into undisturbed areas once they have become established in a disturbed area. Invasive plant encroachment will also be a possibility after a major disturbance event such as a fire and this threat would have a significant effect should a fire occur in the vicinity of these plants. The non-native plant threat from Army training and SBCT Transformation is low for *Cyanea st.-johnii* because of the wet microclimate where the individuals are found and the low frequency of military use. To minimize this threat the Army will prevent secondary non-native plant spread from fire by monitoring and eradicating newly dispersed non-native plants, implementing all minimization actions described in the project description for this threat, and supporting development of detailed methods for the monitoring and eradication of non-native invasive plants by the Oahu Implementation Team. In addition, if a fire does occur and native habitat is lost, the Army will work with the Service regarding their restoration of the damaged area to prevent the spread of additional invasive plant species (U.S. Army 2003a).

The threat of trampling from foot traffic is very low or non-existent for trees and shrubs, unless the plants are in the seedling stage or the trampling occurs close to the root system, causing compaction of the soil and decreasing the plant's ability to take up water and nutrients. The threat to known occurrences of *Cyanea st.-johnii* in KLOA is low, even though these occurrences are not far from trails, due to the extremely steep terrain. To further minimize the threat of trampling, the Army will educate each set of new soldiers on avoidance of trampling of endangered species, establish long-term conservation trend analysis (ITAM) plots to monitor impact of foot traffic trampling by infantry soldiers; and establish signage to identify areas that are off limits due to the

presence of federally listed species. Additional measures will be considered by the Oahu Implementation Team (U.S. Army 2003a).

Feral ungulates are found throughout all of the installations and are a continued additional pressure for *Cyanea st.-johnii*. Pigs are particularly destructive as they trample, root and eat native vegetation and can introduce invasive species through fecal matter. These rooting sites are another avenue for establishment of invasive plants. However, the fencing that will occur to avoid trampling from foot maneuvers will also protect the occurrences within the action area from ungulates. Additional measures will be considered by the Oahu Implementation Team (U.S. Army 2003a).

Military installations with much human activity and food sources may inadvertently provide a source for increased rat populations in the action areas. This in turn adds another pressure to populations with very limited numbers of individuals. With only 58 to 63 plants remaining in the wild, every individual is important for the genetic diversity and health of this species. Bait stations will be part of the stabilization efforts if monitoring indicates this measure is necessary to protect *Cyanea st.-johnii* from rats. Additional measures will be considered by the Oahu Implementation Team (U.S. Army 2003a).

In addition to all of the minimization actions described in the effects section, an Implementation Plan will be developed and implemented for the Oahu biological opinion, which will include a stabilization plan for *Cyanea st.-johnii*. The stabilization plan will include those actions listed in the Conservation Needs in the Action Areas section, along with any additional measures identified by the Oahu Implementation Team. The Army has agreed to fence the *C. st.-johnii* occurrence along the trail in KTA to immediately to avoid loss of any additional plants.

Summary

The risk to *Cyanea st.-johnii* from Legacy and Transformation training has been reduced through the restrictions the Army has made to its routine training activities and the development and implementation of its WFMP. This species is not considered stable at this time, but the stabilization actions to be developed for the Oahu IP will benefit the species so that potential impacts associated with military training activities will be minimized in the short-term and the species will be stabilized in the long-term. The Service has final approval of the Oahu IP to assure the Army's minimization and stabilization actions will stabilize the species and increase the environmental baseline of the species. Based on the actions and issues outlined in the Project Description and the Effects of the Action on the Listed Species sections above and the species stabilization actions as described in the Biological Assessment, the Service believes that the risk of the Army's proposed action is outweighed by the long-term benefits from stabilizing this species.

Cyrtandra dentata

Cyrtandra dentata occurs in both the Waianae and Koolau Mountains on Oahu. There are two occurrences with a total of 76 individuals in the KLOA action area (see Figure 7b in the Biological Assessment) which constitute approximately 16 percent of the species. The plant

occurrences are located in Kawaiiki Gulch (26 individuals) and along Opaeula Stream (50). Individuals are approximately 500 m (1,640 ft) from a trail at Kawaiiki Gulch and 208 m (682 ft) from a trail at Opaeula Stream (K. Kawelo, pers. comm. 2003; J. Lau, HINHP, pers. comm. 2003). Identified actions in these areas include dismounted maneuvers, foot reconnaissance, bivouac, helicopter aviation training, and air assault. These operations take place one to two times per month for an average of two to five days at a time at company level (120 soldiers) size. These operations have the potential of lasting up to 10 days in length. The companies move through the area in squad (9 soldiers) or platoon (35 soldiers) units. Based upon data compiled for Legacy training for the years 1998-2002, it is estimated that the average number of troops that will use this area will be 17,422 over an average of 137 days per year. Mounted (vehicle) maneuvers will be restricted to existing roads, most of which are far from any existing endangered species occurrences; foot maneuvers will be focused on and around trails; bivouac activity will be limited in area due to the extreme terrain found in much of the KLOA action area; and helicopter and air assault activities will be restricted to open landing and drop zones. Blank ammunition and ground pyrotechnics are used in this area during foot maneuvers (U.S. Army 2003a).

One of the effects to this species from ongoing and SBCT training activities is the continued risk of fire particularly due to pyrotechnic exercises, blank training exercises, cigarette smoking, cookstoves/fires at bivouac sites, and other accidental or unforseen ignition sources. The *Cyrtandra dentata* individuals that are located in KLOA have a very low threat from fire because the plants are found in lowland wet forest and shrub habitat that is unlikely to burn. One fire occurred in 2000, burning 125.5 ha (310 ac), was believed to have been started by blank ammunition or a muzzle flash (U.S. Army 2003a). Minimization measures for fire from all ignition sources are outlined in the project description, including implementation of the WFMP. The WFMP includes the following actions for KLOA that will reduce the risk of fire at this installation: implementing a Fire Danger Rating System that will restrict training according to weather and fuel conditions, monitored hourly by range control; fuel load reduction as appropriate; use of the dip pond at DMR; maintaining roads to fuel break standards, and reinitiating this consultation should a fire escape the installation boundary or starts or spreads within 521 m (1,771 ft) of a listed species (U.S. Army 2003b). However, the latest fires at SBMR (July and August 2003) indicate that full control of fire is not possible, even with all of these precautions and restrictions in place, and therefore the Service believes the risk to all species is higher than the Army indicates in the Biological Assessment. Additional restrictions, such as prohibiting smoking on site, are identified in the Standard Operating Procedures and the Biological Assessment for KLOA (U.S. Army 2003a). With these measures in place the threat from fire to these individuals will be minimized; however, the potential for a wildland fire can never be totally eliminated.

The ongoing threat from increased non-native plant invasion is always prevalent within, and adjacent to, high disturbance areas such as military training facilities. There are several potential sources of non-native plant introduction in KLOA. Invasive plants could be spread within the installation by dismounted and mounted maneuvers, helicopter maneuvers, range construction and maintenance, and especially after a fire. Some non-native invasive plants can also spread into undisturbed areas once they have become established in a disturbed area. Invasive plant

encroachment will also be a possibility after a major disturbance event such as a fire and this threat would have a significant effect should a fire occur in the vicinity of these plants. The non-native plant threat from Army training and SBCT Transformation is low to moderate for one occurrence of *Cyrtandra dentata* because of the wet microclimate where the individuals are found and the low frequency of use for military training. The other occurrence is about 448m (1,456 ft) away from a drop zone, and is therefore at a moderate risk from non-native plant introduction. To minimize this threat the Army will prevent secondary non-native plant spread from fire by monitoring and eradicating newly dispersed non-native plants; implementing all minimization actions described in the project description for this threat; and supporting development of detailed methods for the monitoring and eradication of non-native invasive plants by the Oahu Implementation Team. In addition, if a fire does occur and native habitat is lost, the Army will work with the Service regarding their restoration of the damaged area to prevent the spread of additional invasive plant species (U.S. Army 2003a).

The threat of trampling from foot traffic is very low or non-existent for trees and shrubs, unless the plants are in the seedling stage or the trampling occurs close to the root system, causing compaction of the soil and decreasing the plant's ability to take up water and nutrients. Both of the known occurrences of *Cyrtandra dentata* in KLOA are far from any trails, and are therefore at a low risk of trampling. To minimize the threat of trampling, the Army will educate each set of new soldiers on avoidance of trampling of endangered species, establish long-term conservation trend analysis (ITAM) plots to monitor impact of foot traffic trampling by infantry soldiers; and establish signage to identify areas that are off limits due to the presence of federally listed species. Additional measures will be considered by the Oahu Implementation Team (U.S. Army 2003a).

Feral ungulates are found throughout all of the installations and are a continued additional pressure for *Cyrtandra dentata*. Pigs are particularly destructive as they trample, root and eat native vegetation and can introduce invasive species through fecal matter. These rooting sites are another avenue for establishment of invasive plants. The actions listed in the Makua IP minimize the effects of this by stabilizing the species and its surrounding habitat, which will include fencing in appropriate locations both inside and outside of the installation boundaries. Additional measures will be considered by the Oahu Implementation Team (U.S. Army 2003a).

Military installations with much human activity and food sources may inadvertently provide a source for increased rat populations in the action areas. This in turn adds another pressure to populations with very limited numbers of individuals. Bait stations are part of the stabilization efforts if monitoring indicates this measure is necessary to protect *Cyrtandra dentata* from rats. Additional measures will be considered by the Oahu Implementation Team (U.S. Army 2003a).

In addition to all of the minimization actions described in the effects section, the Makua IP includes a stabilization plan for *Cyrtandra dentata*. The stabilization plan includes those actions listed in the Conservation Needs in the Action Areas section of this opinion and the Biological Assessment. The Oahu Implementation Team will review the stabilization plan to reassess the population credits of the KLOA occurrences and to determine what additional management

actions are necessary as a result of 100 percent of the species occurring within action areas. In addition, the Oahu Implementation Team shall reassess the current status of the stabilization actions for *C. dentata* to assure that conservation needs of this species are being met pursuant to the Makua IP and prior to the completion of the Oahu IP.

Summary

The risk to *Cyrtandra dentata* from Legacy and Transformation training has been reduced through the restrictions the Army has made to its routine training activities and the development and implementation of its WFMP. This species is not considered stable at this time, but the high priority stabilization actions the Army is currently implementing (see the Ongoing Conservation Actions section and the Ongoing Conservation Actions within the Action Area section) and the stabilization actions developed for the Makua IP will benefit the species so that potential impacts associated with military training activities will be minimized and the species will be stabilized in the long-term. Because *C. dentata* occurs in both the MMR and Oahu action areas, the Oahu Implementation Team shall consider this species a high priority and address any urgent actions that need to be implemented so that conservation needs of this species are not undermined prior to the completion of the Oahu IP. The Service had final approval of the Makua IP and will have final approval of the Oahu IP to assure the Army's minimization and stabilization actions will stabilize the species and increase the environmental baseline of the species. Based on the actions and issues outlined in the Project Description and the Effects of the Action on the Listed Species sections above and the species stabilization actions as described in the Biological Assessment and the Makua IP, with those changes incorporated through the Oahu IP, the Service believes that the Army's proposed action is outweighed by the long-term benefits from stabilizing this species.

Cyrtandra subumbellata

All current locations of *Cyrtandra subumbellata* occur along the Koolau Mountains on Oahu. One occurrence with six mature and four immature individuals (approximately six percent of the species) occurs within SBER (see Figure 9c in the Biological Assessment). The plants are located within the south Kaukonahua drainage about 716 m (2,349 ft) from the Koolau summit trail in rugged terrain. These individuals are located in an area characterized by the Army as low use, which includes the following: dismounted maneuvers; foot reconnaissance, bivouac, helicopter aviation training, and air assault. Within the training area, it is estimated that there will be one to two operations a month of company size moving through the area in squad (9 soldiers) or platoon (35 soldiers) units for a duration of two to five days, but for battalion-size (500 soldiers) and larger operations, the duration may be 10 to 14 days. Based upon data compiled for Legacy training for the years 1998-2002, the average number of troops using this area annually was 5,067 with the average days of use per year being 47. Foot maneuvers will be focused on and around trails, bivouac activity will be limited in area due to the extreme terrain in the SBER action area, and helicopter and air assault activities will be restricted to open landing and drop zones. Blank ammunition and ground pyrotechnics are used in this area during foot maneuvers (U.S. Army 2003a).

One of the effects to this species from ongoing and SBCT training activities is the continued risk of fire particularly due to pyrotechnic exercises, blank training exercises, cigarette smoking, cookstoves/fires at bivouac sites, and other accidental or unforseen ignition sources. The fire threat is low for the *Cyrtandra subumbellata* individuals that are located in SBER because the plants grow in lowland wet forest shrubland that is unlikely to burn and therefore has a low fire vulnerability rating. However, because of the very low numbers of known individuals, *C. subumbellata* is susceptible to extinction due to a catastrophic event such as a fire. Therefore, the relatively heavy training load of SBER justifies a low vulnerability to fire, rather than very low, for this species. In the periods 1994 to 1998 and 2000 to 2002, a total of 14 fires were reported in SBER, impacting approximately 9 ha (23 ac). The most common cause was pyrotechnics of various types (U.S. Army 2003a). Minimization measures for fire from all ignition sources are outlined in the project description, including implementation of the WFMP. The WFMP includes the following actions for SBER that will reduce the risk of fire at this installation: implementing a Fire Danger Rating System that will restrict training according to weather and fuel conditions and hourly monitoring by range control; fuel load reduction as appropriate; use of the dip pond at DMR; maintaining the road to fuel break standards; and reinitiating this consultation should a fire escape the installation boundary or starts or spreads within 521 m (1,771 ft) of a listed species (U.S. Army 2003b). However, the latest fires at SBMR (July and August 2003) indicate that full control of fire is not possible, even with all of these precautions and restrictions in place, and therefore the Service believes the risk to all species is higher than the Army indicates in the Biological Assessment. Additional restrictions, such as prohibiting smoking on site, are identified in the Standard Operating Procedures and the Biological Assessment for SBER. With these measures in place the threat from fire to these individuals will be minimized; however, the potential for a wildland fire can never be totally eliminated. In addition, the Army will implement any additional minimization actions determined necessary by the Oahu Implementation Team (U.S. Army 2003a).

The ongoing threat from increased non-native plant invasion is always prevalent within, and adjacent to, high disturbance areas such as military training facilities. There are several potential sources of non-native plant introduction in SBER. Invasive plants could be spread within the installation by dismounted and mounted maneuvers, range construction and maintenance, and especially after a fire. Some non-native invasive plants can also spread into undisturbed areas once they have become established in a disturbed area. Invasive plant encroachment will also be a possibility after a major disturbance event such as a fire and this threat would have a significant effect should a fire occur in the vicinity of these plants. The non-native plant threat from Army training and SBCT Transformation is low to moderate for *Cyrtandra subumbellata* found in SBER due to the low frequency of use and the steep terrain. In addition, these plants are not located near trails or open landing zones, further reducing the threat of non-native plants from Army training. However, any loss of seedlings at this time could have a lasting effect of the species ability to survive long-term because of the already limited genetic variability, with only 108 individuals remaining in the wild. To minimize this threat the Army will prevent secondary non-native plant spread from fire by monitoring and eradicating newly dispersed non-native plants;

implementing all minimization actions described in the project description for this threat; and supporting development of detailed methods for the monitoring and eradication of non-native invasive plants by the Oahu Implementation Team. In addition, if a fire does occur and native habitat is lost, the Army will work with the Service regarding their restoration of the damaged area to prevent the spread of additional invasive plant species (U.S. Army 2003a).

The threat of trampling from foot traffic is very low or non-existent for trees and shrubs, unless the plants are in the seedling stage or the trampling occurs close to the root system, causing compaction of the soil and decreasing the plant's ability to take up water and nutrients. The use of the training area is low and the *Cyrtandra subumbellata* in SBER are located in inaccessible areas away from trails or landing zones. Therefore, the threat from trampling is very low. To minimize the threat to seedlings the Army will educate each set of new soldiers on avoidance of trampling of endangered species, establish long-term conservation trend analysis (ITAM) plots to monitor impact of foot traffic trampling by infantry soldiers; and establish signage to identify areas that are off limits due to the presence of federally listed species. Additional measures, such as fencing of those occurrences most in danger of trampling, will be considered by the Oahu Implementation Team (U.S. Army 2003a).

Feral ungulates are found throughout all of the installations and are a continued additional pressure for *Cyrtandra subumbellata*. Pigs are particularly destructive as they trample, root and eat native vegetation and can introduce invasive species through fecal matter. These rooting sites are another avenue for establishment of invasive plants. However, the fencing that will occur to avoid trampling from foot maneuvers will also protect the occurrences within the action area from ungulates. Additional measures will be considered by the Oahu Implementation Team (U.S. Army 2003a).

Military installations with much human activity and food sources may inadvertently provide a source for increased rat populations in the action area. This in turn adds another pressure to populations with very limited numbers of individuals. With only 108 plants remaining in the wild, the loss of the fruit of any of the plants within the action areas could prove devastating for the genetic diversity and health of this species. Bait stations will be part of the stabilization efforts if monitoring indicates this measure is necessary to protect *Cyrtandra subumbellata* from rats.

Slugs impact *Cyrtandra subumbellata* by browsing on seedlings and young vegetation. The Army will support research to control slugs to minimize impacts from this threat and implement the most efficient method for slug control (U.S. Army 2003a).

In addition to all of the minimization actions described in the effects section, an Implementation Plan will be developed and implemented for the Oahu action areas, which will include a stabilization plan for *Cyrtandra subumbellata*. The stabilization plan will include those actions listed in the Conservation Needs in the Action Areas section, along with any additional measures identified by the Oahu Implementation Team.

Summary

The risk to *Cyrtandra subumbellata* from Legacy and Transformation training has been reduced through the restrictions the Army has made to its routine training activities and the development and implementation of its WFMP. This species is not considered stable at this time, but the stabilization actions to be developed for the Oahu IP will benefit the species so that potential impacts associated with military training activities will be minimized in the short-term and the species will be stabilized in the long-term. The Service has final approval of the Oahu IP to assure the Army's minimization and stabilization actions will stabilize the species and increase the environmental baseline of the species. Based on the actions and issues outlined in the Project Description and the Effects of the Action on the Listed Species sections above and the species stabilization actions as described in the Biological Assessment, the Service believes that the risk of the Army's proposed action is outweighed by the long-term benefits from stabilizing this species.

Cyrtandra viridiflora

All current occurrences of *Cyrtandra viridiflora* are found in the Koolau Mountains on the island of Oahu. Five occurrences of this species, with 60 individuals total, are found in two of the Oahu action areas: KLOA, and SBER (see Figures 7b and 9c in the Biological Assessment). These occurrences represent approximately 86 percent of the known individuals of *C. viridiflora*.

KLOA

At KLOA, there are 59 individuals of *Cyrtandra viridiflora* from four occurrences: Kahuku cabin (5), Kawainui and Koloa (8), Opaeula and Helemano (45), and Helemano (1) (HINHP Database 2002; U. S. Army 2003a; K. Kawelo, U.S. Army, pers. comm. 2003; J. Lau, HINHP, pers. comm. 2003). These individuals represent approximately 85 percent of the known individuals of this species. A significant number of individuals occur directly alongside the Koolau summit trail. Identified actions in these areas include dismounted maneuvers, foot reconnaissance, bivouac, helicopter aviation training, and air assault. These operations take place one to two times per month for an average of two to five days at a time at company level (120 soldiers) size. These operations have the potential of lasting up to 10 days in length. The companies move through the area in squad (9 soldiers) or platoon (35 soldiers) units. Based upon data compiled for Legacy training for the years 1998-2002, it is estimated that the average number of troops that will use this area will be 17,422 over an average of 137 days per year. Mounted (vehicle) maneuvers will be restricted to existing roads, most of which are far from any existing endangered species occurrences; foot maneuvers will be focused on and around trails; bivouac activity will be limited in area due to the extreme terrain found in much of the KLOA action area; and helicopter and air assault activities will be restricted to open landing and drop zones. Blank ammunition and ground pyrotechnics are used in this area during foot maneuvers (U.S. Army 2003a).

One of the effects to this species from ongoing and SBCT training activities is the continued risk of fire particularly due to pyrotechnic exercises, blank training exercises, cigarette smoking, cookstoves/fires at bivouac sites, and other accidental or unforseen ignition sources. The

Cyrtandra viridiflora individuals that are located in KLOA have a very low threat from fire because the plants are found in lowland wet forest and shrub habitat that is unlikely to burn. One fire occurred in 2000, burning 125.5 ha (310 ac), and is believed to have been started by blank ammunition or a muzzle flash (U.S. Army 2003a). Minimization measures for fire from all ignition sources are outlined in the project description, including implementation of the WFMP. The WFMP includes the following actions for KLOA that will reduce the risk of fire at this installation: implementing a Fire Danger Rating System that will restrict training according to weather and fuel conditions with hourly monitoring by range control; fuel load reduction as appropriate; use of the dip pond at DMR; maintaining roads to fuel break standards, and reinitiating this consultation should a fire escape the installation boundary or starts or spreads within 521 m (1,771 ft) of a listed species (U.S. Army 2003b). However, the latest fires at SBMR (July and August 2003) indicate that full control of fire is not possible, even with all of these precautions and restrictions in place, and therefore the Service believes the risk to all species is higher than the Army indicates in the Biological Assessment. Additional restrictions, such as prohibiting smoking on site, are identified in the Standard Operating Procedures and the Biological Assessment for KLOA (U.S. Army 2003a). With these measures in place the threat from fire to these individuals will be minimized; however, the potential for a wildland fire can never be totally eliminated.

The ongoing threat from increased non-native plant invasion is always prevalent within, and adjacent to, high disturbance areas such as military training facilities. There are several potential sources of non-native plant introduction in KLOA. Invasive plants could be spread within the installation by dismounted and mounted maneuvers, helicopter maneuvers, range construction and maintenance, and especially after a fire. Some non-native invasive plants can also spread into undisturbed areas once they have become established in a disturbed area. Invasive plant encroachment will also be a possibility after a major disturbance event such as a fire and this threat would have a significant effect should a fire occur in the vicinity of these plants. The non-native plant threat from Army training and SBCT Transformation is low for *Cyrtandra viridiflora* found in the wet microclimate where the individuals are found away from trails. However, a significant number of individuals occur along Koolau summit trail and are at a moderate risk from non-native plant invasion. To minimize this threat the Army will prevent secondary non-native plant spread from fire by monitoring and eradicating newly dispersed non-native plants; implementing all minimization actions described in the project description for this threat; and supporting development of detailed methods for the monitoring and eradication of non-native invasive plants by the Oahu Implementation Team. In addition, if a fire does occur and native habitat is lost, the Army will work with the Service regarding their restoration of the damaged area to prevent the spread of additional invasive plant species (U.S. Army 2003a).

The threat of trampling from foot traffic is very low or non-existent for trees and shrubs, unless the plants are in the seedling stage or the trampling occurs close to the root system, causing compaction of the soil and decreasing the plant's ability to take up water and nutrients. As mentioned above, significant number of individuals of *Cyrtandra viridiflora* in KLOA grow along the Koolau summit trail, which make them vulnerable to trampling. This occurrence would

be especially vulnerable to damage from foot trampling and will be fenced as an urgent action. There are only approximately 70 plants left in the wild. Any loss of seedlings at this point could have a lasting effect of the species ability to survive long-term because of the already limited genetic variability. To minimize the threat of trampling, the Army will educate each set of new soldiers on avoidance of trampling of endangered species, establish long-term conservation trend analysis (ITAM) plots to monitor impact of foot traffic trampling by infantry soldiers, fence *C. viridiflora* occurrences, and establish signage to identify areas that are off limits due to the presence of federally listed species. Additional measures will be considered by the Oahu Implementation Team (U.S. Army 2003a).

SBER

One individual (approximately one percent of the species) occurs within SBER. This plant is located within the south Kaukonahua drainage. These individuals are located in an area characterized by the Army as low use, which includes the following: dismounted maneuvers, foot reconnaissance, bivouac, helicopter aviation training, and air assault. Within the training area, it is estimated that there will be one to two operations a month of company size moving through the area in squad (9 soldiers) or platoon (35 soldiers) units for a duration of two to five days, but for battalion-size (500 soldiers) and larger operations, the duration may be 10 to 14 days. Based upon data compiled for Legacy training for the years 1998-2002, the average number of troops using this area annually was 5,067 with the average days of use per year being 47. Foot maneuvers will be focused on and around trails, bivouac activity will be limited in area due to the extreme terrain in the SBER action area, and helicopter and air assault activities will be restricted to open landing and drop zones. Blank ammunition and ground pyrotechnics are used in this area during foot maneuvers (U.S. Army 2003a).

One of the primary effect to this species from ongoing and SBCT training activities is the continued risk of fire particularly due to pyrotechnic exercises, blank training exercises, cigarette smoking, cookstoves/fires at bivouac sites, and other accidental or unforseen ignition sources. The fire threat is low for the *Cyrtandra viridiflora* individual that is located in SBER because the plant is found in lowland wet forest shrubland that is unlikely to burn. Despite the low vulnerability of the fuels to fire, the relatively heavy training load of SBER justifies a moderate vulnerability to fire for this species. In the periods 1994 to 1998 and 2000 to 2002, a total of 14 fires were reported in SBER, impacting approximately 9 ha (23 ac). The most common cause was pyrotechnics of various types (U.S. Army 2003a). Minimization measures for fire from all ignition sources are outlined in the project description, including implementation of the WFMP. The WFMP includes the following actions for SBER that will reduce the risk of fire at this installation: implementing a Fire Danger Rating System that will restrict training according to weather and fuel conditions, monitored hourly by range control; fuel load reduction as appropriate, use of the dip pond at DMR; maintaining road to fuel break standards, and reinitiating this consultation should a fire escape the installation boundary or starts or spreads within 521 m (1,771 ft) of a listed species (U.S. Army 2003b). However, the latest fires at SBMR (July and August 2003) indicate that full control of fire is not possible, even with all of these precautions and restrictions in place,

and therefore the Service believes the risk to all species is higher than the Army indicates in the Biological Assessment. Additional restrictions, such as prohibiting smoking on site, are identified in the Standard Operating Procedures and the Biological Assessment for SBER. With these measures in place the threat from fire to these individuals will be minimized; however, the potential for a wildland fire can never be totally eliminated. In addition, the Army will implement any additional minimization actions determined necessary by the Oahu Implementation Team (U.S. Army 2003a).

The ongoing threat from increased non-native plant invasion is always prevalent within and adjacent to training facilities. Because the frequency of use of the area where *Cyrtandra viridiflora* is found in SBER is low, the threat from non-native plants from Army training and SBCT Transformation is low to moderate. The minimization measures for *C. viridiflora* in SBER are the same as described above for individuals in KLOA action area, with the exception of fencing, and will reduce the threat from non-native plants to low.

The threat of trampling to the *Cyrtandra viridiflora* in SBER is very low, as they are located in inaccessible areas away from trails or landing zones and the frequency of use by the military is low. The minimization measures for *C. viridiflora* in SBER are the same as described above for individuals in KLOA action area, with the exception of fencing, and will reduce the threat from trampling.

All Installations

Feral ungulates are found throughout all of the installations and are a continued additional pressure for *Cyrtandra viridiflora*. Pigs are particularly destructive as they trample, root and eat native vegetation and can introduce invasive species through fecal matter. These rooting sites are another avenue for establishment of invasive plants. However, the fencing that will occur to avoid trampling from foot maneuvers will also protect the occurrences within the action area from ungulates. Additional measures will be considered by the Oahu Implementation Team (U.S. Army 2003a).

Military installations with much human activity and food sources may inadvertently provide a source for increased rat populations in the action areas. This in turn adds another pressure to populations with very limited numbers of individuals. With only 69 plants remaining in the wild, every individual is important for the genetic diversity and health of this species. Bait stations will be part of the stabilization efforts if monitoring indicates this measure is necessary to protect *Cyrtandra viridiflora* from rats. Additional measures will be considered by the Oahu Implementation Team (U.S. Army 2003a).

In addition to all of the minimization actions described in the effects section, an Implementation Plan will be developed and implemented for the Oahu action areas, which will include a stabilization plan for *Cyrtandra viridiflora*. The stabilization plan will include those actions listed in the Conservation Needs in the Action Areas section, along with any additional measures

identified by the Oahu Implementation Team. The Army has agreed to implement the following actions immediately to avoid loss of any additional plants: fence the *C. viridiflora* occurrence along the trail in KLOA.

Summary

The risk to *Cyrtandra viridiflora* from Legacy and Transformation training has been reduced through the restrictions the Army has made to its routine training activities and the development and implementation of its WFMP. This species is not considered stable at this time, but the stabilization actions to be developed for the Oahu IP will benefit the species so that potential impacts associated with military training activities will be minimized in the short-term and the species will be stabilized in the long-term. The Service has final approval of the Oahu IP to assure the Army's minimization and stabilization actions will stabilize the species and increase the environmental baseline of the species. Based on the actions and issues outlined in the Project Description and the Effects of the Action on the Listed Species sections above and the species stabilization actions as described in the Biological Assessment, the Service believes that the risk of the Army's proposed action is outweighed by the long-term benefits from stabilizing this species.

The Army is conducting (or planning to conduct) the following species-specific actions for *Cyrtandra viridiflora* in the Kawailoa and Schofield East Range Action Areas: removal of pigs from the Opaeula Watershed Protection Project Fence area., monitor populations of *C. viridiflora* at KLOA and SBER to determine if reintroduction is necessary to maintain viable populations and to determine other threats and address them as necessary, and reintroduction of populations of *C. viridiflora*.

Delissea subcordata

All remaining occurrences of *Delissea subcordata* occur in the Waianae Mountains and seven individuals (approximately 13 percent of the total number of wild individuals) are found within the SBMR action area (see Figure 10b in the Biological Assessment) . The single individual plant in south Mohiakea is located approximately 470 m (1,600 feet) from the impact area while the six plants in Palikea Gulch are over 800 m (2,720 feet) from the impact area(K. Kawelo, U.S. Army, pers. comm. 2003; J. Lau, HINHP, pers. comm. 2003). There are no Army actions proposed for the areas where *D. subcordata* is found within SBMR, as mounted and dismounted maneuvers are restricted by the presence of unexploded ordnance. While most of the high explosive rounds fired during live-fire training at SBMR land within the designated impact area, numerous rounds can be found on the ground above the fire break road which forms the boundary of the impact area. This demonstrates that some rounds either ricochet out of the impact area or exceed their expected range. Fire can also carry from the impact area out of the fire break road into habitat of listed species. Live-fire ammunition includes tracers and various types of high explosive rounds, both of which are highly incendiary. Live-fire training exercises currently occur within the impact area an average of 220 days per year, utilizing over 29,000 rounds of high explosive ammunition. Transformation will result in the reduction in 5.56 mm ball and tracer munition use and increases in other small arms ball and munition use. There will be an

increase in the use of grenades and mortar ammunition, which are more likely to land outside of the current fire break road and have been responsible for starting previous fires. Of note is the addition of the mobile gun Stryker-mounted system that shoots 155 mm munition, which behave similarly to mortar rounds. Mortar rounds are currently limited to a charge of three to ensure that they do not land above the upper elevation boundary of SBMR, but this charge does not limit the ability of the round to land outside of the fire break road.

The primary effect to this species in SBMR from ongoing and SBCT training activities is the continued risk of fire, particularly due to use of live-fire ammunition. A fire can start either from a round igniting vegetation within the impact area and the fire jumping the fire break road or a round that lands outside the impact area and starts a fire outside the fire break road. Therefore, additional use of these weapons systems under SBCT will increase the risk of fire in the areas where this species occurs. There is also the potential for ignition caused by catalytic converters and construction equipment (U.S. Army 2003a). Both the south Mohiakea and the Palikea Gulch occurrences of *Delissea subcordata* are rated as areas of low fire vulnerability due to their distance from the impact area and the presence of less flammable vegetation. Minimization measures for fire from all ignition sources are outlined in the project description, including implementation of the WFMP. The WFMP includes the following actions for SBMR that will reduce the risk of fire at this installation: implementation of a Fire Danger Rating System that will restrict training according to weather and fuel conditions, monitored hourly by range control; construction of a 1,136 cubic meter (300,000 gallon) dip pond in fiscal year 2004; relocating targets that are close to the fire break road further into the impact area to reduce the likelihood of overshot rounds landing outside the fire break; improvement of the fire break road around the McCarthy Flats ranges to the same standards as the existing fire break roads; and managing the fuels on the ridge leading to Puu Pane (U.S. Army 2003b). Additional restrictions, such as prohibiting smoking on site, are identified in the Standard Operating Procedures and the Biological Assessment for SBMR (U.S. Army 2003a). However, the latest fires at SBMR (July and August 2003) indicate that full control of fire is not possible, even with all of these precautions and restrictions in place, and therefore the Service believes the risk to all species is higher than the Army indicates in the Biological Assessment. With these measures in place the threat from fire to these individuals will be minimized; however, the potential for a wildland fire can never be totally eliminated.

There is a low threat from a round unintentionally landing outside of the impact area and exploding on or near the population of *Delissea subcordata* in south Mohiakea Gulch under Legacy training. However, there will be an increase in the use of grenades and mortar ammunition, which are more likely to land outside of the current fire break road, and therefore more likely to impact this species (U.S. Army 2003a).

Not only is there the potential for the direct loss of *Delissea subcordata* due to fire, but a fire may open up the habitat allowing for the invasion of non-native plant species. The ongoing threat from increased non-native plant invasion is always prevalent within, and adjacent to, high

disturbance areas such as military training facilities. There are several additional potential sources of non-native plant introduction in SBMR. Invasive plants could be spread within the installation by mounted maneuvers, range construction and maintenance, and especially after a fire. Some non-native invasive plants can also spread into undisturbed areas once they have become established in a disturbed area. Invasive plant encroachment will also be a possibility after a major disturbance event such as a fire and this threat would have a significant effect should a fire occur in the vicinity of these plants. The non-native plant threat from Army training and SBCT Transformation is low for the *D. subcordata*, as they are found in lowland mesic forests. To minimize this threat the Army will prevent secondary non-native plant spread from fire by monitoring and eradicating newly dispersed non-native plants; implementing all minimization actions described in the project description for this threat; and supporting development of detailed methods for the monitoring and eradication of non-native invasive plants by the Oahu Implementation Team. In addition, if a fire does occur and native habitat is lost, the Army will work with the Service regarding their restoration of the damaged area to prevent the spread of additional invasive plant species (U.S. Army 2003a).

Feral ungulates are found throughout all of the installations and are a continued additional pressure for *Delissea subcordata*. Pigs are particularly destructive as they trample, root and eat native vegetation and can introduce invasive species through fecal matter. These rooting sites are another avenue for establishment of invasive plants. In the past in SBMR, the Army allowed private hunting parties to enter these areas for the purpose of controlling feral pigs. Due to unexploded ordinance liability issues, the Army has since curtailed public hunting in SBMR, which has resulted in a drastic increase in pig numbers. Currently, pig control is the sole responsibility of the Army Natural Resource staff. The lack of hunting, and hence proliferation of pigs, presents a direct and constant threat to all *D. subcordata* occurrences within the action area. Additional measures will be considered by the Oahu Implementation Team, including fencing in appropriate locations in and out of the action areas (U.S. Army 2003a).

Military installations with much human activity and food sources may inadvertently provide a source for increased rat populations in the action areas. This in turn adds another pressure to populations with very limited numbers of individuals. With only 52 individuals remaining in the wild, every individual is important for the genetic diversity and health of this species. Bait stations will be part of the stabilization efforts if monitoring indicates this measure is necessary to protect *Delissea subcordata* from rats. The actions listed in the Makua IP minimize the effects of this by stabilizing the species and its surrounding habitat, which will include fencing in appropriate locations both inside and outside of the impact area. Additional measures will be considered by the Oahu Implementation Team (U.S. Army 2003a).

The fruiting structure of *Delissea subcordata* is an attractant for rats which makes this species more vulnerable to rat predation. Military installations with much human activity and food sources may inadvertently provide a source for increased rat populations in the action area. This in turn adds another pressure to populations with very limited numbers of individuals. With only 52

individuals remaining, the loss of the fruit of seven plants could prove devastating for the genetic diversity and health of this species. Bait stations are part of the stabilization efforts if monitoring of the populations indicates this measure necessary to protect *D. subcordata* from rats (U.S. Army 2003a).

In addition to all of the minimization actions described in the effects section, an Implementation Plan has been developed and will be implemented for the Makua and other Oahu action areas, which includes a stabilization plan for *Delissea subcordata*. The stabilization plan includes those actions listed in the Conservation Needs in the Action Areas section, along with any additional measures that will be identified by the Oahu Implementation Team. The Implementation Team will consider additional sites for reintroduction, since the Palikea Gulch population unit was not considered part of the action area in the Makua IP. The Oahu Implementation Team shall reassess the current status of the stabilization actions for *D. subcordata* to assure that conservation needs of this species are being met pursuant to the Makua IP and prior to the completion of the Oahu IP.

Summary

The risk to *Delissea subcordata* from Legacy and Transformation training has been reduced through the restrictions the Army has made to its routine training activities and the development and implementation of its WFMP. This species is not considered stable at this time, but the high priority stabilization actions the Army is currently implementing (see the Ongoing Conservation Actions section and the Ongoing Conservation Actions within the Action Area section) and the stabilization actions developed for the Makua IP will benefit the species so that potential impacts associated with military training activities will be minimized in the short-term and the species will be stabilized in the long-term. Because *D. subcordata* occurs in both the MMR and Oahu action areas, the Oahu Implementation Team shall consider this species a high priority and address any urgent actions that need to be implemented prior to the completion of the Oahu IP. The Service had final approval of the Makua IP and will have final approval of the Oahu IP to assure the Army's minimization and stabilization actions will stabilize the species and increase the environmental baseline of the species. Based on the actions and issues outlined in the Project Description and the Effects of the Action on the Listed Species sections above and the species stabilization actions as described in the Biological Assessment and the Makua IP, the Service believes that the Army's proposed action is outweighed by the long-term benefits from stabilizing this species.

Diellia falcata

All remaining occurrences of *Diellia falcata* occur within the Waianae Mountains and 71 individuals (approximately four percent of the total number of individuals) are found within the SBMR action area (see Figure 10b in the Biological Assessmemt). The occurrence in Mohiakea Gulch is closest to the impact area but still over 350 m (1,190 ft) away. In addition, the Puu Kumakalii occurrence is over 800 m (2,720 ft) from the impact area, Puu Kalena is over 600 m (2,040 ft) away, and Palikea Gulch is the furthest at over 1,000 m (3,400 ft) from the impact area

(K. Kawelo, U.S. Army, pers. comm. 2003; J. Lau, HINHP, pers. comm. 2003). There are no Army actions proposed for the areas where *D. falcata* is found within SBMR, as mounted and dismounted maneuvers are restricted by the presence of unexploded ordnance. While most of the high explosive rounds fired during live-fire training at SBMR land within the designated impact area, numerous rounds can be found on the ground above the fire break road which forms the boundary of the impact area. This demonstrates that some rounds either ricochet out of the impact area or exceed their expected range. Live-fire ammunition includes high explosive rounds and tracer bullets, both of which are highly incendiary. Fire can also carry from within the impact area out of the fire break road into habitat of listed species. Live-fire training exercises currently occur within the impact area an average of 220 days per year, utilizing over 29,000 rounds of tracers and various types of high explosive ammunition. Transformation will result in the reduction in 5.56 mm ball and tracer munition use and increases in other small arms ball and munition use. There will be an increase in the use of grenades and mortar ammunition, which are more likely to land outside of the current fire break road and have been responsible for starting previous fires. Of note is the addition of the mobile gun Stryker-mounted system that shoots 155 mm munition, which behave similarly to mortar rounds. Mortar rounds are currently limited to a charge of three to ensure that they do not land above the upper elevation boundary of SBMR, but this charge does not limit the ability of the round to land outside of the fire break road (U.S. Army 2003a).

The primary effect to this species in SBMR from ongoing and SBCT training activities is the continued risk of fire, particularly due to use of live-fire ammunition. A fire can start either from a round igniting vegetation within the impact area and the fire jumping the fire break road or a round that lands outside the impact area and starts a fire outside the fire break road. Therefore, additional use of these weapons systems under SBCT will increase the risk of fire in the areas where this species occurs. There is also the potential for ignition caused by catalytic converters and construction equipment. The *Diellia falcata* occurrences closest to the fire break road (within 350 m (1,190 ft) and 600 m (2,040 ft)) are Mohiakea Gulch and Puu Kalena, which contain five and 50 individuals respectively. The threat to *D. falcata* in the areas where they occur is considered to be low because these areas are not typically used for training and are dominated by less flammable vegetation. There are an additional 10 plants found in Palikea Gulch and six plants in the Puu Kumakalii area. These plants are all found at least 800 m (2,600 ft) from the fire break road with the farthest plants located over 1,000 m (3,400 ft) from the road. Although the risk of a fire in these areas is always a possibility, the Service considers the risk to these individuals to be low (U.S. Army 2003a). Minimization measures for fire from all ignition sources are outlined in the project description, including implementation of the WFMP. The WFMP includes the following actions for SBMR that will reduce the risk of fire at this installation: implementation of a Fire Danger Rating System that will restrict training according to weather and fuel conditions and will be monitored hourly by range control; construction of a 1,136 cubic meter (300,000 gallon) dip pond in fiscal year 2004; relocating targets that are close to the fire break road further into the impact area to reduce the likelihood of overshot rounds landing outside the fire break; improvement of the fire break road around the McCarthy Flats ranges to the same standards as the existing fire break roads; and managing the fuels on the ridge leading to Puu Pane

(U.S. Army 2003b). Additional restrictions, such as prohibiting smoking on site, are identified in the Standard Operating Procedures and the Biological Assessment for SBMR (U.S. Army 2003a). However, the latest fires at SBMR (July and August 2003) indicate that full control of fire is not possible, even with all of these precautions and restrictions in place, and therefore the Service believes the risk to all species is higher than the Army indicates in the Biological Assessment. With these measures in place the threat from fire to these individuals will be minimized; however, the potential for a wildland fire can never be totally eliminated.

There is a low threat from a round unintentionally landing outside of the impact area and exploding on or near the occurrences of *Diellia falcata* in Mohiakea Gulch and Puu Kalena, which are inside the surface danger zones, and very low, for plants outside of the surface danger zones. These occurrences are located a distance of more than 350 m (1,190 ft) and 600 m (2,040 ft), respectively, from the impact area. However, Transformation will result in an increase in the use of grenades and mortar ammunition, which are more likely to land outside of the current fire break road and have been responsible for starting previous fires. However, because this species is currently residing in a stable condition, the Service does not believe the loss of one or two plants would not affect the species' ability to persist long-term (U.S. Army 2003a).

Not only is there the potential for the direct loss of *Diellia falcata* due to fire, but a fire may open up the habitat allowing for the invasion of non-native plant species. The ongoing threat from increased non-native plant invasion is always prevalent within, and adjacent to, high disturbance areas such as military training facilities. There are several additional potential sources of non-native plant introduction in SBMR. Invasive plants could be spread within the installation by mounted maneuvers, range construction and maintenance, and especially after a fire. Some non-native invasive plants can also spread into undisturbed areas once they have become established in a disturbed area. Invasive plant encroachment will also be a possibility after a major disturbance event such as a fire and this threat would have a significant effect should a fire occur in the vicinity of these plants. The non-native plant threat from these sources is high for all *D. falcata* occurrences because they are located in lowland dry shrublands and in areas dominated by non-native plant species in the SBMR action area. To minimize this threat the Army will prevent secondary non-native plant spread from fire by monitoring and eradicating newly dispersed non-native plants; implementing all minimization actions described in the project description for this threat; and supporting development of detailed methods for the monitoring and eradication of non-native invasive plants by the Oahu Implementation Team. In addition, if a fire does occur and native habitat is lost, the Army will work with the Service regarding their restoration of the damaged area to prevent the spread of additional invasive plant species (U.S. Army 2003a).

Feral ungulates are found throughout all of the installations and are a continued additional pressure for *Diellia falcata*. Pigs are particularly destructive as they trample, root and eat native vegetation and can introduce invasive species through fecal matter. These rooting sites are another avenue for establishment of invasive plants. In the past in SBMR, the Army allowed

private hunting parties to enter these areas for the purpose of controlling feral pigs. Due to unexploded ordinance liability issues, the Army has since curtailed public hunting in SBMR, which has resulted in a drastic increase in pig numbers. Currently, pig control is the sole responsibility of the Army Natural Resource staff. The lack of hunting, and hence proliferation of pigs, presents a direct and constant threat to all *D. falcata* occurrences within the action area. Additional measures will be considered by the Oahu Implementation Team, including fencing in appropriate locations. (U.S. Army 2003a).

Diellia falcata is also threatened by the two spotted leafhopper, which has caused dieback of other fern species throughout the Hawaiian Islands. It is still unclear how this non-native insect causes damage to plants in Hawaii and is currently under investigation. We do not know how many plants have been effected or loss because of this insect at this time.

Diellia falcata does not require stabilization because fifty percent of the known individuals do not occur in the Army action areas, and there are at least three stable population units of greater than 50 mature, reproducing individuals outside of the Army action areas. The Oahu Implementation Team will consider species-specific management actions such as collection for genetic storage.

Summary

The risk to *Diellia falcata* from Legacy and Transformation training has been reduced through the restrictions the Army has made to its routine training activities and the development and implementation of its WFMP. This species is considered stable at this time and the stabilization actions developed for other species in the Makua IP will benefit the species so that potential impacts associated with military training activities will be minimized in the short-term. Based on the actions and issues outlined in the Project Description and the Effects of the Action on the Listed Species sections above and the benefit to this species from the species stabilization actions of other species within SBMR as described in the Biological Assessment and the Oahu IP, the Service believes that the Army's proposed action is outweighed by the long-term benefits to this species.

Eugenia koolauensis

Eugenia koolauensis was historically known from Molokai and Oahu but is currently only extant in the northern Koolau Mountains on Oahu. Approximately 96 percent (165 individuals) of the known individuals of this species are found within KTA (see Figure 6b in the Biological Assessment) in Pahipahialua (30), Oio (50), Kaunala (59), Aimuu (1), and Kaleleiki (25) (K. Kawelo, U.S. Army, pers. comm., 2003; J. Lau, HINHP, pers. comm. 2003; U.S. Army 2003a). Identified actions in these areas include dismounted maneuvers, foot reconnaissance, bivouac, helicopter aviation training, and air assault. Three training operations are conducted of squad (9 soldiers) or platoon (35 soldiers) units, scouts and infantry companies, in long range surveillance detachment operations, per month in the D2 training area. Based on the data compiled for Legacy training for the years 1998-2002, it is estimated that the average number of troops that will use these areas will be 6,504 over an average of 44 days per year. Pyrotechnics

use can occur anywhere that dismounted and mounted training occur, with the following restrictions: approval from range operations, restricted based on the Fire Danger Rating System, and smoke grenades will only be used in areas devoid of vegetation. Blank ammunition is used throughout the action area. Transformation will include the use of live-fire, low-velocity plastic bullets associated with short-range training (U.S. Army 2003a).

The primary effect to this species from ongoing and SBCT training activities is the continued risk of fire. At KTA, sources of ignition include use of pyrotechnics and blanks, smoking, cooking as part of bivouac activities, sparks from construction activities and equipment, low-velocity plastic bullets associated with short-range training, and heat generated by catalytic converters. While the use of plastic bullets with short-range training is considered to be live-fire, it is not expected to pose an additional fire risk as these activities will be conducted in the Combined Arms Collective Training Facility. The Combined Arms Collective Training Facility is located in a highly-altered environment and away from known locations of *Eugenia koolauensis*. Non-live-fire training and pyrotechnics are the most likely source of ignition. All occurrences except the Aimuu occurrence are found within areas used for training at a high frequency where blank ammunition is used as well as ground pyrotechnics. According to the Army Natural Resource staff, the fire threat to *E. koolauensis* in KTA is high due to military and public use of the range (U.S. Army 2003a). There have been at least two fires since 1999 that burned native trees and shrubs. The 2003 fire burned down the gulch slopes on both sides of the LZ and came within 43 cm (16 in) of a seedling of *E. koolauensis* and burned the canopy of one adult tree. According to the Natural Resource staff, seedlings may have burned in the fire but it is impossible to identify them once they are damaged (K. Kawelo, U.S. Army, pers. comm. 2003). A fire could have a devastating effect on this species if it burned an entire stand or even parts of a stand of trees due to the low number of remaining individuals and their limited gene pool. This species currently exists in small, widely dispersed occurrences and is already threatened by risk of extinction from naturally occurring events and/or lack of reproductive vigor. This species occurs in dry and mesic forest dominated by non-native plant species that are fire prone (U.S. Army 2003a). Minimization measures for fire from all ignition sources are outlined in the project description, including implementation of the WFMP. The WFMP includes the following actions for KTA that will reduce the risk of fire at this installation: implementing a Fire Danger Rating System that will restrict training according to weather and fuel conditions, monitored hourly by range control; fuel load reduction as appropriate; construction of a dip pond in fiscal year 2004; maintaining roads to fuel break standards and construction of fire breaks; aerial and ground firefighting resources stationed on site during training; and reinitiating this consultation should a fire escape the installation boundary or starts or spreads within 521 m (1,771 ft) of a listed species (U.S. Army 2003b). Additional restrictions, such as prohibiting smoking on site, are identified in the Standard Operating Procedures and the Biological Assessment for KTA (U.S. Army 2003a; G. Enriques, U.S. Army, pers. comm., 2003; K. Kawelo, U.S. Army, pers. comm., 2003). With these measures in place the threat from fire to these individuals will be minimized; however, the potential for a wildland fire can never be totally eliminated.

The threat of trampling from foot traffic is very low or non-existent for trees and shrubs, unless the plants are in the seedling stage or the trampling occurs close to the root system, causing compaction of the soil and decreasing the plant's ability to take up water and nutrients. There are seedlings in some of the *Eugenia koolauensis* occurrences with a low to moderate threat of trampling from foot traffic. The plants are located in gently sloped areas that do not limit human access. Two individuals are found in an area characterized by the Army as medium use. Medium use is defined as areas that are used once a month by company level moving as squad or platoon size with the primary uses including: mounted maneuvers along Drum Road of 10 to 15 vehicles per month; foot movement throughout the area, mainly occurring on or near roads and trails; bivouacking; field training exercises; Retrans sites (1 to 2 vehicles per month); scouting; and long range surveillance detachment operations. Munition use averages of 44 days per year and includes the use of blank ammunition and ground pyrotechnics. One occurrence that contains approximately 82 seedlings and 66 immature trees is found within 50 m (170 ft) of an area with high foot traffic. This occurrence is especially vulnerable to damage from foot trampling and will be a priority for fencing. Any loss of seedlings at this time could have a lasting effect of the species ability to survive long-term because of the already limited genetic variability, with only 172 of these trees remaining in the wild. There are two other occurrences within 100 m (340 ft) of the areas of high foot traffic but these are mature individuals. To minimize the threat of trampling the Army will educate each set of new soldiers to avoid trampling endangered species; establish long-term conservation trend analysis (ITAM) plots to monitor impact of foot traffic trampling by infantry soldiers; restrict foot traffic to areas outside of a 30 m (102 ft) radius of the canopy of all *E. koolauensis* occurrences within the action area; fence all these occurrences, modify fuels around existing occurrences within KTA; and establish signage to identify areas that are off limits due to the presence of federally listed species. Additional measures will be considered by the Oahu Implementation Team (U.S. Army 2003a).

There are five open landing zones and three open landing/drop zones in the KTA action area. Fifty *Eugenia koolauensis* individuals are within 465 m (1,581 ft) of Hill 904C landing zone and 30 individuals within 400 m (1,360 ft) of Range Control landing zone. The threat to *E. koolauensis* from downdraft damage caused by aviation training is at most low. This threat should be reduced from low to very low by monitoring the occurrence regularly for damage from downdraft and for new seedlings. Additional measures will be considered by the Oahu Implementation Team (U.S. Army 2003a).

The ongoing threat from increased non-native plant invasion is always prevalent within, and adjacent to, high disturbance areas such as military training facilities. There are several potential sources of non-native plant introduction in KTA. Invasive plants could be spread within the installation by dismounted and mounted maneuvers, range construction and maintenance, and especially after a fire. Some non-native invasive plants can also spread into undisturbed areas once they have become established in a disturbed area. Invasive plant encroachment will also be a possibility after a major disturbance event such as a fire and this threat would have a significant effect should a fire occur in the vicinity of these plants. The non-native plant threat from Army

training and SBCT Transformation is high for *E. koolauensis* because of the dry microclimate and prevalence of highly flammable non-native species such as *Eucalyptus* spp. where this species is found. *Eucalyptus* spp. also can preclude seedling germination and establishment. To minimize this threat the Army will prevent secondary non-native plant spread by monitoring and eradicating newly dispersed non-native plants; implementing all minimization actions described in the project description for this threat; and supporting development of detailed methods for the monitoring and eradication of non-native invasive plants by the Oahu Implementation Team. In addition, if a fire does occur and native habitat is lost, the Army will work with the Service regarding their restoration of the damaged area to prevent the spread of additional invasive plant species (U.S. Army 2003a).

Feral ungulates are found throughout the installation and are an additional threat to *Eugenia koolauensis*. Pigs are particularly destructive as they trample, root and eat native vegetation and can introduce invasive species through fecal matter. These rooting sites are another avenue for establishment of invasive plants. However, the fencing that will occur to avoid trampling from foot maneuvers will also protect the occurrences within KTA from ungulates. Additional measures will be considered by the Oahu Implementation Team (U.S. Army 2003a).

These plants are also threatened by disturbance from motorbikes, but the level of disturbance is unclear. The Army has no control over the use of motorbikes in the area, as this is State-owned land leased to the Army for training. To counteract these threats the Army will fence all existing occurrences of this species at KTA and reroute motorbike trails away from existing plants.

In addition to all of the minimization actions described in the effects section, an Implementation Plan will be developed and implemented for the Oahu action areas, which will include a stabilization plan for *Eugenia koolauensis*. The stabilization plan will include those actions listed in the Conservation Needs in the Action Areas section, along with any additional measures identified by the Oahu Implementation Team. The Army has agreed to implement the following urgent actions immediately to avoid loss of any additional plants: restrict foot traffic to areas outside of a 30 m (102 ft) radius of the canopy of *E. koolauensis* occurrences, fence all occurrences, modify fuels around existing occurrences, and establish signage to identify areas that are off limits due to the presence of federally listed species.

Summary

The risk to *Eugenia koolauensis* from Legacy and Transformation training has been reduced through the restrictions the Army has made to its routine training activities and the development and implementation of its WFMP. This species is not considered stable at this time, but the stabilization actions to be developed for the Oahu IP will benefit the species so that potential impacts associated with military training activities will be minimized in the short-term and the species will be stabilized in the long-term. The Service has final approval of the Oahu IP to assure the Army's minimization and stabilization actions will stabilize the species and increase the environmental baseline of the species. Based on the actions and issues outlined in the Project

Description and the Effects of the Action on the Listed Species sections above and the species stabilization actions as described in the Biological Assessment, the Service believes that the risk of the Army's proposed action is outweighed by the long-term benefits from stabilizing this species.

Flueggea neowawraea

Currently, *Flueggea neowawraea* is known from Kauai, Oahu, Maui, and Hawaii. Approximately five percent (five individuals) of the known individuals are found within the SBMR action area (see Figure 10b in the Biological Assessment), all outside of the impact area in Mohiakea and Palikea Gulches. The individual in Mohiakea Gulch is closest to the impact area at distance of over 440 m (1,496 ft). The four individuals located in Palikea Gulch are over 1,000 m (3,400 ft) from the fire break road. There are no Army actions proposed for the areas where *F. neowawraea* is found within SBMR, as mounted and dismounted maneuvers are restricted by the presence of unexploded ordnance. While most of the high explosive rounds fired during live-fire training at SBMR land within the designated impact area, numerous rounds can be found on the ground above the fire break road which forms the boundary of the impact area. This demonstrates that some rounds either ricochet out of the impact area or exceed their expected range. Fire can also carry from within the impact area out of the fire break road into habitat of listed species. Live-fire ammunition includes tracers and various types of high explosive rounds, both of which are highly incendiary. Live-fire training exercises currently occur within the impact area an average of 220 days per year, utilizing over 29,000 rounds of tracers and various types of high explosive ammunition. Transformation will result in the reduction in 5.56 mm ball and tracer munition use and increases in other small arms ball and munition use. There will be an increase in the use of grenades and mortar ammunition, which are more likely to land outside of the current fire break road and have been responsible for starting previous fires. Of note is the addition of the mobile gun Stryker-mounted system that shoots 155 mm munition, which behave similarly to mortar rounds. Mortar rounds are currently limited to a charge of three to ensure that they do not land above the upper elevation boundary of SBMR, but this charge does not limit the ability of the round to land outside of the fire break road (U.S. Army 2003a).

One effect to this species in SBMR from ongoing and SBCT training activities is the continued risk of fire, particularly due to use of live-fire ammunition. A fire can start either from a round igniting vegetation within the impact area and the fire jumping the fire break road or a round that lands outside the impact area and starts a fire outside the fire break road. Therefore, additional use of these weapons systems under SBCT will increase the risk of fire in the areas where this species occurs. There is also the potential for ignition caused by catalytic converters and construction equipment. The threat to *Flueggea neowawraea* in Mohiakea Gulch is considered moderate because these areas are not typically used for training and are dominated by less flammable vegetation and low for the individuals in Palikea Gulch (U.S. Army 2003a). Minimization measures for fire from all ignition sources are outlined in the project description, including implementation of the WFMP. The WFMP includes the following actions for SBMR that will reduce the risk of fire at this installation: implementation of a Fire Danger Rating System that will restrict training according to weather and fuel conditions and will be monitored hourly by

range control; construction of a 1,136 cubic meter (300,000 gallon) dip pond in fiscal year 2004; relocating targets that are close to the fire break road further into the impact area to reduce the likelihood of overshot rounds landing outside the fire break; improvement of the fire break road around the McCarthy Flats ranges to the same standards as the existing fire break roads; and managing the fuels on the ridge leading to Puu Pane (U.S. Army 2003b). Additional restrictions, such as prohibiting smoking on site, are identified in the Standard Operating Procedures and the Biological Assessment for SBMR (U.S. Army 2003a). However, the latest fires at SBMR (July and August 2003) indicate that full control of fire is not possible, even with all of these precautions and restrictions in place, and therefore the Service believes the risk to all species is higher than the Army indicates in the Biological Assessment. With these measures in place the threat from fire to these individuals will be minimized; however, the potential for a wildland fire can never be totally eliminated.

There is a low threat from a round unintentionally landing outside of the impact area and exploding on or near the occurrence of *Flueggea neowawraea* in Mohiakea Gulch, which is inside the surface danger zone, and very low for plants outside of the surface danger zone. This type of direct munition impact has never been observed at SBMR in any occurrences observed by Army Natural Resource staff. However, Transformation will result in increase in the use of grenades and mortar ammunition, which are more likely to land outside of the current fire break road and have been responsible for starting previous fires.

Not only is there the potential for the direct loss of *Flueggea neowawraea* due to fire, but a fire may open up the habitat allowing for the invasion of non-native. The ongoing threat from increased non-native plant invasion is always prevalent within, and adjacent to, high disturbance areas such as military training facilities. There are several additional potential sources of non-native plant introduction in SBMR. Invasive plants could be spread within the installation by mounted maneuvers, range construction and maintenance, and especially after a fire. Some non-native invasive plants can also spread into undisturbed areas once they have become established in a disturbed area. Invasive plant encroachment will also be a possibility after a major disturbance event such as a fire and this threat would have a significant effect should a fire occur in the vicinity of these plants. The non-native plant threat from Army current military training and SBCT Transformation is moderate for the *F. neowawraea* occurrence in lowland mesic forests and high for those individuals in non-native dominated plant areas because of the dry microclimate and prevalence of non-native species there. To minimize this threat the Army will prevent secondary non-native plant spread from fire by monitoring and eradicating newly dispersed non-native plants; implementing all minimization actions described in the project description for this threat; and supporting development of detailed methods for the monitoring and eradication of non-native invasive plants by the Oahu Implementation Team. In addition, if a fire does occur and native habitat is lost, the Army will work with the Service regarding their restoration of the damaged area to prevent the spread of additional invasive plant species (U.S. Army 2003a).

Feral ungulates are found throughout all of the installations and are a continued additional pressure for *Flueggea neowawraea*. Pigs are particularly destructive as they trample, root and eat native

vegetation and can introduce invasive species through fecal matter. These rooting sites are another avenue for establishment of invasive plants plant species. In the past in SBMR, the Army allowed private hunting parties to enter these areas for the purpose of controlling feral pigs. Due to unexploded ordinance liability issues, the Army has since curtailed public hunting in SBMR, which has resulted in a drastic increase in pig numbers. Currently, pig control is the sole responsibility of the Army Natural Resource staff. The lack of hunting, and hence proliferation of pigs, presents a direct and constant threat to all *F. neowawraea* occurrences within the action area. Additional measures will be considered by the Oahu Implementation Team, including fencing in appropriate locations in and out of the action areas (U.S. Army 2003a).

Flueggea neowawraea is also threatened by black twig borer and the Chinese rose beetle. The black twig borer has been cited as an immediate threat to all extant occurrences of this species. The black twig borer burrows into the branches and introduces a pathogenic fungus, pruning the host severely and often killing branches or whole plants. All known plants of this species suffer slight to severe defoliation and reduced vigor due to the infestation of this non-native insect. There is currently no known control for this non-native insect but tests on biological controls are ongoing. The Chinese rose beetle also defoliates portion of the plant and could push a plant over the threshold once weakened by other threats (Service 1999b).

In addition to all of the minimization actions described in the effects section, an Implementation Plan has been developed and will be implemented for Makua and other Oahu action areas, which includes a stabilization plan for *Flueggea neowawraea*. The stabilization plan includes those actions listed in the Conservation Needs in the Action Areas section, along with any additional measures that will be identified by the Oahu Implementation Team. Also, the Implementation Team will reassess the current status of the stabilization actions for *F. neowawraea* to assure that conservation needs of this species are being met pursuant to the Makua IP and prior to the completion of the Oahu IP. They will consider additional sites for reintroduction, since the Palikea Gulch population unit was not considered part of the action area in the Makua IP.

Summary

The risk to *Flueggea neowawraea* from Legacy and Transformation training has been reduced through the restrictions the Army has made to its routine training activities and the development and implementation of its WFMP. This species is not considered stable at this time, but the high priority stabilization actions the Army is currently implementing (see the Ongoing Conservation Actions section and the Ongoing Conservation Actions within the Action Area section) and the stabilization actions developed for the Makua IP will benefit the species so that potential impacts associated with military training activities will be minimized in the short-term and the species will be stabilized in the long-term. The Service had final approval of the Makua IP and will have final approval of the Oahu IP to assure the Army's minimization and stabilization actions will stabilize the species and increase the environmental baseline of the species. Based on the actions and issues outlined in the Project Description and the Effects of the Action on the Listed Species sections above and the species stabilization actions as described in the Biological Assessment and

the Makua IP, the Service believes that the Army's proposed action is outweighed by the long-term benefits from stabilizing this species.

Gardenia mannii

Currently, there are 23 occurrences of 93 to 105 *Gardenia mannii* plants on Oahu, found in both the Waianae and Koolau Mountains. Approximately 15 percent (15 individuals) of the known individuals of *G. mannii* are found within the KTA action area, 52 to 56 percent (48 to 59 individuals) of the known individuals of this species are found within the KLOA action area, two percent (two individuals) of the known individuals of this species are found within the SBER action area, and four percent (four individuals) of the known individuals of this species are found within the SBMR action area (see Figures 6b, 7b, 9c, and 10b, respectively, in the Biological Assesment). A total of approximately 74 percent of the known individuals of this species are within Army action areas (U.S. Army 2003a).

KTA

In KTA, *Gardenia mannii* is found in the following occurrences: Pamalu (2 individuals) and Malaekahana-Waimea summit (13). The Pamalu occurrence is located in an area characterized as a medium land use area, which includes the following uses: mounted and dismounted movement throughout the area on and around roads and trails, bivouacking up to company (62 soldiers) size, filed training exercises up to company size, use of Retrans sites by one to two vehicles at a time, scouting, and long range surveillance detachment operations. Operations in this area occur once per month and include company size groups moving in squad (9 soldiers) or platoon (35 soldiers) units. The use of blank ammunition and pyrotechnics is allowed in this area. The Malaekahana-Waimea summit occurrence is found in an area characterized as a low use area, which includes the following uses: dismounted maneuvers on and around trails and bivouacking very infrequently due to the extreme terrain. This area is only used three times per year and includes company size troops moving in squad or platoon sized units. The use of blank ammunition and ground pyrotechnics is approved in this area. Pyrotechnics use can occur anywhere that dismounted and mounted training occur, with the following restrictions: approval from range operations, is restricted based on the Fire Danger Rating System, and smoke grenades will only be used in areas devoid of vegetation. Blank ammunition is used throughout the action area. Transformation will include the use of live-fire low-velocity plastic bullets associated with short-range training (U.S. Army 2003a).

The primary effect to this species from ongoing and SBCT training activities is the continued risk of fire. At KTA, sources of ignition include use of pyrotechnics and blanks, smoking, cooking as part of bivouac activities, sparks from construction activities and equipment, low-velocity plastic bullets associated with short-range training, and heat generated by catalytic converters. While the use of plastic bullets with short-range training is considered to be live-fire, it is not expected to pose an additional fire risk as these activities will be conducted in the Combined Arms Collective Training Facility. The Combined Arms Collective Training Facility is located in a highly-altered environment and away from known locations of *Gardenia mannii*. Non-live-fire training and pyrotechnics are the most likely source of ignition. The Pamalu occurrence is located in an area

of mesic forest considered low vulnerability to fire. The Malaekahana-Waimea summit occurrence is in an area of negligible fire vulnerability because it is located in a wet forested area. Neither occurrence is located in close proximity to an open landing zone, from which fires often spread. There have been at least two fires since 1999 that burned native trees and shrubs (U.S. Army 2003a; K. Kawelo, U.S. Army, pers. comm. 2003). Minimization measures for fire from all ignition sources are outlined in the project description, including implementation of the WFMP. The WFMP includes the following actions for KTA that will reduce the risk of fire at this installation: implementing a Fire Danger Rating System that will restrict training according to weather and fuel conditions and will be monitored hourly by range control; fuel load reduction as appropriate; construction of a dip pond in fiscal year 2004; maintaining roads to fuel break standards and construction of fire breaks; aerial and ground firefighting resources stationed on site during training; and reinitiating this consultation should a fire escape the installation boundary or starts or spreads within 521 m (1,771 ft) of a listed species (U.S. Army 2003b). However, the latest fires at SBMR (July and August 2003) indicate that full control of fire is not possible, even with all of these precautions and restrictions in place, and therefore the Service believes the risk to all species is higher than the Army indicates in the Biological Assessment. Additional restrictions, such as prohibiting smoking on site, are identified in the Standard Operating Procedures and the Biological Assessment for KTA (U.S. Army 2003a; G. Enriques, U.S. Army, pers. comm., 2003; K. Kawelo, U.S. Army, pers. comm., 2003). With these measures in place the threat from fire to these individuals will be minimized; however, the potential for a wildland fire can never be totally eliminated.

The threat of trampling from foot traffic is very low or non-existent for trees and shrubs, unless the plants are in the seedling stage or the trampling occurs close to the root system, causing compaction of the soil and decreasing the plant's ability to take up water and nutrients. The threat of destruction or degradation from foot traffic trampling is very low or non-existent for *Gardenia mannii* trees, unless they are seedlings. Most of the plants are located in areas identified as either moderate or low probability foot traffic areas. There are however, at least seven individuals found right along or within close proximity (within 50 m (170 ft)) to the Koolau summit trail. This area is identified as a high probability for foot traffic. The chances of seedlings in this area being trampled is greater than those plants found in moderate and low probability foot traffic areas which are not along trails. The individuals in these areas will be considered a priority for fencing when this species is reviewed by the Oahu Implementation Team. The loss of seedlings could be devastating to the long-term survival of this species because there are only a total of between 93 and 105 plants left in the wild. To minimize the threat from trampling the Army will: educate each set of new soldiers on avoidance of trampling of endangered species, establish long-term conservation trend (ITAM) plots to monitor impact of foot traffic trampling by infantry soldiers, fence individuals along the Koolau summit trail; and establish signage to identify areas that are off limits due to the presence of federally listed species. Additional measures will be considered by the Oahu Implementation Team (U.S. Army 2003a).

The ongoing threat from increased non-native plant invasion is always prevalent within and adjacent to training facilities. There are several potential sources of non-native plant introduction

into KTA. Non-native plants could be spread within the installation indirectly by fire caused by the above discussed ignition sources, mounted and dismounted maneuvers, and range construction and maintenance. Some non-native invasive plants can spread also spread into undisturbed areas once they have become established in disturbed area. Invasive plant encroachment will also be a possibility after a major disturbance event such as a fire. The non-native plant threat from Army training and SBCT Transformation is low to moderate in the lowland wet forest location of the KTA action area where *Gardenia mannii* is found. To minimize this threat the Army will prevent secondary non-native plant spread from fire by monitoring and eradicating newly dispersed non-native plants; implementing all minimization actions described in the project description for this threat; and supporting development of detailed methods for the monitoring and eradication of non-native invasive plants by the Oahu Implementation Team. In addition, if a fire does occur and native habitat is lost, the Army will work with the Service regarding their restoration of the damaged area to prevent the spread of additional invasive plant species (U.S. Army 2003a).

SBMR

There is a single occurrence of *Gardenia mannii* in SBMR containing four individuals in north Haleauau Gulch. This occurrence is located over 900 m (3,060 ft) from the impact area. There are no Army actions proposed for the areas where *G. mannii* is found within SBMR, as mounted and dismounted maneuvers are restricted by the presence of unexploded ordnance. While most of the high explosive rounds fired during live-fire training at SBMR land within the designated impact area, numerous rounds can be found on the ground above the fire break road which forms the boundary of the impact area. This demonstrates that some rounds either ricochet out of the impact area or exceed their expected range. Fire can also carry from within the impact area out of the fire break road into habitat of listed species. Live-fire ammunition includes tracers and various types of high explosive rounds, both of which are highly incendiary. Live-fire training exercises currently occur within the impact area an average of 220 days per year, utilizing over 29,000 rounds of tracers and various types of high explosive ammunition. Transformation will result in the reduction in 5.56 mm ball and tracer munition use and increases in other small arms ball and munition use. There will be an increase in the use of grenades and mortar ammunition, which are more likely to land outside of the current fire break road and have been responsible for starting previous fires. Of note is the addition of the mobile gun Stryker-mounted system that shoots 155 mm munition, which behave similarly to mortar rounds. Mortar rounds are currently limited to a charge of three to ensure that they do not land above the upper elevation boundary of SBMR, but this charge does not limit the ability of the round to land outside of the fire break road (U.S. Army 2003a).

The primary effect to this species in SBMR from ongoing and SBCT training activities is the continued risk of fire, particularly due to use of live-fire ammunition. A fire can start either from a round igniting vegetation within the impact area and the fire jumping the fire break road or a round that lands outside the impact area and starts a fire outside the fire break road. Therefore, additional use of these weapons systems under SBCT will increase the risk of fire in the areas where this species occurs. There is also the potential for ignition caused by catalytic converters

and construction equipment. The north Haleauau Gulch occurrence of *Gardenia mannii* is rated low fire vulnerability due to its distance from the impact area and the presence of less flammable vegetation (U.S. Army 2003a). Minimization measures for fire from all ignition sources are outlined in the project description, including implementation of the WFMP. The WFMP includes the following actions for SBMR that will reduce the risk of fire at this installation: implementation of a Fire Danger Rating System that will restrict training according to weather and fuel conditions and will be monitored hourly by range control; construction of a 1,136 cubic meter (300,000 gallon) dip pond in fiscal year 2004; relocating targets that are close to the fire break road further into the impact area to reduce the likelihood of overshot rounds landing outside the fire break; improvement of the fire break road around the McCarthy Flats ranges to the same standards as the existing fire break roads; and managing the fuels on the ridge leading to Puu Pane (U.S. Army 2003b). Additional restrictions, such as prohibiting smoking on site, are identified in the Standard Operating Procedures and the Biological Assessment for SBMR (U.S. Army 2003a). However, the latest fires at SBMR (July and August 2003) indicate that full control of fire is not possible, even with all of these precautions and restrictions in place, and therefore the Service believes the risk to all species is higher than the Army indicates in the Biological Assessment. With these measures in place the threat from fire to these individuals will be minimized; however, the potential for a wildland fire can never be totally eliminated.

There is a very low threat from a round unintentionally landing outside of the impact area and exploding on or near the population of *Gardenia mannii* in north Haleauau Gulch under Legacy training. However, there will be an increase in the use of grenades and mortar ammunition, which are more likely to land outside of the current fire break road, and therefore more likely to impact this species (U.S. Army 2003a).

Not only is there the potential for the direct loss of *Gardenia mannii* due to fire, but a fire may open up the habitat allowing for the invasion of non-native plant species. The ongoing threat from increased non-native plant invasion is always prevalent within, and adjacent to, high disturbance areas such as military training facilities, and especially in SBMR because of the increased fire risk from live-fire training. The possibility of invasive plant species encroaching into existing *G. mannii* locations is moderate, since the individuals are growing in lowland mesic forest and shrub community which are not as prone to invasive plant incursion. The minimization measures for *G. mannii* in SBMR are the same as described above for individuals in KTA action area, and will reduce the threat from trampling to low.

KLOA

The occurrences of *Gardenia mannii* in KLOA are found in the following locations: Opaeula (11 to 22 individuals), Kawailoa trail (12), Poamoho to Halemano (22), upper Kawainui (2), and Kaiwi to Koele (1). All of the occurrences are located in areas characterized by the Army as low use areas. Identified actions in these areas include dismounted maneuvers, foot reconnaissance, bivouac, helicopter aviation training, and air assault. These operations take place one to two times per month for an average of two to five days at a time at company level (120 soldiers) size. These operations have the potential of lasting up to 10 days in length. The companies move

through the area in squad (9 soldiers) or platoon (35 soldiers) units. Based upon data compiled for Legacy training for the years 1998-2002, it is estimated that the average number of troops that will use this area will be 17,422 over an average of 137 days per year. Mounted (vehicle) maneuvers will be restricted to existing roads, most of which are far from any existing endangered species occurrences; foot maneuvers will be focused on and around trails; bivouac activity will be limited in area due to the extreme terrain found in much of the KLOA action area; and helicopter and air assault activities will be restricted to open landing and drop zones. Blank ammunition and ground pyrotechnics are used in this area during foot maneuvers.

One of the effects to this species from ongoing and SBCT training activities is the continued risk of fire particularly due to pyrotechnic exercises, blank training exercises, cigarette smoking, cookstoves/fires at bivouac sites, and other accidental or unforseen ignition sources. Two individuals of *Gardenia mannii* from the Kawailoa trail occurrence, both individuals from the upper Kawainui occurrence, and one individual from the Opaeula occurrence are located in wet summit crest vegetation that has a negligible threat from fire. The remaining occurrences and individuals are located in lowland forest rated as having a very low vulnerability to fire. However, several plants are located within close proximity to open landing zones. These are the areas from which fires normally spread. For these individuals, the Service considers the risk of fire to be moderate. This includes one individual from the Opaeula occurrence that is located within 320 m (1,088 ft) of House landing zone, and at least one individual from the Poamoho to Halemano occurrence that is located within 350 m (1,190 ft) of Field landing zone. The Opaeula individual is of particular concern because the landing zone is located in a *Eucalyptus* sp. forest, which can easily catch fire and spread into the surrounding forested areas. Therefore, the fire threat to *G. mannii* in KLOA is low to moderate. One fire occurred in 2000, burning 125.5 ha (310 ac), and is believed to have been started by blank ammunition or a muzzle flash (U.S. Army 2003a). Minimization measures for fire from all ignition sources are outlined in the project description, including implementation of the WFMP. The WFMP includes the following actions for KLOA that will reduce the risk of fire at this installation: implementing a Fire Danger Rating System that will restrict training according to weather and fuel conditions and will be monitored hourly by range control; fuel load reduction as appropriate; use of the dip pond at DMR; maintaining roads to fuel break standards, and reinitiating this consultation should a fire escape the installation boundary or starts or spreads within 521 m (1,771 ft) of a listed species (U.S. Army 2003b). However, the latest fires at SBMR (July and August 2003) indicate that full control of fire is not possible, even with all of these precautions and restrictions in place, and therefore the Service believes the risk to all species is higher than the Army indicates in the Biological Assessment. Additional restrictions, such as prohibiting smoking on site, are identified in the Standard Operating Procedures and the Biological Assessment for KLOA (U.S. Army 2003a). With these measures in place the threat from fire to these individuals will be minimized; however, the potential for a wildland fire can never be totally eliminated.

The threat from trampling for the majority of the *Gardenia mannii* in KLOA individuals is low or moderate. There are seedlings in these occurrences, and there is a low to high threat from foot traffic where they are located. The majority of individuals are located in areas characterized as

either low or moderate foot traffic probability areas. There are, however, a number of plants located around the trails, which are characterized as high probability foot traffic areas. As mentioned in KTA, any loss of seedlings at this point could have a lasting effect of the species ability to survive long-term because of the already limited genetic variability. The minimization measures for *G. mannii* in KLOA are the same as described above for individuals in KTA action area, and will reduce the threat from trampling to low.

The ongoing threat from increased non-native plant invasion is always prevalent within and adjacent to training facilities. There are several potential sources of non-native plant introduction into KLOA, as mentioned above for KTA. Non-native plants could be spread within the installation indirectly by fire caused by the above discussed ignition sources, dismounted maneuvers, the construction of Drum Road, mounted maneuvers, and range construction and maintenance. The non-native plant threat from Army training and SBCT Transformation is low where *Gardenia mannii* is found in KLOA. The minimization measures for *G. mannii* in KLOA are the same as described above for individuals in KTA action area, except for the fencing, and will reduce the threat from non-native plants to low.

SBER

There is a single occurrence of two individuals of *Gardenia mannii* in SBER, within training area ER-13. They are located in south Kaukonahua Gulch. These individuals are located in an area characterized by the Army as low use, which includes the following: dismounted maneuvers, foot reconnaissance, bivouac, helicopter aviation training, and air assault. Within the training area, it is estimated that there will be one to two operations a month of company size moving through the area in squad (9 soldiers) or platoon (35 soldiers) units for a duration of two to five days, but for battalion-size (500 soldiers) and larger operations, the duration may be 10 to 14 days. Based upon data compiled for Legacy training for the years 1998-2002, the average number of troops using this area annually was 5,067 with the average days of use per year being 47. Foot maneuvers will be focused on and around trails, bivouac activity will be limited in area due to the extreme terrain in the SBER action area, and helicopter and air assault activities will be restricted to open landing and drop zones. Blank ammunition and ground pyrotechnics are used in this area during foot maneuvers (U.S. Army 2003a).

One of the primary effect to this species from ongoing and SBCT training activities is the continued risk of fire particularly due to pyrotechnic exercises, blank training exercises, cigarette smoking, cookstoves/fires at bivouac sites, and other accidental or unforseen ignition sources. The fire threat is low for *G. mannii* in SBER action area because the plants are found in medium elevation sites. Medium elevation sites have a very low vulnerability to fire because they have a mix of non-native and native forest, receive less rainfall than upslope areas, but do not support the fire prone fuels of lower elevations. Therefore, the relatively heavy training load of SBER justifies a low vulnerability to fire, rather than very low, within this elevation range. In the periods 1994 to 1998 and 2000 to 2002, a total of 14 fires were reported in SBER, impacting approximately 9 ha (23 ac). The most common cause was pyrotechnics of various types (U.S. Army 2003a). Minimization measures for fire from all ignition sources are outlined in the project description,

including implementation of the WFMP. The WFMP includes the following actions for SBER that will reduce the risk of fire at this installation: implementing a Fire Danger Rating System that will restrict training according to weather and fuel conditions and will be monitored hourly by range control; fuel load reduction as appropriate, use of the dip pond at DMR; maintaining road to fuel break standards, and reinitiating this consultation should a fire escape the installation boundary or starts or spreads within 521 m (1,771 ft) of a listed species (U.S. Army 2003b). However, the latest fires at SBMR (July and August 2003) indicate that full control of fire is not possible, even with all of these precautions and restrictions in place, and therefore the Service believes the risk to all species is higher than the Army indicates in the Biological Assessment. Additional restrictions, such as prohibiting smoking on site, are identified in the Standard Operating Procedures and the Biological Assessment for SBER. With these measures in place the threat from fire to these individuals will be minimized; however, the potential for a wildland fire can never be totally eliminated. In addition, the Army will implement any additional minimization actions determined necessary by the Oahu Implementation Team (U.S. Army 2003a).

The threat of trampling to the *Gardenia mannii* in upper south Kaukonahua Gulch is low. There is, however, a plant located in lower south Kaukonahua Gulch and at least one sapling within 20 m (68 ft) of a trail. The sapling and any future recruits would have a high threat of trampling because of their proximity to the trail. These individuals will be a priority for fencing. The minimization measures for *G. mannii* in SBER are the same as described above for individuals in KTA action area, and will reduce the threat from trampling.

The ongoing threat from increased non-native plant invasion is always prevalent within and adjacent to training facilities. The non-native plant threat from Army training and SBCT Transformation is low to moderate in the lowland wet forest and shrub location of the SBER action area where *Gardenia mannii* is found. The plant located near the trail is the most vulnerable to non-native species introduction and encroachment. The minimization measures for *G. mannii* in SBER are the same as described above for individuals in KTA action area, and will reduce the threat from non-native plants to low.

All Installations

Feral ungulates are found throughout all of the installations and are a continued additional pressure for *Gardenia mannii*. Pigs are particularly destructive as they trample, root and eat native vegetation and can introduce invasive species through fecal matter. These rooting sites are another avenue for establishment of invasive plants. The fencing that will occur to avoid trampling from foot maneuvers will also protect the occurrences within the action area from ungulates. This species is also threatened by destruction of habitat and trampling by feral pigs and encroachment by non-native plants. In the past in SBMR, the Army allowed private hunting parties to enter these areas for the purpose of controlling feral pigs. Due to unexploded ordinance liability issues, the Army has since curtailed public hunting in SBMR, which has resulted in a drastic increase in pig numbers. Currently, pig control is the sole responsibility of the Army Natural Resource staff. The lack of hunting, and hence proliferation of pigs, presents a direct and constant threat to all *G.*

mannii occurrences within the action area. Additional measures will be considered by the Oahu Implementation Team, including fencing in appropriate locations (U.S. Army 2003a).

Military installations with much human activity and food sources may inadvertently provide a source for increased rat populations in the action areas. This in turn adds another pressure to populations with very limited numbers of individuals. With only 93 to 105 plants remaining in the wild, every individual is important for the genetic diversity and health of this species. Bait stations will be part of the stabilization efforts if monitoring indicates this measure is necessary to protect *Gardenia mannii* from rats. Additional measures will be considered by the Oahu Implementation Team (U.S. Army 2003a).

Gardenia mannii is also threatened by the black twig borer, particularly in the Kapakahi Gulch occurrence. The black twig borer has been cited as an immediate threat to numerous tree species in Hawaii. The black twig borer burrows into the branches and introduces a pathogenic fungus, pruning the host severely and often killing branches or whole plants. The black twig borer can cause slight to severe defoliation and leads to reduced vigor. There is currently no known control for this non-native insect but tests on biological controls are ongoing.

Overall, Legacy training and future Transformation actions at KTA, SBMR, SBER, and KLOA may result in adverse effects to 69 to 80 *Gardenia mannii* individuals due to the loss of plants and suitable habitat from fire, trampling from foot maneuvers, and the spread and introduction of non-native plant species. The impacts from these threats could be significant because of the limited number of total remaining individuals. The individuals in the action area represent 74 percent of the known individuals of this species on Oahu. If several actions affected this species at the same time in different installations or one large action effected the largest occurrence of 11 to 22 plants, they could cause adverse impacts to the species. In addition, if anything were to wipe out the only known occurrences in the Waianae Mountains, the species could suffer a reduced genetic viability because of the loss of potentially unique Waianae genetic adaptations.

In addition to all of the minimization actions described in the effects section, an Implementation Plan will be developed and implemented for the Oahu action areas, which will include a stabilization plan for *Gardenia mannii*. The stabilization plan will include those actions listed in the Conservation Needs in the Action Areas section, along with any additional measures identified by the Oahu Implementation Team.

Summary

The risk to *Gardenia mannii* from Legacy and Transformation training has been reduced through the restrictions the Army has made to its routine training activities and the development and implementation of its WFMP. This species is not considered stable at this time, but the stabilization actions to be developed for the Oahu IP will benefit the species so that potential impacts associated with military training activities will be minimized in the short-term and the species will be stabilized in the long-term. The Service has final approval of the Oahu IP to assure the Army's minimization and stabilization actions will stabilize the species and increase the

environmental baseline of the species. Based on the actions and issues outlined in the Project Description and the Effects of the Action on the Listed Species sections above and the species stabilization actions as described in the Biological Assessment, the Service believes that the Army's proposed action is outweighed by the long-term benefits from stabilizing this species.

Hesperomannia arborescens

Currently, only 192 known individuals of *Hesperomannia arborescens* are extant today on Oahu, Molokai, and Maui. Forty-five percent (82 individuals) of the known individuals of *H. arborescens* are found within the KLOA action area, 32 percent (59 individuals) of the known individuals of this species are found within the SBER action area, and three percent (five individuals) of the known individuals of this species are found within the SBMR action area (see Figures 7b, 9c, and 10b, respectively, in the Biological Assessment). In total, approximately 80 percent of the known individuals of this species are within the Army's action areas in 11 occurrences totaling 146 individuals (U.S. Army 2003a; K. Kawelo, U.S. Army, pers. comm. 2003; J. Lau, HINHP, pers. comm. 2003).

KLOA

Hesperomannia arborescens occurrences in KLOA include: Poamoho trail (2 individuals); lower Peahinaia trail (15); lower north Kaukonahua Gulch (1); upper north Kaukonahua Gulch (4); upper Kawailoa trail (1); lower Kawailoa trail (2); Kawainui (42); and Laie-Waimea Ridge (15) (J. Lau, HINHP, pers. comm. 2003; K. Kawelo, U.S. Army, pers. comm. 2003). Identified actions in these areas include dismounted maneuvers, foot reconnaissance, bivouac, helicopter aviation training, and air assault. These operations take place one to two times per month for an average of two to five days at a time at company level (120 soldiers) size. These operations have the potential of lasting up to 10 days in length. The companies move through the area in squad (9 soldiers) or platoon (35 soldiers) units. Based upon data compiled for Legacy training for the years 1998-2002, it is estimated that the average number of troops that will use this area will be 17,422 over an average of 137 days per year. Mounted (vehicle) maneuvers will be restricted to existing roads, most of which are far from any existing endangered species occurrences; foot maneuvers will be focused on and around trails; bivouac activity will be limited in area due to the extreme terrain found in much of the KLOA action area; and helicopter and air assault activities will be restricted to open landing and drop zones. Blank ammunition and ground pyrotechnics are used in this area during foot maneuvers (U.S. Army 2003a).

One of the effects to this species from ongoing and SBCT training activities is the continued risk of fire particularly due to pyrotechnic exercises, blank training exercises, cigarette smoking, cookstoves/fires at bivouac sites, and other accidental or unforseen ignition sources. The *Hesperomannia arborescens* individuals from Laie-Waimea Ridge, upper Kawailoa trail, and most individuals from the Kawanui area are located in wet summit crest vegetation that has a negligible threat from fire. The remaining individuals are located in lowland forest with a very low fire vulnerability rating. In addition, none of the plants are located within close proximity to open landing zones, which are higher risk fire ignition areas. Therefore, the risk of fire is low for all *H. arborescens* occurrences within KLOA. One fire occurred in 2000, burning 125.5 ha (310 ac),

and is believed to have been started by blank ammunition or a muzzle flash (U.S. Army 2003a). Minimization measures for fire from all ignition sources are outlined in the project description, including implementation of the WFMP. The WFMP includes the following actions for KLOA that will reduce the risk of fire at this installation: implementing a Fire Danger Rating System that will restrict training according to weather and fuel conditions and will be monitored hourly by range control; fuel load reduction as appropriate; use of the dip pond at DMR; maintaining roads to fuel break standards, and reinitiating this consultation should a fire escape the installation boundary or starts or spreads within 521 m (1,771 ft) of a listed species (U.S. Army 2003b). However, the latest fires at SBMR (July and August 2003) indicate that full control of fire is not possible, even with all of these precautions and restrictions in place, and therefore the Service believes the risk to all species is higher than the Army indicates in the Biological Assessment. Additional restrictions, such as prohibiting smoking on site, are identified in the Standard Operating Procedures and the Biological Assessment for KLOA (U.S. Army 2003a). With these measures in place the threat from fire to these individuals will be minimized; however, the potential for a wildland fire can never be totally eliminated.

The threat of trampling from foot traffic is very low or non-existent for trees and shrubs, unless the plants are in the seedling stage or the trampling occurs close to the root system, causing compaction of the soil and decreasing the plant's ability to take up water and nutrients. The majority of individuals of *Hesperomannia arborescens* are located in areas characterized as either low or moderate foot traffic probability areas. There are, however, at least 14 plants located directly along trails, which are characterized as high probability foot traffic areas. These individuals will be a priority for fencing. There are only 187 of these trees left in the wild. Any loss of seedlings at this point could have a lasting effect of the species ability to survive long-term because of the already limited genetic variability. Seedling survival is essential to the stabilization, expansion, and ultimately the long-term survival of this species. To minimize the threat to seedlings the Army will: educate each set of new soldiers on avoidance of trampling of endangered species; fence the occurrences near trails; establish long-term conservation trend analysis (ITAM) plots to monitor impact of foot traffic trampling by infantry soldiers; and establish signage to identify areas that are off limits due to the presence of federally listed species. Additional measures, such as fencing of those occurrences most in danger of trampling, will be considered by the Oahu Implementation Team (U.S. Army 2003a).

The ongoing threat from increased non-native plant invasion is always prevalent within, and adjacent to, high disturbance areas such as military training facilities. There are several potential sources of non-native plant introduction in KLOA. Invasive plants could be spread within the installation by dismounted and mounted maneuvers, Drum Road construction, other range construction and maintenance, and especially after a fire. Some non-native invasive plants can also spread into undisturbed areas once they have become established in a disturbed area. Invasive plant encroachment will also be a possibility after a major disturbance event such as a fire and this threat would have a significant effect should a fire occur in the vicinity of these plants. The non-native plant threat from Army training and SBCT Transformation is low to moderate in the lowland wet forest and shrub locations of KLOA where *Hesperomannia arborescens* is

found. To minimize this threat the Army will prevent secondary non-native plant spread from fire by monitoring and eradicating newly dispersed non-native plants; implementing all minimization actions described in the project description for this threat; and supporting development of detailed methods for the monitoring and eradication of non-native invasive plants by the Oahu Implementation Team. In addition, if a fire does occur and native habitat is lost, the Army will work with the Service regarding their restoration of the damaged area to prevent the spread of additional invasive plant species (U.S. Army 2003a).

SBER

The *Hesperomannia arborescens* occurrences in SBER are found in the following locations: north of Kaukonahua Gulch (13 individuals) and south of Kaukonahua Gulch (46) (J. Lau, HINHP, pers. comm. 2003; K. Kawelo, pers. comm. 2003). These individuals are located in an area characterized by the Army as low use, which includes the following: dismounted maneuvers, foot reconnaissance, bivouac, helicopter aviation training, and air assault. Within the training area, it is estimated that there will be one to two operations a month of company size moving through the area in squad (9 soldiers) or platoon (35 soldiers) units for a duration of two to five days, but for battalion-size (500 soldiers) and larger operations, the duration may be 10 to 14 days. Based upon data compiled for Legacy training for the years 1998-2002, the average number of troops using this area annually was 5,067 with the average days of use per year being 47. Foot maneuvers will be focused on and around trails, bivouac activity will be limited in area due to the extreme terrain in the SBER action area, and helicopter and air assault activities will be restricted to open landing and drop zones. Blank ammunition and ground pyrotechnics are used in this area during foot maneuvers (U.S. Army 2003a).

One of the effects to this species from ongoing and SBCT training activities is the continued risk of fire particularly due to pyrotechnic exercises, blank training exercises, cigarette smoking, cookstoves/fires at bivouac sites, and other accidental or unforseen ignition sources. The fire threat is low for *Hesperomannia arborescens* in SBER action area because the plants are found in medium elevation sites. Medium elevation sites have a very low vulnerability to fire because they have a mix of non-native and native forest, receive less rainfall than upslope areas, but do not support the fire prone fuels of lower elevations. Therefore, the relatively heavy training load of SBER justifies a low vulnerability to fire, rather than very low, within this elevation range. In the periods 1994 to 1998 and 2000 to 2002, a total of 14 fires were reported in SBER, impacting approximately 9 ha (23ac). The most common cause was pyrotechnics of various types (U.S. Army 2003a). Minimization measures for fire from all ignition sources are outlined in the project description, including implementation of the WFMP. The WFMP includes the following actions for SBER that will reduce the risk of fire at this installation: implementing a Fire Danger Rating System that will restrict training according to weather and fuel conditions, monitored hourly by range control; fuel load reduction as appropriate, use of the dip pond at DMR; maintaining road to fuel break standards, and reinitiating this consultation should a fire escape the installation boundary or starts or spreads within 521 m (1,771 ft) of a listed species (U.S. Army 2003b). However, the latest fires at SBMR (July and August 2003) indicate that full control of fire is not possible, even with all of these precautions and restrictions in place, and therefore the Service

believes the risk to all species is higher than the Army indicates in the Biological Assessment. Additional restrictions, such as prohibiting smoking on site, are identified in the Standard Operating Procedures and the Biological Assessment for SBER. With these measures in place the threat from fire to these individuals will be minimized; however, the potential for a wildland fire can never be totally eliminated. In addition, the Army will implement any additional minimization actions determined necessary by the Oahu Implementation Team (U.S. Army 2003a).

The threat of trampling to the *Hesperomannia arborescens* in SBER is very low, as they are located in inaccessible areas away from trails or landing zones and use for military training is low. The minimization measures for *H. arborescens* in SBER are the same as described above for individuals in KLOA action area, and will reduce the threat from trampling.

The ongoing threat from increased non-native plant invasion is always prevalent within and adjacent to training facilities. The non-native plant threat from Army training and SBCT Transformation is low to moderate in the lowland wet forest and shrub location of the SBER action area where *Hesperomannia arborescens* are found. The minimization measures for *H. arborescens* in SBER are the same as described above for individuals in KLOA action area, and will reduce the threat from non-native plants to low.

SBMR

There is one occurrence of five individuals of *Hesperomannia arborescens* in SBMR located in Palikea Gulch. These individuals are located over 700 m (2,380 ft) from the impact area. There are no Army actions proposed for the areas where *H. arborescens* is found within SBMR, as mounted and dismounted maneuvers are restricted by the presence of unexploded ordnance. While most of the high explosive rounds fired during live-fire training at SBMR land within the designated impact area, numerous rounds can be found on the ground above the fire break road which forms the boundary of the impact area. This demonstrates that some rounds either ricochet out of the impact area or exceed their expected range. Fire can also carry from within the impact area out of the fire break road into habitat of listed species. Live-fire ammunition includes tracers and various types of high explosive rounds, both of which are highly incendiary. Live-fire training exercises currently occur within the impact area an average of 220 days per year, utilizing over 29,000 rounds of tracers and various types of high explosive ammunition. Transformation will result in the reduction in 5.56 mm ball and tracer munition use and increases in other small arms ball and munition use. There will be an increase in the use of grenades and mortar ammunition, which are more likely to land outside of the current fire break road and have been responsible for starting previous fires. Of note is the addition of the mobile gun Stryker-mounted system that shoots 155 mm munition, which behave similarly to mortar rounds. Mortar rounds are currently limited to a charge of three to ensure that they do not land above the upper elevation boundary of SBMR, but this charge does not limit the ability of the round to land outside of the fire break road (U.S. Army 2003a).

The primary effect to this species in SBMR from ongoing and SBCT training activities is the continued risk of fire, particularly due to use of live-fire ammunition. A fire can start either from a

round igniting vegetation within the impact area and the fire jumping the fire break road or a round that lands outside the impact area and starts a fire outside the fire break road. Therefore, additional use of these weapons systems under SBCT will increase the risk of fire in the areas where this species occurs. There is also the potential for ignition caused by catalytic converters and construction equipment. The Palikea Gulch occurrences has a low fire vulnerability rating due to its distance from the impact area and the presence of less flammable vegetation (U.S. Army 2003a). Minimization measures for fire from all ignition sources are outlined in the project description, including implementation of the WFMP. The WFMP includes the following actions for SBMR that will reduce the risk of fire at this installation: implementation of a Fire Danger Rating System that will restrict training according to weather and fuel conditions, monitored hourly by range control; construction of a 1,136 cubic meter (300,000 gallon) dip pond in fiscal year 2004; relocating targets that are close to the fire break road further into the impact area to reduce the likelihood of overshot rounds landing outside the fire break; improvement of the fire break road around the McCarthy Flats ranges to the same standards as the existing fire break roads; and managing the fuels on the ridge leading to Puu Pane (U.S. Army 2003b). Additional restrictions, such as prohibiting smoking on site, are identified in the Standard Operating Procedures and the Biological Assessment for SBMR (U.S. Army 2003a). However, the latest fires at SBMR (July and August 2003) indicate that full control of fire is not possible, even with all of these precautions and restrictions in place, and therefore the Service believes the risk to all species is higher than the Army indicates in the Biological Assessment. With these measures in place the threat from fire to these individuals will be minimized; however, the potential for a wildland fire can never be totally eliminated.

There is a very low threat from a round unintentionally landing outside of the impact area and exploding on or near the population of *Hesperomannia arborescens* in Palikea Gulch under Legacy training. However, there will be an increase in the use of grenades and mortar ammunition, which are more likely to land outside of the current fire break road, and therefore more likely to impact this species (U.S. Army 2003a).

Not only is there the potential for the direct loss of *Hesperomannia arborescens* due to fire, but a fire may open up the habitat allowing for the invasion of non-native. The ongoing threat from increased non-native plant invasion is always prevalent within, and adjacent to, high disturbance areas such as military training facilities. There are several additional potential sources of non-native plant introduction in SBMR. Invasive plants could be spread within the installation by mounted maneuvers, range construction and maintenance, and especially after a fire. Some non-native invasive plants can also spread into undisturbed areas once they have become established in a disturbed area. Invasive plant encroachment will also be a possibility after a major disturbance event such as a fire and this threat would have a significant effect should a fire occur in the vicinity of these plants. The possibility of invasive plant species encroaching into existing *H. arborescens* locations is moderate, since the individuals are growing in lowland mesic forest and shrub community which are not as prone to invasive plant incursion. To minimize this threat the Army will prevent secondary non-native plant spread from fire by monitoring and eradicating newly dispersed non-native plants; implementing all minimization actions described in the project

description for this threat; and supporting development of detailed methods for the monitoring and eradication of non-native invasive plants by the Oahu Implementation Team. In addition, if a fire does occur and native habitat is lost, the Army will work with the Service regarding their restoration of the damaged area to prevent the spread of additional invasive plant species (U.S. Army 2003a).

All Installations

Feral ungulates are found throughout all of the installations and are a continued additional pressure for *Hesperomannia arborescens*. Pigs are particularly destructive as they trample, root and eat native vegetation and can introduce invasive species through fecal matter. These rooting sites are another avenue for establishment of invasive plants plant species. The fencing that will occur to avoid trampling from foot maneuvers will also protect the occurrences within the action area from ungulates. This species is also threatened by destruction of habitat and trampling by feral pigs and encroachment by non-native plants. In the past in SBMR, the Army allowed private hunting parties to enter these areas for the purpose of controlling feral pigs. Due to unexploded ordinance liability issues, the Army has since curtailed public hunting in SBMR, which has resulted in a drastic increase in pig numbers. Currently, pig control is the sole responsibility of the Army Natural Resource staff. The lack of hunting, and hence proliferation of pigs, presents a direct and constant threat to all *H. arborescens* occurrences within the action area. Additional measures will be considered by the Oahu Implementation Team, including fencing in appropriate locations in and out of the action areas (U.S. Army 2003a).

Overall, Legacy training and future Transformation actions at SBMR, SBER, and KLOA may result in adverse effects to 146 *Hesperomannia arborescens* individuals due to the loss of plants and suitable habitat from fire, trampling from foot maneuvers, and the spread and introduction of non-native plant species. The impacts from these threats could be significant because of the limited number of total remaining individuals (187) and the percentage of individuals found within Army action area, 80 percent. If several actions affected this species at the same time in different installations or one large action effected any one of these occurrences, they could cause adverse impacts to the species. Since the plants found in Palikea Gulch in the Waianae Mountains are morphologically very different from all other known occurrences in the Koolau Mountains, the loss of this occurrence could mean the loss of important genetic variation which may be necessary for future propagation efforts if it is proved that the other occurrences are genetically depauperate. Any action that caused a loss of any one of these large occurrences found in any one of the action areas could cause an adverse effect to this species.

In addition to all of the minimization actions described in the effects section, an Implementation Plan will be developed and implemented for the Oahu action areas, which will include a stabilization plan for *Hesperomannia arborescens*. The stabilization plan will include those actions listed in the Conservation Needs in the Action Areas section, along with any additional measures identified by the Oahu Implementation Team.

Summary

The risk to *Hesperomannia arborescens* from Legacy and Transformation training has been reduced through the restrictions the Army has made to its routine training activities and the development and implementation of its WFMP. This species is not considered stable at this time, but the stabilization actions to be developed for the Oahu IP will benefit the species so that potential impacts associated with military training activities will be minimized in the short-term and the species will be stabilized in the long-term. The Service has final approval of the Oahu IP to assure the Army's minimization and stabilization actions will stabilize the species and increase the environmental baseline of the species. Based on the actions and issues outlined in the Project Description and the Effects of the Action on the Listed Species sections above and the species stabilization actions as described in the Biological Assessment, the Service believes that the Army's proposed action is outweighed by the long-term benefits from stabilizing this species.

Isodendrion longifolium

Currently, there are less than 900 *Isodendrion longifolium* individuals remaining in scattered locations on Kauai and Oahu. On Oahu three occurrences of about 30 to 40 individuals are known from the Koolau Mountains (Kaukonahua and Makaua drainages) and in the Waianae Mountains (Kaawa and Palikea Gulches of Mount Kaala Natural Area Reserve and in West Makaleha). Two percent (10 individuals) of the known individuals are found within the SBER action area (see Figure 9c in the Biological Assessment) and less than one percent (three individuals) are found within the SBMR action area (see Figure 10b in the Biological Assessment). Approximately three percent of the known individuals of this species are within the action areas (U.S. Army 2003a).

SBER

There is a single occurrence of *Isodendrion longifolium* containing 10 individuals within SBER in the south Kaukonahua Stream area. These individuals are located in an area characterized by the Army as low use, which includes the following: dismounted maneuvers, foot reconnaissance, bivouac, helicopter aviation training, and air assault. Within the training area, it is estimated that there will be one to two operations a month of company size moving through the area in squad (9 soldiers) or platoon (35 soldiers) units for a duration of two to five days, but for battalion-size (500 soldiers) and larger operations, the duration may be 10 to 14 days. Based upon data compiled for Legacy training for the years 1998-2002, the average number of troops using this area annually was 5,067 with the average days of use per year being 47. Foot maneuvers will be focused on and around trails, bivouac activity will be limited in area due to the extreme terrain in the SBER action area, and helicopter and air assault activities will be restricted to open landing and drop zones. Blank ammunition and ground pyrotechnics are used in this area during foot maneuvers (U.S. Army 2003a).

One of the effects to this species from ongoing and SBCT training activities is the continued risk of fire particularly due to pyrotechnic exercises, blank training exercises, cigarette smoking, cookstoves/fires at bivouac sites, and other accidental or unforseen ignition sources. The fire

threat is low for *Isodendrion longifolium* in SBER action area because the plants are found in medium elevation sites. Medium elevation sites have a very low vulnerability to fire because they have a mix of non-native and native forest, receive less rainfall than upslope areas, but do not support the fire prone fuels of lower elevations. Therefore, the relatively heavy training load of SBER justifies a low vulnerability to fire, rather than very low, within this elevation range. In the periods 1994 to 1998 and 2000 to 2002, a total of 14 fires were reported in SBER, impacting approximately 9 ha (23ac). The most common cause was pyrotechnics of various types (U.S. Army 2003a). Minimization measures for fire from all ignition sources are outlined in the project description, including implementation of the WFMP. The WFMP includes the following actions for SBER that will reduce the risk of fire at this installation: implementing a Fire Danger Rating System that will restrict training according to weather and fuel conditions, monitored hourly by range control; fuel load reduction as appropriate, use of the dip pond at DMR; maintaining road to fuel break standards, and reinitiating this consultation should a fire escape the installation boundary or starts or spreads within 521 m (1,771 ft) of a listed species (U.S. Army 2003b). However, the latest fires at SBMR (July and August 2003) indicate that full control of fire is not possible, even with all of these precautions and restrictions in place, and therefore the Service believes the risk to all species is higher than the Army indicates in the Biological Assessment. Additional restrictions, such as prohibiting smoking on site, are identified in the Standard Operating Procedures and the Biological Assessment for SBER. With these measures in place the threat from fire to these individuals will be minimized; however, the potential for a wildland fire can never be totally eliminated. In addition, the Army will implement any additional minimization actions determined necessary by the Oahu Implementation Team (U.S. Army 2003a).

The threat of trampling from foot traffic is very low or non-existent for trees and shrubs, unless the plants are in the seedling stage or the trampling occurs close to the root system, causing compaction of the soil and decreasing the plant's ability to take up water and nutrients. The use of the training area is low and the threat from trampling is low to moderate for *Isodendrion longifolium*, since this is a small shrub. To minimize the threat to seedlings and smaller plants the Army will: educate each set of new soldiers on avoidance of trampling of endangered species, establish long-term conservation trend analysis (ITAM) plots to monitor impact of foot traffic trampling by infantry soldiers; and establish signage to identify areas that are off limits due to the presence of federally listed species. Additional measures, such as fencing of those occurrences most in danger of trampling, will be considered by the Oahu Implementation Team (U.S. Army 2003a).

The ongoing threat from increased non-native plant invasion is always prevalent within, and adjacent to, high disturbance areas such as military training facilities. There are several potential sources of non-native plant introduction in SBER. Invasive plants could be spread within the installation by dismounted and mounted maneuvers, range construction and maintenance, and especially after a fire. Some non-native invasive plants can also spread into undisturbed areas once they have become established in a disturbed area. Invasive plant encroachment will also be a possibility after a major disturbance event such as a fire and this threat would have a significant

effect should a fire occur in the vicinity of these plants. The non-native plant threat from Army training and SBCT Transformation is moderate in the lowland wet forest and shrub location of the SBER action area where *Isodendrion longifolium* are found. To minimize this threat the Army will prevent secondary non-native plant spread from fire by monitoring and eradicating newly dispersed non-native plants; implementing all minimization actions described in the project description for this threat; and supporting development of detailed methods for the monitoring and eradication of non-native invasive plants by the Oahu Implementation Team. In addition, if a fire does occur and native habitat is lost, the Army will work with the Service regarding their restoration of the damaged area to prevent the spread of additional invasive plant species (U.S. Army 2003a).

SBMR

There is a single *Isodendrion longifolium* occurrence containing three individuals in SBMR located in Palikea Gulch. These plants are over 650 m (2,210 ft) from the impact area. There are no Army actions proposed for the areas where *I. longifolium* is found within SBMR, as mounted and dismounted maneuvers are restricted by the presence of unexploded ordnance. While most of the high explosive rounds fired during live-fire training at SBMR land within the designated impact area, numerous rounds can be found on the ground above the fire break road which forms the boundary of the impact area. This demonstrates that some rounds either ricochet out of the impact area or exceed their expected range. Fire can also carry from within the impact area out of the fire break road into habitat of listed species. Live-fire ammunition includes tracers and various types of high explosive rounds, both of which are highly incendiary. Live-fire training exercises currently occur within the impact area an average of 220 days per year, utilizing over 29,000 rounds of tracers and various types of high explosive ammunition. Transformation will result in the reduction in 5.56 mm ball and tracer munition use and increases in other small arms ball and munition use. There will be an increase in the use of grenades and mortar ammunition, which are more likely to land outside of the current fire break road and have been responsible for starting previous fires. Of note is the addition of the mobile gun Stryker-mounted system that shoots 155 mm munition, which behave similarly to mortar rounds. Mortar rounds are currently limited to a charge of three to ensure that they do not land above the upper elevation boundary of SBMR, but this charge does not limit the ability of the round to land outside of the fire break road.

The primary effect to this species in SBMR from ongoing and SBCT training activities is the continued risk of fire, particularly due to use of live-fire ammunition. A fire can start either from a round igniting vegetation within the impact area and the fire jumping the fire break road or a round that lands outside the impact area and starts a fire outside the fire break road. Therefore, additional use of these weapons systems under SBCT will increase the risk of fire in the areas where this species occurs. There is also the potential for ignition caused by catalytic converters and construction equipment. The Palikea Gulch occurrence has a low fire vulnerability ratings due to its distance from the impact area and the presence of less flammable vegetation (U.S. Army 2003a). Minimization measures for fire from all ignition sources are outlined in the project

description, including implementation of the WFMP. The WFMP includes the following actions for SBMR that will reduce the risk of fire at this installation: implementation of a Fire Danger Rating System that will restrict training according to weather and fuel conditions, monitored hourly by range control; construction of a 1,136 cubic meter (300,000 gallon) dip pond in fiscal year 2004; relocating targets that are close to the fire break road further into the impact area to reduce the likelihood of overshot rounds landing outside the fire break; improvement of the fire break road around the McCarthy Flats ranges to the same standards as the existing fire break roads; and managing the fuels on the ridge leading to Puu Pane (U.S. Army 2003b). Additional restrictions, such as prohibiting smoking on site, are identified in the Standard Operating Procedures and the Biological Assessment for SBMR (U.S. Army 2003a). However, the latest fires at SBMR (July and August 2003) indicate that full control of fire is not possible, even with all of these precautions and restrictions in place, and therefore the Service believes the risk to all species is higher than the Army indicates in the Biological Assessment. With these measures in place the threat from fire to these individuals will be minimized; however, the potential for a wildland fire can never be totally eliminated.

There is a very low threat from a round unintentionally landing outside of the impact area and exploding on or near the population of *Isodendrion longifolium* in Palikea Gulch under Legacy training. However, there will be an increase in the use of grenades and mortar ammunition, which are more likely to land outside of the current fire break road, and therefore more likely to impact this species (U.S. Army 2003a).

Not only is there the potential for the direct loss of *Isodendrion longifolium* due to fire, but a fire may open up the habitat allowing for the invasion of non-native plant species. The possibility of invasive plant species encroaching into existing *I. longifolium* locations is low to moderate. The minimization measures for *I. longifolium* in SBMR are the same as described above for individuals in SBER action area, and will reduce the threat from non-native plants to very low.

All Installations

Feral ungulates are found throughout all of the installations and are a continued additional pressure for *Isodendrion longifolium*. Pigs are particularly destructive as they trample, root and eat native vegetation and can introduce invasive species through fecal matter. These rooting sites are another avenue for establishment of invasive plants. The fencing that will occur to avoid trampling from foot maneuvers will also protect the occurrences within the action area from ungulates. This species is also threatened by destruction of habitat and trampling by feral pigs and encroachment by non-native plants. In the past in SBMR, the Army allowed private hunting parties to enter these areas for the purpose of controlling feral pigs. Due to unexploded ordinance liability issues, the Army has since curtailed public hunting in SBMR, which has resulted in a drastic increase in pig numbers. Currently, pig control is the sole responsibility of the Army Natural Resource staff. The lack of hunting, and hence proliferation of pigs, presents a direct and constant threat to all *I. longifolium* occurrences within the action area. Additional measures will be considered by the

Oahu Implementation Team, including fencing in appropriate locations in and out of the action areas (U.S. Army 2003a).

Isodendrion longifolium does not require stabilization because fifty percent of the known individuals do not occur in the Army action areas, and there are at least three stable population units of greater than 50 mature, reproducing individuals outside of the Army action areas. The Oahu Implementation Team will consider species-specific management actions such as collection for genetic storage.

Summary

The risk to *Isodendrion longifolium* from Legacy and Transformation training has been reduced through the restrictions the Army has made to its routine training activities and the development and implementation of its WFMP. This species is considered stable at this time and the stabilization actions developed for other species in the Makua IP and Oahu IP will benefit the species so that potential impacts associated with military training activities will be minimized in the short-term. Based on the actions and issues outlined in the Project Description and the Effects of the Action on the Listed Species sections above and the benefit to this species from the species stabilization actions of other species within SBMR as described in the Biological Assessment and the Oahu IP, the Service believes that the Army's proposed action is outweighed by the long-term benefits to this species.

Labordia cyrtandrae

Currently, there are 19 known *Labordia cyrtandrae* individuals remaining from six occurrences, all located in the Waianae Mountains on the island of Oahu. Sixty-eight percent (13 individuals) of the known individuals are found within the SBMR action area (see Figure 10b in the Biological Assessment). The occurrences in SBMR are found in the following locations: north Mohiakea Gulch (1 individuals), north Haleauau (3), south Haleauau (3), and Kaala (6). All of the plants are located outside of the impact area. The closest plants are located in the north Mohiakea Gulch and north Haleauau occurrences, a distance of over 450 m (1,530 ft) and 1,300 m (4,420 ft) respectively from the fire break road. The remaining occurrences are over 2,000 m (6,800 ft) from the impact area (J. Lau, HINHP, pers. comm. 2003; K. Kawelo, U.S. Army 2003). There are no Army actions proposed for the areas where *L. cyrtandrae* is found within SBMR, as mounted and dismounted maneuvers are restricted by the presence of unexploded ordnance. While most of the high explosive rounds fired during live-fire training at SBMR land within the designated impact area, numerous rounds can be found on the ground above the fire break road which forms the boundary of the impact area. This demonstrates that some rounds either ricochet out of the impact area or exceed their expected range. Fire can also carry from within the impact area out of the fire break road into habitat of listed species. Live-fire ammunition includes tracers and various types of high explosive rounds, both of which are highly incendiary. Live-fire training exercises currently occur within the impact area an average of 220 days per year, utilizing over 29,000 rounds of tracers and various types of high explosive ammunition. Transformation will result in the reduction in 5.56 mm ball and tracer munition use and increases in other small arms

ball and munition use. There will be an increase in the use of grenades and mortar ammunition, which are more likely to land outside of the current fire break road and have been responsible for starting previous fires. Of note is the addition of the mobile gun Stryker-mounted system that shoots 155 mm munition, which behave similarly to mortar rounds. Mortar rounds are currently limited to a charge of three to ensure that they do not land above the upper elevation boundary of SBMR, but this charge does not limit the ability of the round to land outside of the fire break road (U.S. Army 2003a).

The primary effect to this species in SBMR from ongoing and SBCT training activities is the continued risk of fire, particularly due to use of live-fire ammunition. A fire can start either from a round igniting vegetation within the impact area and the fire jumping the fire break road or a round that lands outside the impact area and starts a fire outside the fire break road. Therefore, additional use of these weapons systems under SBCT will increase the risk of fire in the areas where this species occurs. There is also the potential for ignition caused by catalytic converters and construction equipment. The *Labordia cyrtandrae* occurrences are found in areas rated as low to very low fire vulnerability due to their distance from the impact area and the presence of less flammable vegetation (U.S. Army 2003a). Minimization measures for fire from all ignition sources are outlined in the project description, including implementation of the WFMP. The WFMP includes the following actions for SBMR that will reduce the risk of fire at this installation: implementation of a Fire Danger Rating System that will restrict training according to weather and fuel conditions and will be monitored hourly by range control; construction of a 1,136 cubic meter (300,000 gallon) dip pond in fiscal year 2004; relocating targets that are close to the fire break road further into the impact area to reduce the likelihood of overshot rounds landing outside the fire break; improvement of the fire break road around the McCarthy Flats ranges to the same standards as the existing fire break roads; and managing the fuels on the ridge leading to Puu Pane (U.S. Army 2003b). Additional restrictions, such as prohibiting smoking on site, are identified in the Standard Operating Procedures and the Biological Assessment for SBMR (U.S. Army 2003a). However, the latest fires at SBMR (July and August 2003) indicate that full control of fire is not possible, even with all of these precautions and restrictions in place, and therefore the Service believes the risk to all species is higher than the Army indicates in the Biological Assessment. With these measures in place the threat from fire to these individuals will be minimized; however, the potential for a wildland fire can never be totally eliminated.

There is a low threat from a round unintentionally landing outside of the impact area and exploding on or near the population of *Labordia cyrtandrae* in north Mohiakea Gulch under Legacy training. However, there will be an increase in the use of grenades and mortar ammunition, which are more likely to land outside of the current fire break road, and therefore more likely to impact this species (U.S. Army 2003a).

Not only is there the potential for the direct loss of *Labordia cyrtandrae* due to fire, but a fire may open up the habitat allowing for the invasion of non-native plant species. The ongoing threat from increased non-native plant invasion is always prevalent within, and adjacent to, high

disturbance areas such as military training facilities. There are several additional potential sources of non-native plant introduction in SBMR. Invasive plants could be spread within the installation by mounted maneuvers, range construction and maintenance, and especially after a fire. Some non-native invasive plants can also spread into undisturbed areas once they have become established in a disturbed area. Invasive plant encroachment will also be a possibility after a major disturbance event such as a fire and this threat would have a significant effect should a fire occur in the vicinity of these plants. The possibility of invasive plant species encroaching into existing *Labordia cyrtandrae* locations is moderate in the lowland mesic forest and shrubland, and low to moderate in the wet cliff and lowland wet forest and shrubland which are not as prone to invasive plant incursion. To minimize this threat the Army will prevent secondary non-native plant spread from fire by monitoring and eradicating newly dispersed non-native plants; implementing all minimization actions described in the project description for this threat; and supporting development of detailed methods for the monitoring and eradication of non-native invasive plants by the Oahu Implementation Team. In addition, if a fire does occur and native habitat is lost, the Army will work with the Service regarding their restoration of the damaged area to prevent the spread of additional invasive plant species (U.S. Army 2003a).

Feral ungulates are found throughout all of the installations and are a continued additional pressure for *Labordia cyrtandrae*. Pigs are particularly destructive as they trample, root and eat native vegetation and can introduce invasive species through fecal matter. These rooting sites are another avenue for establishment of invasive plants plant species. In the past in SBMR, the Army allowed private hunting parties to enter these areas for the purpose of controlling feral pigs. Due to unexploded ordinance liability issues, the Army has since curtailed public hunting in SBMR, which has resulted in a drastic increase in pig numbers. Currently, pig control is the sole responsibility of the Army Natural Resource staff. The lack of hunting, and hence proliferation of pigs, presents a direct and constant threat to all *L. cyrtandrae* occurrences within the action area. Additional measures will be considered by the Oahu Implementation Team, including fencing in appropriate locations in and out of the action areas (U.S. Army 2003a).

Overall, Legacy training and future Transformation actions at SBMR may result in adverse effects to 13 *Labordia cyrtandrae* individuals due to the loss of plants and suitable habitat from fire, munitions training, and the spread and introduction of non-native plant species. The lack of access to this area also exacerbates the threat to this species from feral pigs and non-native plant species. The impacts from these threats could be significant because of the limited number of total remaining individuals, 68 percent of which occur within SBMR action area. There is the potential that a sizable number of these plants could be wiped out by one catastrophic event due to the highly concentrated distribution of the remaining plants. The loss of even one plant could cause an adverse effect to this species because there are only a total of 19 plants left in the wild.

In addition to all of the minimization actions described in the effects section, an Implementation Plan will be developed and implemented for the Oahu action areas, which will include a stabilization plan for *Labordia cyrtandrae*. The stabilization plan will include those actions listed

in the Conservation Needs in the Action Areas section, along with any additional measures identified by the Oahu Implementation Team.

Summary

The risk to *Labordia cyrtandrae* from Legacy and Transformation training has been reduced through the restrictions the Army has made to its routine training activities and the development and implementation of its WFMP. This species is not considered stable at this time, but the stabilization actions to be developed for the Oahu IP will benefit the species so that potential impacts associated with military training activities will be minimized in the short-term and the species will be stabilized in the long-term. The Service has final approval of the Oahu IP to assure the Army's minimization and stabilization actions will stabilize the species and increase the environmental baseline of the species. Based on the actions and issues outlined in the Project Description and the Effects of the Action on the Listed Species sections above and the species stabilization actions as described in the Biological Assessment, the Service believes that the Army's proposed action is outweighed by the long-term benefits from stabilizing this species.

Lepidium arbuscula

Currently, there are 906 *Lepidium arbuscula* individuals remaining in 10 occurrences on the island of Oahu, distributed from Kuaokala in the northern Waianae Mountains to Lualualei-Nanakuli Ridge in the southern Waianae Mountains. One percent (10 individuals) of the known individuals of this species are found within the SBMR action area in a single occurrence in Mohiakea Gulch containing ten individual plants (see Figure 10b in the Biological Assessment). The closest individuals to the firebreak are located over 500 m (1,700 ft) away. Additional individuals occur within the MMR action area: Ohikilolo (1 individual); Makua/Keaau Ridge (60); Kapuhi Gulch (20); and Manini Gulch (1), representing nine percent of the species. In total, 10 percent of the species occurs within action areas J. Lau, HINHP, pers. comm. 2003; K. Kawelo, U.S. Army, pers. comm. 2003). There are no Army actions proposed for the areas where *L. arbuscula* is found within SBMR, as mounted and dismounted maneuvers are restricted by the presence of unexploded ordnance. While most of the high explosive rounds fired during live-fire training at SBMR land within the designated impact area, numerous rounds can be found on the ground above the fire break road which forms the boundary of the impact area. This demonstrates that some rounds either ricochet out of the impact area or exceed their expected range. Fire can also carry from within the impact area out of the fire break road into habitat of listed species. Live-fire ammunition includes tracers and various types of high explosive rounds, both of which are highly incendiary. Live-fire training exercises currently occur within the impact area an average of 220 days per year, utilizing over 29,000 rounds of tracers and various types of high explosive ammunition. Transformation will result in the reduction in 5.56 mm ball and tracer munition use and increases in other small arms ball and munition use. There will be an increase in the use of grenades and mortar ammunition, which are more likely to land outside of the current fire break road and have been responsible for starting previous fires. Of note is the addition of the mobile gun Stryker-mounted system that shoots 155 mm munition, which behave similarly to mortar rounds. Mortar rounds are currently limited to a charge of three to ensure that they do not

land above the upper elevation boundary of SBMR, but this charge does not limit the ability of the round to land outside of the fire break road (U.S. Army 2003a).

The primary effect to this species in SBMR from ongoing and SBCT training activities is the continued risk of fire, particularly due to use of live-fire ammunition. A fire can start either from a round igniting vegetation within the impact area and the fire jumping the fire break road or a round that lands outside the impact area and starts a fire outside the fire break road. Therefore, additional use of these weapons systems under SBCT will increase the risk of fire in the areas where this species occurs. There is also the potential for ignition caused by catalytic converters and construction equipment. The *Lepidium arbuscula* occurrences are found in areas with a low fire vulnerability rating due to their distance from the impact area and the presence of less flammable vegetation (U.S. Army 2003a). Minimization measures for fire from all ignition sources are outlined in the project description, including implementation of the WFMP. The WFMP includes the following actions for SBMR that will reduce the risk of fire at this installation: implementation of a Fire Danger Rating System that will restrict training according to weather and fuel conditions, monitored hourly by range control; construction of a 1,136 cubic meter (300,000 gallon) dip pond in fiscal year 2004; relocating targets that are close to the fire break road further into the impact area to reduce the likelihood of overshot rounds landing outside the fire break; improvement of the fire break road around the McCarthy Flats ranges to the same standards as the existing fire break roads; and managing the fuels on the ridge leading to Puu Pane (U.S. Army 2003b). Additional restrictions, such as prohibiting smoking on site, are identified in the Standard Operating Procedures and the Biological Assessment for SBMR (U.S. Army 2003a). However, the latest fires at SBMR (July and August 2003) indicate that full control of fire is not possible, even with all of these precautions and restrictions in place, and therefore the Service believes the risk to all species is higher than the Army indicates in the Biological Assessment. With these measures in place the threat from fire to these individuals will be minimized; however, the potential for a wildland fire can never be totally eliminated.

There is a low threat from a round unintentionally landing outside of the impact area and exploding on or near the population of *Lepidium arbuscula* in Mohiakea Gulch under Legacy training. However, there will be an increase in the use of grenades and mortar ammunition, which are more likely to land outside of the current fire break road, and therefore more likely to impact this species (U.S. Army 2003a).

Not only is there the potential for the direct loss of *Lepidium arbuscula* due to fire, but a fire may open up the habitat allowing for the invasion of non-native plant species. The ongoing threat from increased non-native plant invasion is always prevalent within, and adjacent to, high disturbance areas such as military training facilities. There are several additional potential sources of non-native plant introduction in SBMR. Invasive plants could be spread within the installation by mounted maneuvers, range construction and maintenance, and especially after a fire. Some non-native invasive plants can also spread into undisturbed areas once they have become established in a disturbed area. Invasive plant encroachment will also be a possibility after a major

disturbance event such as a fire and this threat would have a significant effect should a fire occur in the vicinity of these plants. The possibility of invasive plant species encroaching into existing *L. arbuscula* locations is high for those occurrences in lowland dry shrubland and grassland community and moderate for the occurrence in lowland mesic forest and shrubland. To minimize this threat the Army will prevent secondary non-native plant spread from fire by monitoring and eradicating newly dispersed non-native plants; implementing all minimization actions described in the project description for this threat; and supporting development of detailed methods for the monitoring and eradication of non-native invasive plants by the Oahu Implementation Team. In addition, if a fire does occur and native habitat is lost, the Army will work with the Service regarding their restoration of the damaged area to prevent the spread of additional invasive plant species (U.S. Army 2003a).

Feral ungulates are found throughout all of the installations and are a continued additional pressure for *Lepidium arbuscula*. Pigs are particularly destructive as they trample, root and eat native vegetation and can introduce invasive species through fecal matter. These rooting sites are another avenue for establishment of invasive plants. In the past in SBMR, the Army allowed private hunting parties to enter these areas for the purpose of controlling feral pigs. Due to unexploded ordinance liability issues, the Army has since curtailed public hunting in SBMR, which has resulted in a drastic increase in pig numbers. Currently, pig control is sole responsibility of the Army Natural Resource staff. The lack of hunting, and hence proliferation of pigs, presents a direct and constant threat to all *L. arbuscula* occurrences within the action area. Additional measures will be considered by the Oahu Implementation Team, including fencing in appropriate locations in and out of the action areas (U.S. Army 2003a).

Lepidium arbuscula does not require stabilization because fifty percent of the known individuals do not occur in the Army action areas, and there are at least three stable population units of greater than 50 mature, reproducing individuals outside of the Army action areas. The Oahu Implementation Team will consider species-specific management actions such as collection for genetic storage.

Summary

The risk to *Lepidium arbuscula* from Legacy and Transformation training has been reduced through the restrictions the Army has made to its routine training activities and the development and implementation of its WFMP. This species is considered stable at this time and the stabilization actions developed for other species in the Makua IP will benefit the species so that potential impacts associated with military training activities will be minimized in the short-term. Based on the actions and issues outlined in the Project Description and the Effects of the Action on the Listed Species sections above and the benefit to this species from the species stabilization actions of other species within SBMR as described in the Biological Assessment and the Makua IP, the Service believes that the Army's proposed action is outweighed by the long-term benefits to this species.

Lobelia gaudichaudii* ssp. *koolauensis

Currently, *Lobelia gaudichaudii* ssp. *koolauensis* is known from two occurrences totaling less 263 individuals. Ten percent (26 individuals) of the known individuals of this species are found in south Kaukonahua within the SBER action area (see Figure 9c in the Biological Assessment) (K. Kawelo, U.S. Army, pers. comm. 2003; J. Lau, HINHP, pers. comm. 2003). These individuals are located in an area characterized by the Army as low use, which includes the following: dismounted maneuvers, foot reconnaissance, bivouac, helicopter aviation training, and air assault. Within the training area, it is estimated that there will be one to two operations a month of company size moving through the area in squad (9 soldiers) or platoon (35 soldiers) units for a duration of two to five days, but for battalion-size (500 soldiers) and larger operations, the duration may be 10 to 14 days. Based upon data compiled for Legacy training for the years 1998-2002, the average number of troops using this area annually was 5,067 with the average days of use per year being 47. Foot maneuvers will be focused on and around trails, bivouac activity will be limited in area due to the extreme terrain in the SBER action area, and helicopter and air assault activities will be restricted to open landing and drop zones. Blank ammunition and ground pyrotechnics are used in this area during foot maneuvers (U.S. Army 2003a).

One of the effects to this species from ongoing and SBCT training activities is the continued risk of fire particularly due to pyrotechnic exercises, blank training exercises, cigarette smoking, cookstoves/fires at bivouac sites, and other accidental or unforseen ignition sources. The fire threat is very low for *Lobelia gaudichaudii* ssp. *koolauensis* individuals that are located in SBER because the plants are found in lowland wet forest or shrubland and are not near any trails or landing zones. In the periods 1994 to 1998 and 2000 to 2002, a total of 14 fires were reported in SBER, impacting approximately 9 ha (23 ac). The most common cause was pyrotechnics of various varieties. Minimization measures for fire from all ignition sources are outlined in the project description, including implementation of the WFMP. The WFMP includes the following actions for SBER that will reduce the risk of fire at this installation: implementing a Fire Danger Rating System that will restrict training according to weather and fuel conditions, monitored hourly by range control; fuel load reduction as appropriate, use of the dip pond at DMR; maintaining road to fuel break standards, and reinitiating this consultation should a fire escape the installation boundary or starts or spreads within 521 m (1,771 ft) of a listed species (U.S. Army 2003b). However, the latest fires at SBMR (July and August 2003) indicate that full control of fire is not possible, even with all of these precautions and restrictions in place, and therefore the Service believes the risk to all species is higher than the Army indicates in the Biological Assessment. Additional restrictions, such as prohibiting smoking on site, are identified in the Standard Operating Procedures and the Biological Assessment for SBER. With these measures in place the threat from fire to these individuals will be minimized; however, the potential for a wildland fire can never be totally eliminated. In addition, the Army will implement any additional minimization actions determined necessary by the Oahu Implementation Team (U.S. Army 2003a).

The main effect to *Lobelia gaudichaudii koolauensis* from Army training and SBCT Transformation in SBER is trampling from foot maneuvers. The threat of trampling from foot

traffic is very low or non-existent for trees and shrubs, unless the plants are in the seedling stage or the trampling occurs close to the root system, causing compaction of the soil and decreasing the plant's ability to take up water and nutrients. The threat of trampling from foot traffic is low for *L. gaudichaudii* ssp. *koolauensis* in the SBER action area. These plants are found in areas of low and moderate vulnerability foot traffic areas, in the highest elevations of SBER. It is unlikely that these plants will come into contact with foot maneuvers because they are located in such a remote area. The Army will fence these two occurrences to guard against damage by feral pigs and foot traffic. In addition, to minimize the threat to seedlings the Army will educate each set of new soldiers on avoidance of trampling of endangered species, establish long-term conservation trend analysis (ITAM) plots to monitor impact of foot traffic trampling by infantry soldiers; and establish signage to identify areas that are off limits due to the presence of federally listed species. Additional measures will be considered by the Oahu Implementation Team (U.S. Army 2003a).

The ongoing threat from increased non-native plant invasion is always prevalent within, and adjacent to, high disturbance areas such as military training facilities. There are several potential sources of non-native plant introduction in SBER. Invasive plants could be spread within the installation by dismounted and mounted maneuvers, range construction and maintenance, and especially after a fire. Some non-native invasive plants can also spread into undisturbed areas once they have become established in a disturbed area. Invasive plant encroachment will also be a possibility after a major disturbance event such as a fire and this threat would have a significant effect should a fire occur in the vicinity of these plants. The non-native plant threat from Army training and SBCT Transformation is low to moderate in the lowland wet forest and shrub location of the SBER action area where *Lobelia gaudichaudii* var. *koolauensis* are found. In addition, these plants are not located near trails or open landing zones, further reducing the threat of non-native plants from Army training. To minimize this threat the Army will prevent secondary non-native plant spread from fire by monitoring and eradicating newly dispersed non-native plants; implementing all minimization actions described in the project description for this threat; and supporting development of detailed methods for the monitoring and eradication of non-native invasive plants by the Oahu Implementation Team. In addition, if a fire does occur and native habitat is lost, the Army will work with the Service regarding their restoration of the damaged area to prevent the spread of additional invasive plant species (U.S. Army 2003a).

Feral ungulates are found throughout all of the installations and are a continued additional pressure for *Lobelia gaudichaudii* ssp. *koolauensis*. Pigs are particularly destructive as they trample, root and eat native vegetation and can introduce invasive species through fecal matter. These rooting sites are another avenue for establishment of invasive plants. However, the fencing that will occur to avoid trampling from foot maneuvers will also protect the occurrences within the action area from ungulates. Additional measures will be considered by the Oahu Implementation Team (U.S. Army 2003a).

In addition to all of the minimization actions described in the effects section, an Implementation Plan will be developed and implemented for the Oahu action areas, which will include a

stabilization plan for *Lobelia gaudichaudii* ssp. *koolauensis*. The stabilization plan will include those actions listed in the Conservation Needs in the Action Areas section, along with any additional measures identified by the Oahu Implementation Team.

Summary

The risk to *Lobelia gaudichaudii* ssp. *koolauensis* from Legacy and Transformation training has been reduced through the restrictions the Army has made to its routine training activities and the development and implementation of its WFMP. This species is not considered stable at this time, but the stabilization actions to be developed for the Oahu IP will benefit the species so that potential impacts associated with military training activities will be minimized in the short-term and the species will be stabilized in the long-term. The Service has final approval of the Oahu IP to assure the Army's minimization and stabilization actions will stabilize the species and increase the environmental baseline of the species. Based on the actions and issues outlined in the Project Description and the Effects of the Action on the Listed Species sections above and the species stabilization actions as described in the Biological Assessment, the Service believes that the Army's proposed action is outweighed by the long-term benefits from stabilizing this species.

Melicope lydgatei

Currently, two occurrences of 39 to 40 *Melicope lydgatei* are known in the wild. There is a single occurrence containing 38 individuals located in Opaeula/lower Peahinaia trail within KLOA (see Figure 7b in the Biological Assessment) (J. Lau, HINHP, pers. comm. 2003; K. Kawelo, U.S. Army, pers. comm. 2003). Identified actions in these areas include dismounted maneuvers, foot reconnaissance, bivouac, helicopter aviation training, and air assault. These operations take place one to two times per month for an average of two to five days at a time at company level (120 soldiers) size. These operations have the potential of lasting up to 10 days in length. The companies move through the area in squad (9 soldiers) or platoon (35 soldiers) units. Based upon data compiled for Legacy training for the years 1998-2002, it is estimated that the average number of troops that will use this area will be 17,422 over an average of 137 days per year. Mounted (vehicle) maneuvers will be restricted to existing roads, most of which are far from any existing endangered species occurrences; foot maneuvers will be focused on and around trails; bivouac activity will be limited in area due to the extreme terrain found in much of the KLOA action area; and helicopter and air assault activities will be restricted to open landing and drop zones. Blank ammunition and ground pyrotechnics are used in this area during foot maneuvers.

One of the effects to this species from ongoing and SBCT training activities is the continued risk of fire particularly due to pyrotechnic exercises, blank training exercises, cigarette smoking, cookstoves/fires at bivouac sites, and other accidental or unforseen ignition sources. The *Melicope lydgatei* individuals in KLOA are located in wet summit crest vegetation that has a negligible threat from fire. One fire occurred in 2000, burning 125.5 ha (310 ac), and is believed to have been started by blank ammunition or a muzzle flash (U.S. Army 2003a). Minimization measures for fire from all ignition sources are outlined in the project description, including implementation of the WFMP. The WFMP includes the following actions for KLOA that will

reduce the risk of fire at this installation: implementing a Fire Danger Rating System that will restrict training according to weather and fuel conditions and will be monitored hourly by range control; fuel load reduction as appropriate; use of the dip pond at DMR; maintaining roads to fuel break standards, and reinitiating this consultation should a fire escape the installation boundary, or starts or spreads within 521 m (1,771 ft) of a listed species (U.S. Army 2003b). However, the latest fires at SBMR (July and August 2003) indicate that full control of fire is not possible, even with all of these precautions and restrictions in place, and therefore the Service believes the risk to all species is higher than the Army indicates in the Biological Assessment. Additional restrictions, such as prohibiting smoking on site, are identified in the Standard Operating Procedures and the Biological Assessment for KLOA (U.S. Army 2003a). With these measures in place the threat from fire to these individuals will be minimized; however, the potential for a wildland fire can never be totally eliminated.

The threat of trampling from foot traffic is very low or non-existent for trees and shrubs, unless the plants are in the seedling stage or the trampling occurs close to the root system, causing compaction of the soil and decreasing the plant's ability to take up water and nutrients. Trampling from foot maneuvers is the main threat to *Melicope lydgatei* from Army training and SBCT Transformation. All individuals within KLOA are located either directly along a trail or within 300 m (1,020 ft) of a trail, and therefore are highly susceptible to damage from someone stepping off the trail, especially since they are found at lower elevations. The Army is more likely to use the lower elevations of the trails rather than hike to the summit on a regular basis (K. Kawelo, U.S. Army, pers. comm. 2003). The Army will fence all individuals of this species to protect them from damage from feral pigs and military foot traffic. With only 38 plants remaining in the wild, the loss of even one individual, mature or seedling, could do harm to the genetic variability of this species. Compounding this problem is the fact that *Melicopes* in Hawaii are one of the least studied and understood genera. To minimize the threat to seedlings the Army will educate each set of new soldiers on avoidance of trampling of endangered species; fence the occurrences near trails; establish long-term conservation trend analysis (ITAM) plots to monitor impact of foot traffic trampling by infantry soldiers; and establish signage to identify areas that are off limits due to the presence of federally listed species. Additional measures, such as fencing of those occurrences most in danger of trampling, will be considered by the Oahu Implementation Team (U.S. Army 2003a).

The ongoing threat from increased non-native plant invasion is always prevalent within, and adjacent to, high disturbance areas such as military training facilities. There are several potential sources of non-native plant introduction in KLOA. Invasive plants could be spread within the installation by dismounted and mounted maneuvers, Drum Road construction, other range construction and maintenance, and especially after a fire. Some non-native invasive plants can also spread into undisturbed areas once they have become established in a disturbed area. Invasive plant encroachment will also be a possibility after a major disturbance event such as a fire and this threat would have a significant effect should a fire occur in the vicinity of these plants. The non-native plant threat from Army training and SBCT Transformation is low to moderate in

the lowland wet forest and shrub location where *Melicope lydgatei* is found. To minimize this threat the Army will prevent secondary non-native plant spread from fire by monitoring and eradicating newly dispersed non-native plants; implementing all minimization actions described in the project description for this threat; and supporting development of detailed methods for the monitoring and eradication of non-native invasive plants by the Oahu Implementation Team. In addition, if a fire does occur and native habitat is lost, the Army will work with the Service regarding their restoration of the damaged area to prevent the spread of additional invasive plant species (U.S. Army 2003a).

Feral ungulates are found throughout all of the installations and are a continued additional pressure for *Melicope lydgatei*. Pigs are particularly destructive as they trample, root and eat native vegetation and can introduce invasive species through fecal matter. These rooting sites are another avenue for establishment of invasive plants. However, the fencing that will occur to avoid trampling from foot maneuvers will also protect the occurrences within the action area from ungulates. Additional measures will be considered by the Oahu Implementation Team (U.S. Army 2003a).

Melicope lydgatei is also threatened by the black twig borer. The black twig borer has been cited as an immediate threat to many tree species in Hawaii. The black twig borer burrows into the branches and introduces a pathogenic fungus, pruning the host severely and often killing branches or whole plants. Plants often suffer slight to severe defoliation that leads to reduced vigor due to the infestation of this non-native insect. There is currently no known control for this non-native insect but tests on biological controls are ongoing (Service 1999a).

In addition to all of the minimization actions described in the effects section, an Implementation Plan will be developed and implemented for the Oahu action areas, which will include a stabilization plan for *Melicope lydgatei*. The stabilization plan will include those actions listed in the Conservation Needs in the Action Areas section, along with any additional measures identified by the Oahu Implementation Team.

Summary

The risk to *Melicope lydgatei* from Legacy and Transformation training has been reduced through the restrictions the Army has made to its routine training activities and the development and implementation of its WFMP. This species is not considered stable at this time, but the stabilization actions to be developed for the Oahu IP will benefit the species so that potential impacts associated with military training activities will be minimized in the short-term and the species will be stabilized in the long-term. The Service has final approval of the Oahu IP to assure the Army's minimization and stabilization actions will stabilize the species and increase the environmental baseline of the species. Based on the actions and issues outlined in the Project Description and the Effects of the Action on the Listed Species sections above and the species stabilization actions as described in the Biological Assessment, the Service believes that the Army's proposed action is outweighed by the long-term benefits from stabilizing this species.

Myrsine juddii

Currently, there is a single occurrence of *Myrsine juddii* containing 3,000 individuals located between Puu Kainapuaa and north Kaukonahua in KLOA (see Figure 7b in the Biological Assessment) (J. Lau, HINHP, pers. comm. 2003; K. Kawelo, U.S. Army, pers. comm. 2003). Identified actions in these areas include dismounted maneuvers, foot reconnaissance, bivouac helicopter aviation training, and air assault. These operations take place one to two times per month for an average of two to five days at a time at company level (120 soldiers) size. These operations have the potential of lasting up to 10 days in length. The companies move through the area in squad (9 soldiers) or platoon (35 soldiers) units. Based upon data compiled for Legacy training for the years 1998-2002, it is estimated that the average number of troops that will use this area will be 17,422 over an average of 137 days per year. Mounted (vehicle) maneuvers will be restricted to existing roads, most of which are far from any existing endangered species occurrences; foot maneuvers will be focused on and around trails; bivouac activity will be limited in area due to the extreme terrain found in much of the KLOA action area; and helicopter and air assault activities will be restricted to open landing and drop zones. Blank ammunition and ground pyrotechnics are used in this area during foot maneuvers (U.S. Army 2003a).

One of the effects to this species from ongoing and SBCT training activities is the continued risk of fire particularly due to pyrotechnic exercises, blank training exercises, cigarette smoking, cookstoves/fires at bivouac sites, and other accidental or unforseen ignition sources. The Biological Assessment states that there is no threat from fire to *Myrsine juddii* individuals because they occur in wet summit crest vegetation or in lowland forest far removed from any ignition sources, such as landing zones. One fire occurred in 2000, burning 125.5 ha (310 ac), and is believed to have been started by blank ammunition or a muzzle flash (U.S. Army 2003a). Minimization measures for fire from all ignition sources are outlined in the project description, including implementation of the WFMP. The WFMP includes the following actions for KLOA that will reduce the risk of fire at this installation: implementing a Fire Danger Rating System that will restrict training according to weather and fuel conditions and will be monitored hourly by range control; fuel load reduction as appropriate; use of the dip pond at DMR; maintaining roads to fuel break standards, and reinitiating this consultation should a fire escape the installation boundary, or starts or spreads within 521 m (1,771 ft) of a listed species (U.S. Army 2003b). However, the latest fires at SBMR (July and August 2003) indicate that full control of fire is not possible, even with all of these precautions and restrictions in place, and therefore the risk to all species is higher than the Army indicates in the Biological Assessment. Additional restrictions, such as prohibiting smoking on site, are identified in the Standard Operating Procedures and the Biological Assessment for KLOA (U.S. Army 2003a). With these measures in place the threat from fire to these individuals will be minimized; however, the potential for a wildland fire can never be totally eliminated.

The threat of trampling from foot traffic is very low or non-existent for trees and shrubs, unless the plants are in the seedling stage or the trampling occurs close to the root system, causing compaction of the soil and decreasing the plant's ability to take up water and nutrients. Trampling from foot maneuvers is the main threat to *Myrsine juddii* from Army training and SBCT

Transformation. Some of the plants are located in an area characterized as low foot traffic probability and are more than 300 m (1,020 ft) from a trail. The likelihood of these individuals getting trampled is low because of the remote location of the plants and distance from the trail. The individuals located along the summit trail are less than 10 m (34 ft) from the trail. The likelihood of foot trampling at this location is high. This will be a priority area for either fencing or some other way of restricting the probability of someone stepping off the trail onto the area surrounding this plant, in case seedlings are present (U.S. Army 2003a). To minimize the threat to seedlings the Army will educate each set of new soldiers on avoidance of trampling of endangered species; fence the occurrences near trails; establish long-term conservation trend analysis (ITAM) plots to monitor impact of foot traffic trampling by infantry soldiers; and establish signage to identify areas that are off limits due to the presence of federally listed species. Additional measures, such as fencing of those occurrences most in danger of trampling, will be considered by the Oahu Implementation Team (U.S. Army 2003a).

The ongoing threat from increased non-native plant invasion is always prevalent within, and adjacent to, high disturbance areas such as military training facilities. There are several potential sources of non-native plant introduction in KLOA. Invasive plants could be spread within the installation by dismounted and mounted maneuvers, Drum Road construction, other range construction and maintenance, and especially after a fire. Some non-native invasive plants can also spread into undisturbed areas once they have become established in a disturbed area. Invasive plant encroachment will also be a possibility after a major disturbance event such as a fire and this threat would have a significant effect should a fire occur in the vicinity of these plants. The non-native plant threat from current military training and SBCT Transformation is low to moderate in the lowland wet forest and shrub location where *Myrsine juddii* is found, but is considered high for the plants found along the summit trail. The Army will conduct regular weeding trips to this plant to ensure the survival of future seedlings in the area, since these are more threatened by non-native species competition than adult plants (U.S. Army 2003a). To further minimize this threat the Army will prevent secondary non-native plant spread from fire by monitoring and eradicating newly dispersed non-native plants; implementing all minimization actions described in the project description for this threat; and supporting development by the Oahu Implementation Team of detailed methods for the monitoring and eradication of non-native invasive plants. In addition, if a fire does occur and native habitat is lost, the Army will work with the Service regarding their restoration of the damaged area to prevent the spread of additional invasive plant species (U.S. Army 2003a).

Feral ungulates are found throughout all of the installations and are a continued additional pressure for *Myrsine juddii*. Pigs are particularly destructive as they trample, root and eat native vegetation and can introduce invasive species through fecal matter. These rooting sites are another avenue for establishment of invasive plants. However, the fencing that will occur to avoid trampling from foot maneuvers will also protect the occurrences within the action area from ungulates. Additional measures will be considered by the Oahu Implementation Team (U.S. Army 2003a).

In addition to all of the minimization actions described in the effects section, an implementation plan will be developed and implemented for the Oahu action areas, which will include a stabilization plan for *Myrsine juddii*. The stabilization plan will include those actions listed in the Conservation Needs in the Action Areas section, along with any additional measures identified by the Oahu Implementation Team.

Summary

The risk to *Myrsine juddii* from Legacy and Transformation training has been reduced through the restrictions the Army has made to its routine training activities and the development and implementation of its WFMP. This species is not considered stable at this time, but the stabilization actions to be developed for the Oahu IP will benefit the species so that potential impacts associated with military training activities will be minimized in the short-term and the species will be stabilized in the long-term. The Service has final approval of the Oahu IP to assure the Army's minimization and stabilization actions will stabilize the species and increase the environmental baseline of the species. Based on the actions and issues outlined in the Project Description and the Effects of the Action on the Listed Species sections above and the species stabilization actions as described in the Biological Assessment, the Service believes that the Army's proposed action is outweighed by the long-term benefits from stabilizing this species.

Phlegmariurus nutans

All extant *Phlegmariurus nutans* are found in the Koolau Mountains of Oahu. Here 11 individuals are found in five occurrences. Five individuals occur in two of the Oahu action areas: KLOA and SBER (see Figures 7b and 9c in the Biological Assessment). These represent 45 percent of the known individuals of *P. nutans.*

KLOA

The four individual *Phlegmariurus nutans* occur in training area KB-1 which is located in the southeast corner of the action area. They are found in lowland wet forest and shrubland habitat. Identified actions in these areas include dismounted maneuvers, foot reconnaissance, bivouac, helicopter aviation training, and air assault. These operations take place one to two times per month for an average of two to five days at a time at company level (120 soldiers) size. These operations have the potential of lasting up to 10 days in length. The companies move through the area in squad (9 soldiers) or platoon (35 soldiers) units. Based upon data compiled for Legacy training for the years 1998-2002, it is estimated that the average number of troops that will use this area will be 17,422 over an average of 137 days per year. Mounted (vehicle) maneuvers will be restricted to existing roads, most of which are far from any existing endangered species occurrences; foot maneuvers will be focused on and around trails; bivouac activity will be limited in area due to the extreme terrain found in much of the KLOA action area; and helicopter and air assault activities will be restricted to open landing and drop zones. Blank ammunition and ground pyrotechnics are used in this area during foot maneuvers (U.S. Army 2003a).

One of the effects to this species from ongoing and SBCT training activities is the continued risk of fire particularly due to pyrotechnic exercises, blank training exercises, cigarette smoking,

cookstoves/fires at bivouac sites, and other accidental or unforseen ignition sources. Four of the five *Phlegmariurus nutans* occur in an area ranked as low vulnerability, with the fifth individual located above the summit trail in an area considered to have no vulnerability. The threat of *Phlegmariurus nutans* being directly and adversely affected by fire is considered to be very low. Individuals occur in wet forest and in an areas where training use is low. The closest open landing or drop zones are greater than 5,000 m (16,250 ft) from the closest individual of *P. nutans*. While the threat from fire to *P. nutans* at KLOA can be reduced to very low with the implementation of those relevant minimization measures and Standard Operating Procedures within the WFMP, these five individuals represent 45 percent of the species rangewide and their loss as a result of fire would significantly affect this species and compromise recovery efforts. One fire occurred in 2000, burning 125.5 ha (310 ac), and is believed to have been started by blank ammunition or a muzzle flash (U.S. Army 2003a). Minimization measures for fire from all ignition sources are outlined in the project description, including implementation of the WFMP. The WFMP includes the following actions for KLOA that will reduce the risk of fire at this installation: implementing a Fire Danger Rating System that will restrict training according to weather and fuel conditions and will be monitored hourly by range control; fuel load reduction as appropriate; use of the dip pond at DMR; maintaining roads to fuel break standards, and reinitiating this consultation should a fire escape the installation boundary, or starts or spreads within 521 m (1,771 ft) of a listed species (U.S. Army 2003b). However, the latest fires at SBMR (July and August 2003) indicate that full control of fire is not possible, even with all of these precautions and restrictions in place, and therefore the Service believes the risk to all species is higher than the Army indicates in the Biological Assessment. Additional restrictions, such as prohibiting smoking on site, are identified in the Standard Operating Procedures and the Biological Assessment for KLOA (U.S. Army 2003a). With these measures in place the threat from fire to these individuals will be minimized; however, the potential for a wildland fire can never be totally eliminated.

The ongoing threat from increased non-native plant invasion is always prevalent within, and adjacent to, high disturbance areas such as military training facilities. There are several potential sources of non-native plant introduction in KLOA. Invasive plants could be spread within the installation by dismounted and mounted maneuvers, range construction and maintenance, and especially after a fire. Some non-native invasive plants can also spread into undisturbed areas once they have become established in a disturbed area. Invasive plant encroachment will also be a possibility after a major disturbance event such as a fire and this threat would have a significant effect should a fire occur in the vicinity of these plants. These non-native plant species could affect the vigor of the plant providing substrate for *Phlegmariurus nutans* or lianas and vines could overgrow the epiphyte. The non-native plant threat from Army training and SBCT Transformation is moderate for *P. nutans*. To minimize this threat the Army will prevent secondary non-native plant spread from fire by monitoring and eradicating newly dispersed non-native plants; implementing all minimization actions described in the project description for this threat; and supporting development of detailed methods for the monitoring and eradication of non-native invasive plants by the Oahu Implementation Team. In addition, if a fire does occur and

native habitat is lost, the Army will work with the Service regarding their restoration of the damaged area to prevent the spread of additional invasive plant species (U.S. Army 2003a). These actions will reduce the threat from non-native plants to low for *P. nutans* in KLOA.

Considering the habit of *Phlegmariurus nutans* (epiphyte), location of individuals within the action area, and the types and frequency of training actions that are proposed, it is the Service's opinion that the threat from trampling due to military training is very low. While trampling could occur to plants if present on fallen wood, there is no evidence of plants being trampled at any of the occurrences.

SBER

One individual of *Phlegmariurus nutans* is found as part of lowland wet forest and shrubland in the eastern portion of the SBER action area. This individual is located in south Kaukonahua Gulch within training area ER-13. Considering the habit of the species (epiphyte), location of the individual within the action area, and the types and frequency of training actions that are proposed, the only direct effect of proposed training activities on *P. nutans* would be fire. This individual is located in an area characterized by the Army as low use, which includes the following: dismounted maneuvers, foot reconnaissance, bivouac, helicopter aviation training, and air assault. Within the training area, it is estimated that there will be one to two operations a month of company size moving through the area in squad (9 soldiers) or platoon (35 soldiers) units for a duration of two to five days, but for battalion-size (500 soldiers) and larger operations, the duration may be 10 to 14 days. Based upon data compiled for Legacy training for the years 1998-2002, the average number of troops using this area annually was 5,067 with the average days of use per year being 47. Foot maneuvers will be focused on and around trails, bivouac activity will be limited in area due to the extreme terrain in the SBER action area, and helicopter and air assault activities will be restricted to open landing and drop zones. Blank ammunition and ground pyrotechnics are used in this area during foot maneuvers (U.S. Army 2003a).

One of the effects to this species from ongoing and SBCT training activities is the continued risk of fire particularly due to pyrotechnic exercises, blank training exercises, cigarette smoking, cookstoves/fires at bivouac sites, and other accidental or unforseen ignition sources. The fire threat is low for the *Phlegmariurus nutans* individual that is located in SBER because the plant is found in lowland wet forest or shrubland that is unlikely to burn and therefore has a low fire vulnerability rating. However, because of the very low numbers of known individuals, *P. nutans* is susceptible to catastrophic events such as fire. Therefore, despite the low vulnerability of the fuels to fire, the relatively heavy training load of SBER justifies a moderate vulnerability to fire for this species. In the periods 1994 to 1998 and 2000 to 2002, a total of 14 fires were reported in SBER, impacting approximately 9 ha (23 ac). The most common cause was pyrotechnics of various types (U.S. Army 2003a). Minimization measures for fire from all ignition sources are outlined in the project description, including implementation of the WFMP. The WFMP includes the following actions for SBER that will reduce the risk of fire at this installation: implementing a Fire Danger Rating System that will restrict training according to weather and fuel conditions and

will be monitored hourly by range control; fuel load reduction as appropriate, use of the dip pond at DMR; maintaining road to fuel break standards, and reinitiating this consultation should a fire escape the installation boundary, or starts or spreads within 521 m (1,771 ft) of a listed species (U.S. Army 2003b). However, the latest fires at SBMR (July and August 2003) indicate that full control of fire is not possible, even with all of these precautions and restrictions in place, and therefore the Service believes the risk to all species is higher than the Army indicates in the Biological Assessment. Additional restrictions, such as prohibiting smoking on site, are identified in the Standard Operating Procedures and the Biological Assessment for SBER. With these measures in place the threat from fire to these individuals will be minimized; however, the potential for a wildland fire can never be totally eliminated. In addition, the Army will implement any additional minimization actions determined necessary by the Oahu Implementation Team (U.S. Army 2003a).

The threat of trampling from foot traffic is moderate for the *Phlegmariurus nutans* within SBER as it is found near a main trail. The minimization measures for *P. nutans* in SBER are the same as described above for individuals in the KLOA action area, and will reduce the threat from trampling.

All Installations

Feral ungulates are found throughout all of the installations and are a continued additional pressure for *Phlegmariurus nutans*. Pigs are particularly destructive as they trample, root and eat native vegetation and can introduce invasive species through fecal matter. These rooting sites are another avenue for establishment of invasive plants. However, the fencing that will occur to avoid trampling from foot maneuvers will also protect the occurrences within the action area from ungulates. Additional measures will be considered by the Oahu Implementation Team (U.S. Army 2003a).

In addition to all of the minimization actions described in the effects section, an Implementation Plan will be developed and implemented for the Oahu action areas, which will include a stabilization plan for *Phlegmariurus nutans*. The stabilization plan will include those actions listed in the Conservation Needs in the Action Areas section, along with any additional measures identified by the Oahu Implementation Team.

Summary

The risk to *Phlegmariurus nutans* from Legacy and Transformation training has been reduced through the restrictions the Army has made to its routine training activities and the development and implementation of its WFMP. This species is not considered stable at this time, but the stabilization actions to be developed for the Oahu IP will benefit the species so that potential impacts associated with military training activities will be minimized in the short-term and the species will be stabilized in the long-term. The Service has final approval of the Oahu IP to assure the Army's minimization and stabilization actions will stabilize the species and increase the environmental baseline of the species. Based on the actions and issues outlined in the Project

Description and the Effects of the Action on the Listed Species sections above and the species stabilization actions as described in the Biological Assessment, the Service believes that the risk of the Army's proposed action is outweighed by the long-term benefits from stabilizing this species.

Phyllostegia hirsuta

All extant *Phyllostegia hirsuta* are restricted to the Koolau and Waianae Mountains of Oahu where between 243 and 254 individuals are found as part of 19 occurrences. One hundred and thirteen individuals are found in three of the Oahu action areas: KLOA, SBMR, and SBER (see Figures 7b,10b and 9c, respectively, in the Biological Assessment). These represent approximately 46 percent of the total known individuals of *P. hirsuta*.

KLOA

The fourteen individuals of *Phyllostegia hirsuta* at KLOA represent approximately six percent of the total remaining rangewide, and are found as seven occurrences in training areas KA-2 and KB-2: south Halemano (4 individuals), Opaeula (2), Kawai Iki (2), south branch of north Kaukonahua (1), north Kaukonahua and Poamoho (2), Kawainui (2), north Halemano and Punaluu (1) (K. Kawelo, U.S. Army, pers. comm. 2003; J. Lau, HINHP, pers. comm. 2003). Identified actions in these areas include dismounted maneuvers, foot reconnaissance, bivouac, helicopter aviation training, and air assault. These operations take place one to two times per month for an average of two to five days at a time at company level (120 soldiers) size. These operations have the potential of lasting up to 10 days in length. The companies move through the area in squad (9 soldiers) or platoon (35 soldiers) units. Based upon data compiled for Legacy training for the years 1998-2002, it is estimated that the average number of troops that will use this area will be 17,422 over an average of 137 days per year. Mounted (vehicle) maneuvers will be restricted to existing roads, most of which are far from any existing endangered species occurrences; foot maneuvers will be focused on and around trails; bivouac activity will be limited in area due to the extreme terrain found in much of the KLOA action area; and helicopter and air assault activities will be restricted to open landing and drop zones. Blank ammunition and ground pyrotechnics are used in this area during foot maneuvers.

One of the effects to this species from ongoing and SBCT training activities is the continued risk of fire particularly due to pyrotechnic exercises, blank training exercises, cigarette smoking, cookstoves/fires at bivouac sites, and other accidental or unforseen ignition sources. All of the occurrences are found in either very low or low fire vulnerability areas. Individuals of *Phyllostegia hirsuta* occur in wet forest and in an areas where training use is low. The closest open landing or drop zones are farther than 3,500 m (11,375 ft) from an occurrence. One fire occurred in 2000, burning 125.5 ha (310 ac), and is believed to have been started by blank ammunition or a muzzle flash (U.S. Army 2003a). Minimization measures for fire from all ignition sources are outlined in the project description, including implementation of the WFMP. The WFMP includes the following actions for KLOA that will reduce the risk of fire at this installation: implementing a Fire Danger Rating System that will restrict training according to weather and fuel conditions and will be monitored hourly by range control; fuel load reduction as appropriate; use

of the dip pond at DMR; maintaining roads to fuel break standards, and reinitiating this consultation should a fire escape the installation boundary, or starts or spreads within 521 m (1,771 ft) of a listed species (U.S. Army 2003b). However, the latest fires at SBMR (July and August 2003) indicate that full control of fire is not possible, even with all of these precautions and restrictions in place, and therefore the Service believes the risk to all species is higher than the Army indicates in the Biological Assessment. Additional restrictions, such as prohibiting smoking on site, are identified in the Standard Operating Procedures and the Biological Assessment for KLOA (U.S. Army 2003a). With these measures in place the threat from fire to these individuals will be minimized; however, the potential for a wildland fire can never be totally eliminated.

The threat of trampling from foot traffic is very low or non-existent for trees and shrubs, unless the plants are in the seedling stage or the trampling occurs close to the root system, causing compaction of the soil and decreasing the plant's ability to take up water and nutrients. Locations where all 14 individuals occur are in low use areas and both foot reconnaissance and bivouac activities will be constrained by the extreme topography found in the KLOA action area. Only three individuals of *P. hirsuta* occur within 10 m (32 ft) of a road or trail and for these, the threat of trampling is considered to be high. The remaining individuals are located greater than 60 m (195 ft) from a trail or road. Depending upon the terrain in these areas, the potential threat of trampling ranges from low to moderate for these plants. To minimize the threat to seedlings the Army will educate each set of new soldiers on avoidance of trampling of endangered species; fence the occurrences near trails; establish long-term conservation trend analysis (ITAM) plots to monitor impact of foot traffic trampling by infantry soldiers; and establish signage to identify areas that are off limits due to the presence of federally listed species. Additional measures, such as fencing of those occurrences most in danger of trampling, will be considered by the Oahu Implementation Team (U.S. Army 2003a). These actions will reduce the threat to *P. hirsuta* from trampling to low.

The ongoing threat from increased non-native plant invasion is always prevalent within, and adjacent to, high disturbance areas such as military training facilities. There are several potential sources of non-native plant introduction in KLOA. Invasive plants could be spread within the installation by dismounted and mounted maneuvers, range construction and maintenance, and especially after a fire. Some non-native invasive plants can also spread into undisturbed areas once they have become established in a disturbed area. Invasive plant encroachment will also be a possibility after a major disturbance event such as a fire and this threat would have a significant effect should a fire occur in the vicinity of these plants. The non-native plant threat from Army training and SBCT Transformation is low for *Phyllostegia hirsuta* in the wet forests where the individuals are found. To minimize this threat the Army will prevent secondary non-native plant spread from fire by monitoring and eradicating newly dispersed non-native plants; implementing all minimization actions described in the project description for this threat; and supporting development of detailed methods for the monitoring and eradication of non-native invasive plants by the Oahu Implementation Team. In addition, if a fire does occur and native habitat is lost, the Army will work with the Service regarding their restoration of the damaged area to prevent the spread of additional invasive plant species (U.S. Army 2003a).

SBER

Nine individuals of *Phyllostegia hirsuta* occur as one occurrence in training area ER-13 of the SBER action area in south Kaukonahua Gulch. These represent approximately four percent of the total remaining individuals of this species rangewide (K. Kawelo, U.S. Army, pers. comm. 2003; J. Lau, HINHP, pers. comm. 2003). These individuals are located in an area characterized by the Army as low use, which includes the following: dismounted maneuvers, foot reconnaissance, bivouac, helicopter aviation training, and air assault. Within the training area, it is estimated that there will be one to two operations a month of company size moving through the area in squad (9 soldiers) or platoon (35 soldiers) units for a duration of two to five days, but for battalion-size (500 soldiers) and larger operations, the duration may be 10 to 14 days. Based upon data compiled for Legacy training for the years 1998-2002, the average number of troops using this area annually was 5,067 with the average days of use per year being 47. Foot maneuvers will be focused on and around trails, bivouac activity will be limited in area due to the extreme terrain in the SBER action area, and helicopter and air assault activities will be restricted to open landing and drop zones. Blank ammunition and ground pyrotechnics are used in this area during foot maneuvers (U.S. Army 2003a).

One of the effects to this species from ongoing and SBCT training activities is the continued risk of fire particularly due to pyrotechnic exercises, blank training exercises, cigarette smoking, cookstoves/fires at bivouac sites, and other accidental or unforseen ignition sources. The fire threat is low for the *Phyllostegia hirsuta* individuals that are located in SBER because the plants are found in lowland wet forest or shrubland that is unlikely to burn and therefore has a low fire vulnerability rating. Despite the low vulnerability of the fuels to fire, the relatively heavy training load of SBER justifies a moderate vulnerability to fire for this species. In the periods 1994 to 1998 and 2000 to 2002, a total of 14 fires were reported in SBER, impacting approximately 9 ha (23 ac). The most common cause was pyrotechnics of various types (U.S. Army 2003a). Minimization measures for fire from all ignition sources are outlined in the project description, including implementation of the WFMP. The WFMP includes the following actions for SBER that will reduce the risk of fire at this installation: implementing a Fire Danger Rating System that will restrict training according to weather and fuel conditions and will be monitored hourly by range control; fuel load reduction as appropriate, use of the dip pond at DMR; maintaining road to fuel break standards, and reinitiating this consultation should a fire escape the installation boundary, or starts or spreads within 521 m (1,771 ft) of a listed species (U.S. Army 2003b). However, the latest fires at SBMR (July and August 2003) indicate that full control of fire is not possible, even with all of these precautions and restrictions in place, and therefore the Service believes the risk to all species is higher than the Army indicates in the Biological Assessment. Additional restrictions, such as prohibiting smoking on site, are identified in the Standard Operating Procedures and the Biological Assessment for SBER. With these measures in place the threat from fire to these individuals will be minimized; however, the potential for a wildland fire can never be totally eliminated. In addition, the Army will implement any additional minimization actions determined necessary by the Oahu Implementation Team (U.S. Army 2003a).

The overall use of the training area is low, but all 21 individuals of *Phyllostegia hirsuta* within SBER occur in moderate use areas and within 60 m (195 ft) of a road or trail. As such, the threat of trampling is considered to be moderate to high. The minimization measures for *P. hirsuta* in SBER are the same as described above for individuals in KLOA action area, and will reduce the threat from trampling.

The ongoing threat from increased non-native plant invasion is always prevalent within and adjacent to training facilities. There are several potential sources of non-native plant introduction into SBER, as mentioned above for KLOA. The non-native plant threat from Army training and SBCT Transformation is low for the *Phyllostegia hirsuta* individuals in SBER. The minimization measures for *P. hirsuta* in SBER are the same as described above for individuals in KLOA action area, and will reduce the threat from non-native plants to very low.

SBMR

There are at least 90 individuals of *Phyllostegia hirsuta*, in three occurrences, within the action area for SBMR. These individuals are distributed along the summit of the Koolau Mountains and represent approximately 36 percent of the total remaining individuals of this species rangewide. All are located in the western portion of the installation outside of the impact zone: north Mohiakea Gulch (50), Waianae Kai-Haleauau Ridge (20), and central Haleauau (20) (J. Lau, HINHP, pers. comm. 2003; K. Kawelo, U.S. Army, pers. comm. 2003). There are no Army actions proposed for the areas where *P. hirsuta* is found within SBMR, as mounted and dismounted maneuvers are restricted by the presence of unexploded ordnance. While most of the high explosive rounds fired during live-fire training at SBMR land within the designated impact area, numerous rounds can be found on the ground above the fire break road which forms the boundary of the impact area. This demonstrates that some rounds either ricochet out of the impact area or exceed their expected range. Live-fire ammunition includes high explosive rounds and tracer bullets, both of which are highly incendiary. Fire can also carry from within the impact area out of the fire break road into habitat of listed species. Live-fire training exercises currently occur within the impact area an average of 220 days per year, utilizing over 29,000 rounds of tracers and various types of high explosive ammunition. Transformation will result in the reduction in 5.56 mm ball and tracer munition use and increases in other small arms ball and munition use. There will be an increase in the use of grenades and mortar ammunition, which are more likely to land outside of the current fire break road and have been responsible for starting previous fires. Of note is the addition of the mobile gun Stryker-mounted system that shoots 155 mm munition, which behave similarly to mortar rounds. Mortar rounds are currently limited to a charge of three to ensure that they do not land above the upper elevation boundary of SBMR, but this charge does not limit the ability of the round to land outside of the fire break road (U.S. Army 2003a).

The primary effect to this species in SBMR from ongoing and SBCT training activities is the continued risk of fire, particularly due to use of live-fire ammunition. A fire can start either from a round igniting vegetation within the impact area and the fire jumping the fire break road or a round that lands outside the impact area and starts a fire outside the fire break road. Therefore,

additional use of these weapons systems under SBCT will increase the risk of fire in the areas where this species occurs. There is also the potential for ignition caused by catalytic converters and construction equipment. The *Phyllostegia hirsuta* occurrences are found in wet forest areas with a low fire vulnerability rating due to their distance from the impact area (U.S. Army 2003a). Minimization measures for fire from all ignition sources are outlined in the project description, including implementation of the WFMP. The WFMP includes the following actions for SBMR that will reduce the risk of fire at this installation: implementation of a Fire Danger Rating System that will restrict training according to weather and fuel conditions and will be monitored hourly by range control; construction of a 1,136 cubic meter (300,000 gallon) dip pond in fiscal year 2004; relocating targets that are close to the fire break road further into the impact area to reduce the likelihood of overshot rounds landing outside the fire break; improvement of the fire break road around the McCarthy Flats ranges to the same standards as the existing fire break roads; and managing the fuels on the ridge leading to Puu Pane (U.S. Army 2003b). Additional restrictions, such as prohibiting smoking on site, are identified in the Standard Operating Procedures and the Biological Assessment for SBMR (U.S. Army 2003a). However, the latest fires at SBMR (July and August 2003) indicate that full control of fire is not possible, even with all of these precautions and restrictions in place, and therefore the Service believes the risk to all species is higher than the Army indicates in the Biological Assessment. With these measures in place the threat from fire to these individuals will be minimized; however, the potential for a wildland fire can never be totally eliminated.

There is a low threat from a round unintentionally landing outside of the impact area and exploding on or near the population of *Phyllostegia hirsuta* under Legacy training. However, there will be an increase in the use of grenades and mortar ammunition under SBCT Transformation, which are more likely to land outside of the current fire break road, and therefore more likely to impact this species (U.S. Army 2003a).

The ongoing threat from increased non-native plant invasion is always prevalent within and adjacent to training facilities. There are several potential sources of non-native plant introduction into SBMR, as mentioned above for KLOA, while increased invasive species from fire is a larger threat for this action area. The non-native plant threat from Army training and SBCT Transformation is low for the *Phyllostegia hirsuta* in SBMR. The minimization measures for *P. hirsuta* in SBMR are the same as described above for individuals in the KLOA action area, and will reduce the threat from non-native plants to very low.

All Installations

Feral ungulates are found throughout all of the installations and are a continued additional pressure for *Phyllostegia hirsuta*. Pigs are particularly destructive as they trample, root and eat native vegetation and can introduce invasive species through fecal matter. These rooting sites are another avenue for establishment of invasive plant species. The fencing that will occur to avoid trampling from foot maneuvers will also protect the occurrences within the action area from ungulates. In the past in SBMR, the Army allowed private hunting parties to enter these areas for

the purpose of controlling feral pigs. Due to unexploded ordinance liability issues, the Army has since curtailed public hunting in SBMR, which has resulted in a drastic increase in pig numbers. Currently, pig control is the sole responsibility of the Army Natural Resource staff. The lack of hunting, and hence proliferation of pigs, presents a direct and constant threat to all *P. hirsuta* occurrences within the SBMR action area. Additional measures will be considered by the Oahu Implementation Team, including fencing in appropriate locations in and out of the installation boundaries (U.S. Army 2003a).

Military installations with much human activity and food sources may inadvertently provide a source for increased rat populations in the action areas. This in turn adds another pressure to plant populations with very limited numbers of individuals. Additional measures will be considered by the Oahu Implementation Team (U.S. Army 2003a).

In addition to all of the minimization actions described in the effects section, an Implementation Plan will be developed and implemented for the Oahu action areas, which will include a stabilization plan for *Phyllostegia hirsuta*. The stabilization plan will include those actions listed in the Conservation Needs in the Action Areas section, along with any additional measures identified by the Oahu Implementation Team.

Summary

The risk to *Phyllostegia hirsuta* from Legacy and Transformation training has been reduced through the restrictions the Army has made to its routine training activities and the development and implementation of its WFMP. This species is not considered stable at this time, but the stabilization actions to be developed for the Oahu IP will benefit the species so that potential impacts associated with military training activities will be minimized in the short-term and the species will be stabilized in the long-term. The Service has final approval of the Oahu IP to assure the Army's minimization and stabilization actions will stabilize the species and increase the environmental baseline of the species. Based on the actions and issues outlined in the Project Description and the Effects of the Action on the Listed Species sections above and the species stabilization actions as described in the Biological Assessment, the Service believes that the risk of the Army's proposed action is outweighed by the long-term benefits from stabilizing this species.

Phyllostegia kaalaensis

All extant *Phyllostegia kaalaensis* are restricted to the Waianae Mountains of Oahu where between 33 and 28 individuals are found in six occurrences. Ten individuals are found in SBMR (see Figure 10b in the Biological Assessment) at Palikea Gulch and represent between 26 and 30 percent of the total known individuals of *P. kaalaensis*. *Phyllostegia kaalaensis* occurs in mesic forest and is found at least 1,000 m (3,250 ft) upslope of the fuel break road (K. Kawelo, U.S. Army 2003; J. Lau, HINHP, pers. comm. 2003). There are no Army actions proposed for the areas where *P. kaalaensis* is found within SBMR, as mounted and dismounted maneuvers are restricted by the presence of unexploded ordnance. While most of the high explosive rounds fired during live-fire training at SBMR land within the designated impact area, numerous rounds can be

found on the ground above the fire break road which forms the boundary of the impact area. This demonstrates that some rounds either ricochet out of the impact area or exceed their expected range. Fire can also carry from within the impact area out of the fire break road into habitat of listed species. Live-fire ammunition includes tracers and various types of high explosive rounds, both of which are highly incendiary. Live-fire training exercises currently occur within the impact area an average of 220 days per year, utilizing over 29,000 rounds of tracers and various types of high explosive ammunition. Transformation will result in the reduction in 5.56 mm ball and tracer munition use and increases in other small arms ball and munition use. There will be an increase in the use of grenades and mortar ammunition, which are more likely to land outside of the current fire break road and have been responsible for starting previous fires. Of note is the addition of the mobile gun Stryker-mounted system that shoots 155 mm munition, which behave similarly to mortar rounds. Mortar rounds are currently limited to a charge of three to ensure that they do not land above the upper elevation boundary of SBMR, but this charge does not limit the ability of the round to land outside of the fire break road (U.S. Army 2003a).

The primary effect to this species in SBMR from ongoing and SBCT training activities is the continued risk of fire, particularly due to use of live-fire ammunition. A fire can start either from a round igniting vegetation within the impact area and the fire jumping the fire break road or a round that lands outside the impact area and starts a fire outside the fire break road. Therefore, additional use of these weapons systems under SBCT will increase the risk of fire in the areas where this species occurs. There is also the potential for ignition caused by catalytic converters and construction equipment. The *Phyllostegia kaalaensis* occurrences are found in mesic forest areas with a low fire vulnerability rating due to their distance from the impact area (U.S. Army 2003a). Minimization measures for fire from all ignition sources are outlined in the project description, including implementation of the WFMP. The WFMP includes the following actions for SBMR that will reduce the risk of fire at this installation: implementation of a Fire Danger Rating System that will restrict training according to weather and fuel conditions and will be monitored hourly by range control; construction of a 1,136 cubic meter (300,000 gallon) dip pond in fiscal year 2004; relocating targets that are close to the fire break road further into the impact area to reduce the likelihood of overshot rounds landing outside the fire break; improvement of the fire break road around the McCarthy Flats ranges to the same standards as the existing fire break roads; and managing the fuels on the ridge leading to Puu Pane (U.S. Army 2003b). Additional restrictions, such as prohibiting smoking on site, are identified in the Standard Operating Procedures and the Biological Assessment for SBMR (U.S. Army 2003a). However, the latest fires at SBMR (July and August 2003) indicate that full control of fire is not possible, even with all of these precautions and restrictions in place, and therefore the Service believes the risk to all species is higher than the Army indicates in the Biological Assessment. With these measures in place the threat from fire to these individuals will be minimized; however, the potential for a wildland fire can never be totally eliminated.

There is a low threat from a round unintentionally landing outside of the impact area and exploding on or near the population of *Phyllostegia kaalaensis* under Legacy training. However, there will be an increase in the use of grenades and mortar ammunition under SBCT Transformation, which

are more likely to land outside of the current fire break road, and therefore more likely to impact this species (U.S. Army 2003a).

Not only is there the potential for the direct loss of *Phyllostegia kaalaensis* due to fire, but a fire may open up the habitat allowing for the invasion of non-native plant species. The ongoing threat from increased non-native plant invasion is always prevalent within, and adjacent to, high disturbance areas such as military training facilities. There are several additional potential sources of non-native plant introduction in SBMR. Invasive plants could be spread within the installation by mounted maneuvers, range construction and maintenance, and especially after a fire. Some non-native invasive plants can also spread into undisturbed areas once they have become established in a disturbed area. Invasive plant encroachment will also be a possibility after a major disturbance event such as a fire and this threat would have a significant effect should a fire occur in the vicinity of these plants. The non-native plant threat from Army training and SBCT Transformation is low for *P. kaalaensis*, in the lowland mesic forests where they are found. To minimize this threat the Army will prevent secondary non-native plant spread from fire by monitoring and eradicating newly dispersed non-native plants; implementing all minimization actions described in the project description for this threat; and supporting development of detailed methods for the monitoring and eradication of non-native invasive plants by the Oahu Implementation Team. In addition, if a fire does occur and native habitat is lost, the Army will work with the Service regarding their restoration of the damaged area to prevent the spread of additional invasive plant species (U.S. Army 2003a).

Feral ungulates are found throughout all of the installations and are a continued additional pressure for *Phyllostegia kaalaensis*. Pigs are particularly destructive as they trample, root and eat native vegetation and can introduce invasive species through fecal matter. These rooting sites are another avenue for establishment of invasive plants. In the past in SBMR, the Army allowed private hunting parties to enter these areas for the purpose of controlling feral pigs. Due to unexploded ordinance liability issues, the Army has since curtailed public hunting in SBMR, which has resulted in a drastic increase in pig numbers. Currently, pig control is the sole responsibility of the Army Natural Resource staff. The lack of hunting, and hence proliferation of pigs, presents a direct and constant threat to all *P. kaalaensis* occurrences within the action area. Additional measures will be considered by the Oahu Implementation Team, including fencing in appropriate locations in and out of the action area (U.S. Army 2003a).

In addition to all of the minimization actions described in the effects section, the Makua IP has been finalized which includes stabilization actions for *Phyllostegia kaalaensis*. These stabilization actions are listed in the Conservation Needs in the Action Areas section of this opinion and the Biological Assessment. Also, the Implementation Team will reassess the current status of the stabilization actions for *P. kaalaensis* to assure that conservation needs of this species are being met pursuant to the Makua IP and prior to the completion of the Oahu IP. The implementation team will consider additional sites for reintroduction, since the Palikea Gulch population unit was not considered part of the action area in the Makua IP.

Summary

The risk to *Phyllostegia kaalaensis* from Legacy and Transformation training has been reduced through the restrictions the Army has made to its routine training activities and the development and implementation of its WFMP. This species is not considered stable at this time, but the high priority stabilization actions the Army is currently implementing (see the Ongoing Conservation Actions section and the Ongoing Conservation Actions within the Action Area section) and the stabilization actions developed for the Makua IP will benefit the species so that potential impacts associated with military training activities will be minimized in the short-term and the species will be stabilized in the long-term. Because *P. kaalaensis* occurs in both the MMR and Oahu action areas, the Oahu Implementation Team will consider this species a high priority and address any urgent actions that need to be implemented so that the conservation needs of this species are not undermined prior to the completion of the Oahu IP. The Service had final approval of the Makua IP and will have final approval of the Oahu IP to assure the Army's minimization and stabilization actions will stabilize the species and increase the environmental baseline of the species. Based on the actions and issues outlined in the Project Description and the Effects of the Action on the Listed Species sections above and the species stabilization actions as described in the Biological Assessment and the Makua IP, the Service believes that the Army's proposed action is outweighed by the long-term benefits from stabilizing this species.

Phyllostegia mollis

All extant *Phyllostegia mollis* are known only from the islands of Oahu and Maui. On Oahu, between 98 to 118 individuals are found in eight occurrences. Between 55 and 75 individuals are found in SBMR (see Figure 10b in the Biological Assessment), representing between 56 and 64 percent of the total known individuals of *P. mollis*. These two occurrences are in south Mohiakea Gulch (5 individuals) and Mohiakea Gulch (50 to 70) (J. Lau, HINHP, pers. comm. 2003; K. Kawelo, U.S. Army, pers. comm. 2003). There are no Army actions proposed for the areas where *P. mollis* is found within SBMR, as mounted and dismounted maneuvers are restricted by the presence of unexploded ordnance. While most of the high explosive rounds fired during live-fire training at SBMR land within the designated impact area, numerous rounds can be found on the ground above the fire break road which forms the boundary of the impact area. This demonstrates that some rounds either ricochet out of the impact area or exceed their expected range. Live-fire ammunition includes high explosive rounds and tracer bullets, both of which are highly incendiary. Fire can also carry from within the impact area out of the fire break road into habitat of listed species. Live-fire training exercises currently occur within the impact area an average of 220 days per year, utilizing over 29,000 rounds of tracers and various types of high explosive ammunition. Transformation will result in the reduction in 5.56 mm ball and tracer munition use and increases in other small arms ball and munition use. There will be an increase in the use of grenades and mortar ammunition, which are more likely to land outside of the current fire break road and have been responsible for starting previous fires. Of note is the addition of the mobile gun Stryker-mounted system that shoots 155 mm munition, which behave similarly to mortar rounds. Mortar rounds are currently limited to a charge of three to ensure that they do not land above the upper elevation boundary of SBMR, but this charge does not limit the ability of the round to land outside of the fire break road (U.S. Army 2003a).

The primary effect to this species in SBMR from ongoing and SBCT training activities is the continued risk of fire, particularly due to use of live-fire ammunition. A fire can start either from a round igniting vegetation within the impact area and the fire jumping the fire break road or a round that lands outside the impact area and starts a fire outside the fire break road. Therefore, additional use of these weapons systems under SBCT will increase the risk of fire in the areas where this species occurs. There is also the potential for ignition caused by catalytic converters and construction equipment (U.S. Army 2003a). The area where *Phyllostegia mollis* occurs is mesic forest which is variably vulnerable to fire throughout the year and is at least 700 m (2,275 ft) up slope of the fuel break road; therefore there is a low threat from fire due to military training (U.S. Army 2003a). Minimization measures for fire from all ignition sources are outlined in the project description, including implementation of the WFMP. The WFMP includes the following actions for SBMR that will reduce the risk of fire at this installation: implementation of a Fire Danger Rating System that will restrict training according to weather and fuel conditions and will be monitored hourly by range control; construction of a 1,136 cubic meter (300,000 gallon) dip pond in fiscal year 2004; relocating targets that are close to the fire break road further into the impact area to reduce the likelihood of overshot rounds landing outside the fire break; improvement of the fire break road around the McCarthy Flats ranges to the same standards as the existing fire break roads; and managing the fuels on the ridge leading to Puu Pane (U.S. Army 2003b). Additional restrictions, such as prohibiting smoking on site, are identified in the Standard Operating Procedures and the Biological Assessment for SBMR (U.S. Army 2003a). However, the latest fires at SBMR (July and August 2003) indicate that full control of fire is not possible, even with all of these precautions and restrictions in place, and therefore the Service believes the risk to all species is higher than the Army indicates in the Biological Assessment. With these measures in place the threat from fire to these individuals will be minimized; however, the potential for a wildland fire can never be totally eliminated.

There is a low threat from a round unintentionally landing outside of the impact area and exploding on or near the population of *Phyllostegia mollis* in both south Mohiakea Gulch and Mohiakea Gulch under Legacy training. However, there will be an increase in the use of grenades and mortar ammunition under SBCT Transformation, which are more likely to land outside of the current fire break road, and therefore more likely to impact this species (U.S. Army 2003a).

Not only is there the potential for the direct loss of *Phyllostegia mollis* due to fire, but a fire may open up the habitat allowing for the invasion of non-native plant species. The ongoing threat from increased non-native plant invasion is always prevalent within, and adjacent to, high disturbance areas such as military training facilities. There are several additional potential sources of non-native plant introduction in SBMR. Invasive plants could be spread within the installation by mounted maneuvers, range construction and maintenance, and especially after a fire. Some non-native invasive plants can also spread into undisturbed areas once they have become established in a disturbed area. Invasive plant encroachment will also be a possibility after a major disturbance event such as a fire and this threat would have a significant effect should a fire occur in the vicinity of these plants. The non-native plant threat from Army training and SBCT Transformation is low for the *P. mollis*, in the lowland mesic forests where it is found. To

minimize this threat the Army will prevent secondary non-native plant spread from fire by monitoring and eradicating newly dispersed non-native plants; implementing all minimization actions described in the project description for this threat; and supporting development of detailed methods for the monitoring and eradication of non-native invasive plants by the Oahu Implementation Team. In addition, if a fire does occur and native habitat is lost, the Army will work with the Service regarding their restoration of the damaged area to prevent the spread of additional invasive plant species (U.S. Army 2003a).

Feral ungulates are found throughout all of the installations and are a continued additional pressure for *Phyllostegia mollis*. Pigs are particularly destructive as they trample, root and eat native vegetation and can introduce invasive species through fecal matter. These rooting sites are another avenue for establishment of invasive plants. In the past in SBMR, the Army allowed private hunting parties to enter these areas for the purpose of controlling feral pigs. Due to unexploded ordinance liability issues, the Army has since curtailed public hunting in SBMR, which has resulted in a drastic increase in pig numbers. Currently, pig control is the sole responsibility of the Army Natural Resource staff. The lack of hunting, and hence proliferation of pigs, presents a direct and constant threat to all *P. mollis* occurrences within the action area. Additional measures will be considered by the Oahu Implementation Team, including fencing in appropriate locations in and out of the action areas (U.S. Army 2003a).

In addition to all of the minimization actions described in the effects section, an Implementation Plan will be developed and implemented for the Oahu action areas, which will include a stabilization plan for *Phyllostegia mollis*. The stabilization plan will include those actions listed in the Conservation Needs in the Action Areas section, along with any additional measures identified by the Oahu Implementation Team.

Summary

The risk to *Phyllostegia mollis* from Legacy and Transformation training has been reduced through the restrictions the Army has made to its routine training activities and the development and implementation of its WFMP. This species is not considered stable at this time, but the stabilization actions to be developed for the Oahu IP will benefit the species so that potential impacts associated with military training activities will be minimized in the short-term and the species will be stabilized in the long-term. The Service has final approval of the Oahu IP to assure the Army's minimization and stabilization actions will stabilize the species and increase the environmental baseline of the species. Based on the actions and issues outlined in the Project Description and the Effects of the Action on the Listed Species sections above and the species stabilization actions as described in the Biological Assessment, the Service believes that the risk of the Army's proposed action is outweighed by the long-term benefits from stabilizing this species.

Plantago princeps* var. *princeps

All extant *Plantago princeps* var. *princeps* are found in the Waianae and Koolau Mountains of Oahu where between 201 and 251 individuals are found as part of eight occurrences. Seventy individuals are found in SBMR (see Figure 10b in the Biological Assessment), representing

between 28 and 35 percent of the total known individuals of *P. princeps* var. *princeps*. Two occurrences of *Plantago princeps*, consisting of 70 individuals, are found in the western portion of the action area at Puu Kalena and north Mohiakea Gulch. *Plantago princeps* occurs in mesic forest upslope and outside of the impact area by at least 860 m (2,795 ft) (J. Lau, HINHP, pers. comm. 2003; K. Kawelo, U.S. Army, pers. comm. 2003). There are no Army actions proposed for the areas where *P. princeps* is found within SBMR, as mounted and dismounted maneuvers are restricted by the presence of unexploded ordnance. While most of the high explosive rounds fired during live-fire training at SBMR land within the designated impact area, numerous rounds can be found on the ground above the fire break road which forms the boundary of the impact area. This demonstrates that some rounds either ricochet out of the impact area or exceed their expected range. Fire can also carry from within the impact area out of the fire break road into habitat of listed species. Live-fire ammunition includes tracers and various types of high explosive rounds, both of which are highly incendiary. Live-fire training exercises currently occur within the impact area an average of 220 days per year, utilizing over 29,000 rounds of tracers and various types of high explosive ammunition. Transformation will result in the reduction in 5.56 mm ball and tracer munition use and increases in other small arms ball and munition use. There will be an increase in the use of grenades and mortar ammunition, which are more likely to land outside of the current fire break road and have been responsible for starting previous fires. Of note is the addition of the mobile gun Stryker-mounted system that shoots 155 mm munition, which behave similarly to mortar rounds. Mortar rounds are currently limited to a charge of three to ensure that they do not land above the upper elevation boundary of SBMR, but this charge does not limit the ability of the round to land outside of the fire break road (U.S. Army 2003a).

The primary effect to this species in SBMR from ongoing and SBCT training activities is the continued risk of fire, particularly due to use of live-fire ammunition. A fire can start either from a round igniting vegetation within the impact area and the fire jumping the fire break road or a round that lands outside the impact area and starts a fire outside the fire break road. Therefore, additional use of these weapons systems under SBCT will increase the risk of fire in the areas where this species occurs. There is also the potential for ignition caused by catalytic converters and construction equipment. The area where *Plantago princeps* occurs is mesic forest which is considered to be too wet to sustain fire for a majority of the year and is at least 860 m (2,795 ft) up slope of the fuel break road; therefore there is a low threat from fire due to military training (U.S. Army 2003a). Minimization measures for fire from all ignition sources are outlined in the project description, including implementation of the WFMP. The WFMP includes the following actions for SBMR that will reduce the risk of fire at this installation: implementation of a Fire Danger Rating System that will restrict training according to weather and fuel conditions and will be monitored hourly by range control; construction of a 1,136 cubic meter (300,000 gallon) dip pond in fiscal year 2004; relocating targets that are close to the fire break road further into the impact area to reduce the likelihood of overshot rounds landing outside the fire break; improvement of the fire break road around the McCarthy Flats ranges to the same standards as the existing fire break roads; and managing the fuels on the ridge leading to Puu Pane (U.S. Army 2003b). Additional restrictions, such as prohibiting smoking on site, are identified in the Standard Operating Procedures and the Biological Assessment for SBMR (U.S. Army 2003a). However,

the latest fires at SBMR (July and August 2003) indicate that full control of fire is not possible, even with all of these precautions and restrictions in place, and therefore the Service believes the risk to all species is higher than the Army indicates in the Biological Assessment. With these measures in place the threat from fire to these individuals will be minimized; however, the potential for a wildland fire can never be totally eliminated.

There is a low threat from a round unintentionally landing outside of the impact area and exploding on or near the population of *Plantago princeps* in both north Mohiakea Gulch and Puu Kalena under Legacy training. However, there will be an increase in the use of grenades and mortar ammunition under SBCT Transformation, which are more likely to land outside of the current fire break road, and therefore more likely to impact this species (U.S. Army 2003a).

Not only is there the potential for the direct loss of *Plantago princeps* due to fire and direct explosions, but a fire may open up the habitat allowing for the invasion of non-native plant species. The ongoing threat from increased non-native plant invasion is always prevalent within, and adjacent to, high disturbance areas such as military training facilities. There are several additional potential sources of non-native plant introduction in SBMR. Invasive plants could be spread within the installation by mounted maneuvers, range construction and maintenance, and especially after a fire. Some non-native invasive plants can also spread into undisturbed areas once they have become established in a disturbed area. Invasive plant encroachment will also be a possibility after a major disturbance event such as a fire and this threat would have a significant effect should a fire occur in the vicinity of these plants. The non-native plant threat from Army training and SBCT Transformation is low for the *P. princeps*, where it is found in mesic forest. To minimize this threat the Army will prevent secondary non-native plant spread from fire by monitoring and eradicating newly dispersed non-native plants; implementing all minimization actions described in the project description for this threat; and supporting development of detailed methods for monitoring and eradication of non-native invasive plants by the Oahu Implementation Team. In addition, if a fire does occur and native habitat is lost, the Army will work with the Service regarding their restoration of the damaged area to prevent the spread of additional invasive plant species (U.S. Army 2003a).

Feral ungulates are found throughout all of the installations and are a continued additional pressure for *Plantago princeps*. Pigs are particularly destructive as they trample, root and eat native vegetation and can introduce invasive species through fecal matter. These rooting sites are another avenue for establishment of invasive plants. In the past in SBMR, the Army allowed private hunting parties to enter these areas for the purpose of controlling feral pigs. Due to unexploded ordinance liability issues, the Army has since curtailed public hunting in SBMR, which has resulted in a drastic increase in pig numbers. Currently, pig control is the sole responsibility of the Army Natural Resource staff. The lack of hunting, and hence proliferation of pigs, presents a direct and constant threat to all *P. princeps* occurrences within the action area. Additional measures will be considered by the Oahu Implementation Team, including fencing in appropriate locations in and out of the action area (U.S. Army 2003a).

In addition to all of the minimization actions described in the effects section, the Makua IP has been finalized which includes stabilization actions for *Plantago princeps*. These stabilization actions are outlined in the Conservation Needs in the Action Areas section of this opinion and in the Biological Assessment. The Oahu Implementation Team will reassess the current status of the stabilization actions for *P. princeps* to assure that conservation needs of this species are being met pursuant to the Makua IP and prior to the completion of the Oahu IP. The Implementation Team will consider additional sites for reintroduction, since the Puu Kalena population unit was not known at the time the Makua IP was developed.

Summary

The risk to *Plantago princeps* from Legacy and Transformation training has been reduced through the restrictions the Army has made to its routine training activities and the development and implementation of its WFMP. This species is not considered stable at this time, but the high priority stabilization actions the Army is currently implementing (see the Ongoing Conservation Actions section and the Ongoing Conservation Actions within the Action Area section) and the stabilization actions developed for the Makua IP will benefit the species so that potential impacts associated with military training activities will be minimized in the short-term and the species will be stabilized in the long-term. Because *P. princeps* occurs in both the MMR and the Oahu action areas, the Oahu Implementation Team will consider this species a high priority and address any urgent actions that need to be implemented so that conservation needs of this species are not undermined prior to the completion of the Oahu IP. The Service had final approval of the Makua IP and will have final approval of the Oahu IP to assure the Army's minimization and stabilization actions will stabilize the species and increase the environmental baseline of the species. Based on the actions and issues outlined in the Project Description and the Effects of the Action on the Listed Species sections above and the species stabilization actions as described in the Biological Assessment and the Makua IP, the Service believes that the Army's proposed action is outweighed by the long-term benefits from stabilizing this species.

Pteris lidgatei

All extant *Pteris lidgatei* are found only on the islands of Oahu and Maui. On Oahu, there are an estimated 25 individuals which are found as part of six occurrences. Twenty-one individuals are found as part of four occurrences in two Oahu installation action areas: KLOA and SBER (see Figures 7b and 9c in the Biological Assessment). These represent 47 percent of the known individuals of *P. lidgatei*.

KLOA

The seven individual *Pteris lidgatei* found within KLOA occur in north Kaukonahua, Kawainui, and Kawai Iki within training areas KB-1 (southeast corner) and KA-2 and KB-2 (eastern region) of the action area. They are found along streams in lowland wet forest and shrubland habitat. Identified actions in these areas include dismounted maneuvers, foot reconnaissance, bivouac, helicopter aviation training, and air assault. These operations take place one to two times per month for an average of two to five days at a time at company level (120 soldiers) size. These operations have the potential of lasting up to 10 days in length. The companies move

through the area in squad (9 soldiers) or platoon (35 soldiers) units. Based upon data compiled for Legacy training for the years 1998-2002, it is estimated that the average number of troops that will use this area will be 17,422 over an average of 137 days per year. Mounted (vehicle) maneuvers will be restricted to existing roads, most of which are far from any existing endangered species occurrences; foot maneuvers will be focused on and around trails; bivouac activity will be limited in area due to the extreme terrain found in much of the KLOA action area; and helicopter and air assault activities will be restricted to open landing and drop zones. Blank ammunition and ground pyrotechnics are used in this area during foot maneuvers (U.S. Army 2003a).

One of the effects to this species from ongoing and SBCT training activities is the continued risk of fire particularly due to pyrotechnic exercises, blank training exercises, cigarette smoking, cookstoves/fires at bivouac sites, and other accidental or unforseen ignition sources. All of the occurrences are found in very low fire vulnerability areas due to the wet forest and shrubland habitat, and in areas where training use is low. One fire occurred in 2000, burning 125.5 ha (310 ac), and is believed to have been started by blank ammunition or a muzzle flash (U.S. Army 2003a). Minimization measures for fire from all ignition sources are outlined in the project description, including implementation of the WFMP. The WFMP includes the following actions for KLOA that will reduce the risk of fire at this installation: implementing a Fire Danger Rating System that will restrict training according to weather and fuel conditions and will be monitored hourly by range control; fuel load reduction as appropriate; use of the dip pond at DMR; maintaining roads to fuel break standards, and reinitiating this consultation should a fire escape the installation boundary, or starts or spreads within 521 m (1,771 ft) of a listed species (U.S. Army 2003b). However, the latest fires at SBMR (July and August 2003) indicate that full control of fire is not possible, even with all of these precautions and restrictions in place, and therefore the Service believes the risk to all species is higher than the Army indicates in the Biological Assessment. Additional restrictions, such as prohibiting smoking on site, are identified in the Standard Operating Procedures and the Biological Assessment for KLOA (U.S. Army 2003a). With these measures in place the threat from fire to these individuals will be minimized; however, the potential for a wildland fire can never be totally eliminated.

Considering the habit of the species, location of individuals within the action area (along streams and streambanks), and the types and frequency of training actions that are proposed, the only major direct effect of proposed training activities on *Pteris lidgatei* would be trampling. The rhizomatous nature of this species provides additional protection against infrequent crushing of above-ground fronds. As such, the threat of trampling is considered low. To minimize the threat to sporelings, the Army will educate each set of new soldiers on avoidance of trampling of endangered species; fence those occurrences most at risk from trampling, as determined by the Oahu Implementation Team; establish long-term conservation trend analysis (ITAM) plots to monitor impact of foot traffic trampling by infantry soldiers; and establish signage to identify areas that are off limits due to the presence of federally listed species. Additional measures will be considered by the Oahu Implementation Team (U.S. Army 2003a).

The ongoing threat from increased non-native plant invasion is always prevalent within, and adjacent to, high disturbance areas such as military training facilities. There are several potential sources of non-native plant introduction in KLOA. Invasive plants could be spread within the installation by dismounted and mounted maneuvers, range construction and maintenance, and especially after a fire. Some non-native invasive plants can also spread into undisturbed areas once they have become established in a disturbed area. Invasive plant encroachment will also be a possibility after a major disturbance event such as a fire and this threat would have a significant effect should a fire occur in the vicinity of these plants. The non-native plant threat from Army training and SBCT Transformation is moderate for *Pteris lidgatei*. To minimize this threat the Army will prevent secondary non-native plant spread from fire by monitoring and eradicating newly dispersed non-native plants; implementing all minimization actions described in the project description for this threat; and supporting development of detailed methods for the monitoring and eradication of non-native invasive plants by the Oahu Implementation Team. In addition, if a fire does occur and native habitat is lost, the Army will work with the Service regarding their restoration of the damaged area to prevent the spread of additional invasive plant species (U.S. Army 2003a).

SBER

The 14 individuals of *Pteris lidgatei* at SBER are found in south Kaukonahua Gulch in training area ER-13. These individuals are located in an area characterized by the Army as low use, which includes the following: dismounted maneuvers, foot reconnaissance, bivouac, helicopter aviation training, and air assault. Within the training area, it is estimated that there will be one to two operations a month of company size moving through the area in squad (9 soldiers) or platoon (35 soldiers) units for a duration of two to five days, but for battalion-size (500 soldiers) and larger operations, the duration may be 10 to 14 days. Based upon data compiled for Legacy training for the years 1998-2002, the average number of troops using this area annually was 5,067 with the average days of use per year being 47. Foot maneuvers will be focused on and around trails, bivouac activity will be limited in area due to the extreme terrain in the SBER action area, and helicopter and air assault activities will be restricted to open landing and drop zones. Blank ammunition and ground pyrotechnics are used in this area during foot maneuvers (U.S. Army 2003a).

As mentioned for KLOA, the threat to this species is low from trampling. To minimize the threat to sporelings, the Army will educate each set of new soldiers on avoidance of trampling of endangered species; fence those occurrences most at risk from trampling, as determined by the Oahu Implementation Team; establish long-term conservation trend analysis (ITAM) plots to monitor impact of foot traffic trampling by infantry soldiers; and establish signage to identify areas that are off limits due to the presence of federally listed species. Additional measures will be considered by the Oahu Implementation Team (U.S. Army 2003a).

Fire is not considered a threat to *Pteris lidgatei* as no live-fire activities are conducted at SBER. While pyrotechnics are used, the occurrence of this species on streambanks in wet upland forest

and its rhizomatous nature makes the likelihood of a fire which would destroy an occurrence of *P. lidgatei* extremely low.

The ongoing threat from increased non-native plant invasion is always prevalent within and adjacent to training facilities. There are several potential sources of non-native plant introduction into SBER, as mentioned above for KLOA. The non-native plant threat from Army training and SBCT Transformation is moderate for *Pteris lidgatei* in SBER, because it is found within 30 m (100 ft) of a main trail. The minimization measures for *P. lidgatei* in SBER are the same as described above for individuals in KLOA action area, and will reduce the threat from non-native plants to very low.

All Installations

Feral ungulates are found throughout all of the installations and are a continued additional pressure for *Pteris lidgatei*. Pigs are particularly destructive as they trample, root and eat native vegetation and can introduce invasive species through fecal matter. These rooting sites are another avenue for establishment of invasive plants. However, the fencing that will occur to avoid trampling from foot maneuvers will also protect the occurrences within the action area from ungulates. Additional measures will be considered by the Oahu Implementation Team (U.S. Army 2003a).

In addition to all of the minimization actions described in the effects section, an Implementation Plan will be developed and implemented for the Oahu action areas, which will include a stabilization plan for *Pteris lidgatei*. The stabilization plan will include those actions listed in the Conservation Needs in the Action Areas section, along with any additional measures identified by the Oahu Implementation Team.

Summary

The risk to *Pteris lidgatei* from Legacy and Transformation training has been reduced through the restrictions the Army has made to its routine training activities and the development and implementation of its WFMP. This species is not considered stable at this time, but the stabilization actions to be developed for the Oahu IP will benefit the species so that potential impacts associated with military training activities will be minimized in the short-term and the species will be stabilized in the long-term. The Service has final approval of the Oahu IP to assure the Army's minimization and stabilization actions will stabilize the species and increase the environmental baseline of the species. Based on the actions and issues outlined in the Project Description and the Effects of the Action on the Listed Species sections above and the species stabilization actions as described in the Biological Assessment, the Service believes that the risk of the Army's proposed action is outweighed by the long-term benefits from stabilizing this species.

Sanicula purpurea

On the islands of Oahu and Maui there are 245 known extant individuals of *Sanicula purpurea*. An estimated 45 individuals in six occurrences are found on Oahu. Forty individuals in three

occurrences are found on two Oahu installation action areas: KLOA and SBER (see Figures 7b and 9c in the Biological Assessment). These represent 16 percent of the known individuals of *S. purpurea*.

KLOA

There are 18 individuals of *Sanicula purpurea* (as two occurrences) within the KLOA action area. Eight of these individuals occur south of north Kaukonahua-Punaluu summit in training area KB-2 and 10 individuals occur at Helemano-Punaluu summit divide in training area KB-1 (K. Kawelo, U.S. Army, pers. comm. 2003; J. Lau, HINHP, pers. comm. 2003). Identified actions in these areas include dismounted maneuvers, foot reconnaissance, bivouac, helicopter aviation training, and air assault. These operations take place one to two times per month for an average of two to five days at a time at company level (120 soldiers) size. These operations have the potential of lasting up to 10 days in length. The companies move through the area in squad (9 soldiers) or platoon (35 soldiers) units. Based upon data compiled for Legacy training for the years 1998-2002, it is estimated that the average number of troops that will use this area will be 17,422 over an average of 137 days per year. Mounted (vehicle) maneuvers will be restricted to existing roads, most of which are far from any existing endangered species occurrences; foot maneuvers will be focused on and around trails; bivouac activity will be limited in area due to the extreme terrain found in much of the KLOA action area; and helicopter and air assault activities will be restricted to open landing and drop zones. Blank ammunition and ground pyrotechnics are used in this area during foot maneuvers (U.S. Army 2003a).

One of the effects to this species from ongoing and SBCT training activities is the continued risk of fire particularly due to pyrotechnic exercises, blank training exercises, cigarette smoking, cookstoves/fires at bivouac sites, and other accidental or unforseen ignition sources. All of the occurrences are found in very low fire vulnerability areas due to the extremely wet cloud forest habitat, and in areas where training use is low. One fire occurred in 2000, burning 125.5 ha (310 ac), and is believed to have been started by blank ammunition or a muzzle flash (U.S. Army 2003a). Minimization measures for fire from all ignition sources are outlined in the project description, including implementation of the WFMP. The WFMP includes the following actions for KLOA that will reduce the risk of fire at this installation: implementing a Fire Danger Rating System that will restrict training according to weather and fuel conditions and will be monitored hourly by range control; fuel load reduction as appropriate; use of the dip pond at DMR; maintaining roads to fuel break standards, and reinitiating this consultation should a fire escape the installation boundary, or starts or spreads within 521 m (1,771 ft) of a listed species (U.S. Army 2003b). However, the latest fires at SBMR (July and August 2003) indicate that full control of fire is not possible, even with all of these precautions and restrictions in place, and, therefore, the Service believes the risk to all species is higher than the Army indicates in the Biological Assessment. Additional restrictions, such as prohibiting smoking on site, are identified in the Standard Operating Procedures and the Biological Assessment for KLOA (U.S. Army 2003a). With these measures in place the threat from fire to these individuals will be minimized; however, the potential for a wildland fire can never be totally eliminated.

The threat of trampling from foot traffic is very low or non-existent for trees and shrubs, unless the plants are in the seedling stage or the trampling occurs close to the root system, causing compaction of the soil and decreasing the plant's ability to take up water and nutrients. While above-ground portions of *Sanicula purpurea* (stems, leaves, inflorescences) would be crushed by foot traffic, it is expected that resprouting would occur from the underground stem (caudex). As such, it is expected that individual *S. purpurea* would recover from occasional trampling incidents. Repeated crushing from troops straying off-trail and bivouac activities could be expected to result in the loss of individuals as the caudex would likely be damaged under such conditions. However, the likelihood of adverse effects of foot maneuvers are considered very low because individuals of *S. purpurea* occur in areas where training use is low. To minimize the threat to seedlings, the Army will: educate each set of new soldiers on avoidance of trampling of endangered species, establish long-term conservation trend analysis (ITAM) plots to monitor impact of foot traffic trampling by infantry soldiers; and establish signage to identify areas that are off limits due to the presence of federally listed species. Additional measures will be considered by the Oahu Implementation Team (U.S. Army 2003a).

The ongoing threat from increased non-native plant invasion is always prevalent within, and adjacent to, high disturbance areas such as military training facilities. There are several potential sources of non-native plant introduction in KLOA. Invasive plants could be spread within the installation by dismounted and mounted maneuvers, range construction and maintenance, and especially after a fire. Some non-native invasive plants can also spread into undisturbed areas once they have become established in a disturbed area. Invasive plant encroachment will also be a possibility after a major disturbance event such as a fire and this threat would have a significant effect should a fire occur in the vicinity of these plants. The non-native plant threat from Army training and SBCT Transformation is moderate for *Sanicula purpurea*. To minimize this threat the Army will prevent secondary non-native plant spread from fire by monitoring and eradicating newly dispersed non-native plants; implementing all minimization actions described in the project description for this threat; and supporting development of detailed methods for monitoring and eradication of non-native invasive plants by the Oahu Implementation Team. In addition, if a fire does occur and native habitat is lost, the Army will work with the Service regarding their restoration of the damaged area to prevent the spread of additional invasive plant species (U.S. Army 2003a).

SBER

Within SBER, there is one occurrence that contains 22 individuals. These individuals are located in training area ER-13 near south Kaukonahua-Kahana Divide (K. Kawelo, U.S. Army, pers. comm. 2003; J. Lau, HINHP, pers. comm. 2003). These individuals are located in an area characterized by the Army as low use, which includes the following: dismounted maneuvers, foot reconnaissance, bivouac, helicopter aviation training, and air assault. Within the training area, it is estimated that there will be one to two operations a month of company size moving through the area in squad (9 soldiers) or platoon (35 soldiers) units for a duration of two to five days, but for battalion-size (500 soldiers) and larger operations, the duration may be 10 to 14 days. Based

upon data compiled for Legacy training for the years 1998-2002, the average number of troops using this area annually was 5,067 with the average days of use per year being 47. Foot maneuvers will be focused on and around trails, bivouac activity will be limited in area due to the extreme terrain in the SBER action area, and helicopter and air assault activities will be restricted to open landing and drop zones. Blank ammunition and ground pyrotechnics are used in this area during foot maneuvers (U.S. Army 2003a).

The effect of trampling to *Sanicula purpurea* from Army training activities is the same as that described above for individuals in KLOA action area. The minimization measures are also the same.

The ongoing threat from increased non-native plant invasion is always prevalent within and adjacent to training facilities. There are several potential sources of non-native plant introduction into SBER, as mentioned above for KLOA. The non-native plant threat from Army training and SBCT Transformation is low for *Sanicula purpurea* in SBER. The minimization measures for *S. purpurea* in SBER are the same as described above for individuals in KLOA action area, and will reduce the threat from non-native plants to very low.

All Installations

Feral ungulates are found throughout all of the installations and are a continued additional pressure for *Sanicula purpurea*. Pigs are particularly destructive as they trample, root and eat native vegetation and can introduce invasive species through fecal matter. These rooting sites are another avenue for establishment of invasive plants. However, the fencing that will occur to avoid trampling from foot maneuvers will also protect the occurrences within the action area from ungulates. Additional measures will be considered by the Oahu Implementation Team (U.S. Army 2003a).

In addition to all of the minimization actions described in the effects section, an Implementation Plan will be developed and implemented for the Oahu action areas, which will include a stabilization plan for *Sanicula purpurea*. The stabilization plan will include those actions listed in the Conservation Needs in the Action Areas section, along with any additional measures identified by the Oahu Implementation Team.

Summary

The risk to *Sanicula purpurea* from Legacy and Transformation training has been reduced through the restrictions the Army has made to its routine training activities and the development and implementation of its WFMP. This species is not considered stable at this time, but the stabilization actions to be developed for the Oahu IP will benefit the species so that potential impacts associated with military training activities will be minimized in the short-term and the species will be stabilized in the long-term. The Service has final approval of the Oahu IP to assure the Army's minimization and stabilization actions will stabilize the species and increase the environmental baseline of the species. Based on the actions and issues outlined in the Project

Description and the Effects of the Action on the Listed Species sections above and the species stabilization actions as described in the Biological Assessment, the Service believes that the risk of the Army's proposed action is outweighed by the long-term benefits from stabilizing this species.

Schiedea hookeri

All extant *Schiedea hookeri* are found in the Waianae Mountains of Oahu where 265 individuals are found as part of 13 occurrences. Only five individuals are found in one occurrence in the action area for SBMR (see Figure 10b in the Biological Assessment), representing two percent of the known individuals. *S. hookeri* is found outside of the impact area. *S. hookeri* occurs in dry shrubland and mesic forest and the occurrence at SBMR is located approximately 460 m (1,495 ft) outside of the fuel break road (K. Kawelo, U.S. Army 2003; J. Lau, HINHP, pers. comm. 2003). There are no Army actions proposed for the areas where *S. hookeri* is found within SBMR, as mounted and dismounted maneuvers are restricted by the presence of unexploded ordnance. While most of the high explosive rounds fired during live-fire training at SBMR land within the designated impact area, numerous rounds can be found on the ground above the fire break road which forms the boundary of the impact area. This demonstrates that some rounds either ricochet out of the impact area or exceed their expected range. Fire can also carry from within the impact area out of the fire break road into habitat of listed species. Live-fire ammunition includes tracers and various types of high explosive rounds, both of which are highly incendiary. Live-fire training exercises currently occur within the impact area an average of 220 days per year, utilizing over 29,000 rounds of tracers and various types of high explosive ammunition. Transformation will result in the reduction in 5.56 mm ball and tracer munition use and increases in other small arms ball and munition use. There will be an increase in the use of grenades and mortar ammunition, which are more likely to land outside of the current fire break road and have been responsible for starting previous fires. Of note is the addition of the mobile gun Stryker-mounted system that shoots 155 mm munition, which behave similarly to mortar rounds. Mortar rounds are currently limited to a charge of three to ensure that they do not land above the upper elevation boundary of SBMR, but this charge does not limit the ability of the round to land outside of the fire break road (U.S. Army 2003a).

The primary effect to this species in SBMR from ongoing and SBCT training activities is the continued risk of fire, particularly due to use of live-fire ammunition. A fire can start either from a round igniting vegetation within the impact area and the fire jumping the fire break road or a round that lands outside the impact area and starts a fire outside the fire break road. Therefore, additional use of these weapons systems under SBCT will increase the risk of fire in the areas where this species occurs. There is also the potential for ignition caused by catalytic converters and construction equipment. *S. hookeri* occurs in dry shrubland and mesic forest with a moderate fire vulnerability rating (U.S. Army 2003a). Minimization measures for fire from all ignition sources are outlined in the project description, including implementation of the WFMP. The WFMP includes the following actions for SBMR that will reduce the risk of fire at this installation: implementation of a Fire Danger Rating System that will restrict training according to weather and fuel conditions and will be monitored hourly by range control; construction of a

1,136 cubic meter (300,000 gallon) dip pond in fiscal year 2004; relocating targets that are close to the fire break road further into the impact area to reduce the likelihood of overshot rounds landing outside the fire break; improvement of the fire break road around the McCarthy Flats ranges to the same standards as the existing fire break roads; and managing the fuels on the ridge leading to Puu Pane (U.S. Army 2003b). Additional restrictions, such as prohibiting smoking on site, are identified in the Standard Operating Procedures and the Biological Assessment for SBMR (U.S. Army 2003a). However, the latest fires at SBMR (July and August 2003) indicate that full control of fire is not possible, even with all of these precautions and restrictions in place, and therefore the Service believes the risk to all species is higher than the Army indicates in the Biological Assessment. With these measures in place the threat from fire to these individuals will be minimized; however, the potential for a wildland fire can never be totally eliminated.

There is a low threat from a round unintentionally landing outside of the impact area and exploding on or near the population of *Schiedea hookeri* under Legacy training. However, there will be an increase in the use of grenades and mortar ammunition under SBCT Transformation, which are more likely to land outside of the current fire break road, and therefore more likely to impact this species (U.S. Army 2003a).

Not only is there the potential for the direct loss of *Schiedea hookeri* due to fire, but a fire may open up the habitat allowing for the invasion of non-native plant species. The ongoing threat from increased non-native plant invasion is always prevalent within, and adjacent to, high disturbance areas such as military training facilities. There are several additional potential sources of non-native plant introduction in SBMR. Invasive plants could be spread within the installation by mounted maneuvers, range construction and maintenance, and especially after a fire. Some non-native invasive plants can also spread into undisturbed areas once they have become established in a disturbed area. Invasive plant encroachment will also be a possibility after a major disturbance event such as a fire and this threat would have a significant effect should a fire occur in the vicinity of these plants. The non-native plant threat from Army training and SBCT Transformation is moderate for *S. hookeri* in the lowland dry forests and shrublands where it is found. To minimize this threat the Army will prevent secondary non-native plant spread from fire by monitoring and eradicating newly dispersed non-native plants; implementing all minimization actions described in the project description for this threat; and supporting development of detailed methods for the monitoring and eradication of non-native invasive plants by the Oahu Implementation Team. In addition, if a fire does occur and native habitat is lost, the Army will work with the Service regarding their restoration of the damaged area to prevent the spread of additional invasive plant species (U.S. Army 2003a).

Feral ungulates are found throughout all of the installations and are a continued additional pressure for *Schiedea hookeri*. Pigs are particularly destructive as they trample, root and eat native vegetation and can introduce invasive species through fecal matter. These rooting sites are another avenue for establishment of invasive plants. In the past in SBMR, the Army allowed private hunting parties to enter these areas for the purpose of controlling feral pigs. Due to

unexploded ordinance liability issues, the Army has since curtailed public hunting in SBMR, which has resulted in a drastic increase in pig numbers. Currently, pig control is the sole responsibility of the Army Natural Resource staff. The lack of hunting, and hence proliferation of pigs, presents a direct and constant threat to all *S. hookeri* occurrences within the action area. Additional measures will be considered by the Oahu Implementation Team, including fencing in appropriate locations in and out of the action areas (U.S. Army 2003a).

Slugs impact *Schiedea hookeri* by browsing on seedlings and young vegetation. The Army will support research to control slugs to minimize impacts from this threat and implement the most efficient method for slug control (U.S. Army 2003a).

Schiedea hookeri does not require stabilization because fifty percent of the known individuals do not occur in the Army action areas, and there are at least three stable population units of greater than 50 mature, reproducing individuals outside of the Army action areas. The Oahu Implementation Team will consider species-specific management actions such as collection for genetic storage.

Summary

The risk to *Schiedea hookeri* from Legacy and Transformation training has been reduced through the restrictions the Army has made to its routine training activities and the development and implementation of its WFMP. This species is considered stable at this time and the stabilization actions developed for other species in the Oahu IP will benefit the species so that potential impacts associated with military training activities will be minimized in the short-term. Based on the actions and issues outlined in the Project Description and the Effects of the Action on the Listed Species sections above and the benefit to this species from the species stabilization actions of other species within SBMR as described in the Biological Assessment and the Makua IP, the Service believes that the Army's proposed action is outweighed by the long-term benefits to this species.

Schiedea kaalae

All extant *Schiedea kaalae* are found in the Waianae and Koolau Mountains of Oahu where between 22 and 23 individuals are found as part of eight occurrences. Only one individual occurs in the SBMR action area (see Figure 10b in the Biological Assessment) and represents approximately four percent of the known individuals of *S. kaalae*. An additional three individuals are found within the MMR action area, representing 13 percent of the species (K. Kawelo, U.S. Army, pers. comm. 2003; J. Lau, HINHP, pers. comm. 2003). There are no Army actions proposed for the areas where *S. kaalae* is found within SBMR, as mounted and dismounted maneuvers are restricted by the presence of unexploded ordnance. While most of the high explosive rounds fired during live-fire training at SBMR land within the designated impact area, numerous rounds can be found on the ground above the fire break road which forms the boundary of the impact area. This demonstrates that some rounds either ricochet out of the impact area or exceed their expected range. Fire can also carry from within the impact area out

of the fire break road into habitat of listed species. Live-fire ammunition includes tracers and various types of high explosive rounds, both of which are highly incendiary. Live-fire training exercises currently occur within the impact area an average of 220 days per year, utilizing over 29,000 rounds of tracers and various types of high explosive ammunition. Transformation will result in the reduction in 5.56 mm ball and tracer munition use and increases in other small arms ball and munition use. There will be an increase in the use of grenades and mortar ammunition, which are more likely to land outside of the current fire break road and have been responsible for starting previous fires. Of note is the addition of the mobile gun Stryker-mounted system that shoots 155 mm munition, which behave similarly to mortar rounds. Mortar rounds are currently limited to a charge of three to ensure that they do not land above the upper elevation boundary of SBMR, but this charge does not limit the ability of the round to land outside of the fire break road (U.S. Army 2003a).

The primary effect to this species in SBMR from ongoing and SBCT training activities is the continued risk of fire, particularly due to use of live-fire ammunition. A fire can start either from a round igniting vegetation within the impact area and the fire jumping the fire break road or a round that lands outside the impact area and starts a fire outside the fire break road. Therefore, additional use of these weapons systems under SBCT will increase the risk of fire in the areas where this species occurs. There is also the potential for ignition caused by catalytic converters and construction equipment. The area where *Schiedea kaalae* occurs is mesic forest which is variably vulnerable to fire throughout the year and is at least 220 m (715 ft) up slope of the fire break road (U.S. Army 2003a). Minimization measures for fire from all ignition sources are outlined in the project description, including implementation of the WFMP. The WFMP includes the following actions for SBMR that will reduce the risk of fire at this installation: implementation of a Fire Danger Rating System that will restrict training according to weather and fuel conditions and will be monitored hourly by range control; construction of a 1,136 cubic meter (300,000 gallon) dip pond in fiscal year 2004; relocating targets that are close to the fire break road further into the impact area to reduce the likelihood of overshot rounds landing outside the fire break; improvement of the fire break road around the McCarthy Flats ranges to the same standards as the existing fire break roads; and managing the fuels on the ridge leading to Puu Pane (U.S. Army 2003b). Additional restrictions, such as prohibiting smoking on site, are identified in the Standard Operating Procedures and the Biological Assessment for SBMR (U.S. Army 2003a). However, the latest fires at SBMR (July and August 2003) indicate that full control of fire is not possible, even with all of these precautions and restrictions in place, and therefore the Service believes the risk to all species is higher than the Army indicates in the Biological Assessment. With these measures in place the threat from fire to these individuals will be minimized; however, the potential for a wildland fire can never be totally eliminated.

There is a low threat from a round unintentionally landing outside of the impact area and exploding on or near the population of *Schiedea kaalae* under Legacy training. However, there will be an increase in the use of grenades and mortar ammunition under SBCT Transformation, which are more likely to land outside of the current fire break road, and therefore more likely to impact this species (U.S. Army 2003a).

Not only is there the potential for the direct loss of *Schiedea kaalae* due to fire, but a fire may open up the habitat allowing for the invasion of non-native plant species. The ongoing threat from increased non-native plant invasion is always prevalent within, and adjacent to, high disturbance areas such as military training facilities. There are several additional potential sources of non-native plant introductions in SBMR. Invasive plants could be spread within the installation by mounted maneuvers, range construction and maintenance, and especially after a fire. Some non-native invasive plants can also spread into undisturbed areas once they have become established in a disturbed area. Invasive plant encroachment will also be a possibility after a major disturbance event such as a fire and this threat would have a significant effect should a fire occur in the vicinity of these plants. The non-native plant threat from Army training and SBCT Transformation is low for *S. kaalae* in the lowland mesic forest where it occurs. To minimize this threat the Army will prevent secondary non-native plant spread from fire by monitoring and eradicating newly dispersed non-native plants; implementing all minimization actions described in the project description for this threat; and supporting development of detailed methods for monitoring and eradication of non-native invasive plants by the Oahu Implementation Team. In addition, if a fire does occur and native habitat is lost, the Army will work with the Service regarding their restoration of the damaged area to prevent the spread of additional invasive plant species (U.S. Army 2003a).

Feral ungulates are found throughout all of the installations and are a continued additional pressure for *Schiedea kaalae*. Pigs are particularly destructive as they trample, root and eat native vegetation and can introduce invasive species through fecal matter. These rooting sites are another avenue for establishment of invasive plants. In the past in SBMR, the Army allowed private hunting parties to enter these areas for the purpose of controlling feral pigs. Due to unexploded ordinance liability issues, the Army has since curtailed public hunting in SBMR, which has resulted in a drastic increase in pig numbers. Currently, pig control is the sole responsibility of the Army Natural Resource staff. The lack of hunting, and hence proliferation of pigs, presents a direct and constant threat to *S. kaalae* within the action area. Additional measures will be considered by the Oahu Implementation Team, including fencing in appropriate locations in and out of the action area (U.S. Army 2003a).

Slugs impact *Schiedea kaalae* by browsing on seedlings and young vegetation. The Army will support research to control slugs to minimize impacts from this threat and implement the most efficient method for slug control (U.S. Army 2003a).

In addition to all of the minimization actions described in the effects section, the Makua IP has been finalized which includes stabilization actions for *Schiedea kaalae*. These stabilization actions include the actions as discussed in the Conservation Needs in the Action Areas section of this opinion and in the Biological Assessment. The Army has agreed to immediately fence the one individual of *S. kaalae* within the SBMR action area. The Oahu Implementation Team will reassess the current status of the stabilization actions for *S. kaalae* to assure that conservation needs of this species are being met pursuant to the Makua IP. The Implementation Team will

consider additional sites for reintroduction, since the Mohiakea population unit was not known at the time the Makua IP was developed.

Summary

The risk to *Schiedea kaalae* from Legacy and Transformation training has been reduced through the restrictions the Army has made to its routine training activities and the development and implementation of its WFMP. This species is not considered stable at this time, but the high priority stabilization actions the Army is currently implementing (see the Ongoing Conservation Actions section and the Ongoing Conservation Actions within the Action Area section) and the stabilization actions developed for the Makua IP will benefit the species so that potential impacts associated with military training activities will be minimized and the species will be stabilized in the long-term. Because *S. kaalae* occurs in both the MMR and the Oahu action areas, the Oahu Implementation Team will consider this species a high priority and address any urgent actions that need to be implemented so that conservation needs of this species are not undermined prior to the completion of the Oahu IP. The Service had final approval of the Makua IP and will have final approval of the Oahu IP to assure the Army's minimization and stabilization actions will stabilize the species and increase the environmental baseline of the species. Based on the actions and issues outlined in the Project Description and the Effects of the Action on the Listed Species sections above and the species stabilization actions as described in the Biological Assessment and the Makua IP, the Service believes that the Army's proposed action is outweighed by the long-term benefits from stabilizing this species.

Tetraplasandra gymnocarpa

All current occurrences of *Tetraplasandra gymnocarpa* are found along the summit of the Koolau Mountains. At least forty-four individuals of *Tetraplasandra gymnocarpa* occur within the action areas of KTA, KLOA, and SBER (see Figures 6b, 7b, and 9c, respectively, in the Biological Assessment). Together, they make up approximately 25 percent of the known individuals rangewide.

KTA

Within the KTA action area, four individuals of *Tetraplasandra gymnocarpa* occur in training areas A-2 and A-3 in the southern region of the action area, at Paumalu and Kaunala Gulches. All of the KTA occurrences are in areas designated as at a high threat from fire. Identified actions in these areas include dismounted maneuvers, foot reconnaissance, bivouac, helicopter aviation training, and air assault. Three training operations are conducted consisting of squad (9 soldiers) or platoon (35 soldiers) units, along with scouts and infantry companies, in long range surveillance detachment operations, per month in the D2 training area. Non-live-fire training exercises occur within the action area an average of 44 days per year. Data compiled for Legacy training for the years 1998-2002 does not include training frequency for the D2 training area. Pyrotechnics use can occur anywhere that dismounted and mounted training occur, with the following restrictions: 1) approval from range operations, based on the Fire Danger Rating System, and; 2) smoke grenades will only be used in areas devoid of vegetation. Blank

ammunition is used throughout the action area. Transformation will include the use of live-fire low-velocity plastic bullets associated with short-range training (U.S. Army 2003a).

The primary effect to this species from ongoing and SBCT training activities is the continued risk of fire. At KTA, sources of ignition include use of pyrotechnics and blanks, smoking, cooking as part of bivouac activities, sparks from construction activities and equipment, low-velocity plastic bullets associated with short-range training, and heat generated by catalytic converters. While the use of plastic bullets with short-range training is considered to be live-fire, it is not expected to pose an additional fire risk as these activities will be conducted in the Combined Arms Collective Training Facility. The Combined Arms Collective Training Facility is located in a highly-altered environment and away from known locations of *Tetraplasandra gymnocarpa*. All of the KTA occurrences are in areas designated as at a high threat from fire. Minimization measures for fire from all ignition sources are outlined in the project description, including implementation of the WFMP. The WFMP includes the following actions for KTA that will reduce the risk of fire at this installation: implementing a Fire Danger Rating System that will restrict training according to weather and fuel conditions and will be monitored hourly by range control; fuel load reduction as appropriate; construction of a dip pond in fiscal year 2004; maintaining roads to fuel break standards and construction of fire breaks; aerial and ground firefighting resources stationed on site during training; and reinitiating this consultation should a fire escape the installation boundary or start or spread within 521 m (1,771 ft) of a listed species (U.S. Army 2003b). However, the latest fires at SBMR (July and August 2003) indicate that full control of fire is not possible, even with all of these precautions and restrictions in place, and therefore the Service believes the risk to all species is higher than the Army indicates in the Biological Assessment. Additional restrictions, such as prohibiting smoking on site, are identified in the Standard Operating Procedures and the Biological Assessment for KTA (U.S. Army 2003a; G. Enriques, U.S. Army, pers. comm., 2003; K. Kawelo, U.S. Army, pers. comm., 2003). With these measures in place the threat from fire to these individuals will be minimized; however, the potential for a wildland fire can never be totally eliminated.

As the final construction drawings for the improvements to Drum Road are not available, it is not possible to determine the magnitude of potential direct effects to this species as a result of construction activities. Some *Tetraplasandra gymnocarpa* occur within 35 to 75 m (113 to 243 ft) of Drum Road. While mature trees could be damaged from construction activities, seedlings would likely be lost if significant earth work were to occur in these areas.

The threat of trampling from foot traffic is very low or non-existent for trees and shrubs, unless the plants are in the seedling stage or the trampling occurs close to the root system, causing compaction of the soil and decreasing the plant's ability to take up water and nutrients. It is unknown if there are seedlings present near the mature trees found within 75 m (243 ft) of roads or trails. There is a low to moderate threat from foot traffic where they are located in the action area, as one individual is 270 m (877 ft) from Drum Road and the topography is steep on either side, reducing the likelihood of troop egress into this area. To minimize the threat to seedlings

which may occur in areas where the threat of trampling from foot traffic is moderate or high, the Army proposes to educate each set of new soldiers on avoidance of trampling of endangered species, establish long-term conservation trend analysis (ITAM) plots to monitor impact of foot traffic trampling by infantry soldiers, and establish signage to identify areas that are off limits due to the presence of federally listed species. Additional measures will be considered by the Oahu Implementation Team (U.S. Army 2003a).

There are five open landing zones and three open landing/drop zones in the KTA action area. Two separate *Tetraplasandra gymnocarpa* individuals are found 195 and 270 m (634 and 877 ft), respectively, of Puu Kea landing zone. As such, the threat of damage to mature trees from downdraft which could result from aviation training is considered to be low. The Oahu Implementation Team will determine if monitoring of the effects of downdraft on these individuals and any associated seedlings is necessary to further reduce any identified adverse effects.

The ongoing threat from increased non-native plant invasion is always prevalent within, and adjacent to, high disturbance areas such as military training facilities. There are several sources of non-native weed introduction in KTA. Invasive plants could be spread within the installation by dismounted and mounted maneuvers, construction of Drum Road, other range construction and maintenance, and especially after a fire. Some non-native invasive plants can also spread into undisturbed areas once they have become established in a disturbed area. Invasive plant encroachment will also be a possibility after a major disturbance event such as a fire and this threat would have a significant effect should a fire occur in the vicinity of these plants. The invasive plant threat from Army training and SBCT Transformation is high for *Tetraplasandra gymnocarpa* because of the dry microclimate and prevalence of highly flammable non-native species such as *Eucalyptus* where this species is found. *Eucalyptus* also can preclude seedling germination and establishment. To minimize this threat the Army will prevent secondary non-native plant spread from fire by monitoring and eradicating newly dispersed non-native plants; implementing all minimization actions described in the project description for this threat; and supporting development of detailed methods for the monitoring and eradication of non-native invasive plants by the Oahu Implementation Team. In addition, if a fire does occur and native habitat is lost, the Army will work with the Service regarding their restoration of the damaged area to prevent the spread of additional invasive plant species (U.S. Army 2003a).

KLOA

Within the KLOA action area there are 13 individuals (five occurrences) found in training areas KB-2 and KB-3 between Kawailoa trail and the north side of Peahinaia Ridge. Identified actions in these areas include dismounted maneuvers, foot reconnaissance, bivouac, helicopter aviation training, and air assault. Within each training area, it is estimated that there will be one or two operations every month, each of which would be two to five days (up to 10 days for battalion - size and larger groups) in duration. Based upon Legacy training data collected from 1998-2002 for training area KB-2 (none available for KB-3), it is anticipated that there will be an average of 19,200 troops using this area over an average of 149 days per year. Mounted (vehicle)

maneuvers will be restricted to existing roads, most of which are far from any existing endangered species occurrences; foot maneuvers will be focused on and around trails; bivouac activity will be limited in area due to the extreme terrain found in much of the KLOA action area; and helicopter and air assault activities will be restricted to open landing and drop zones. Blank ammunition and ground pyrotechnics are used in this area during foot maneuvers (U.S. Army 2003a).

One of the effects to this species from ongoing and SBCT training activities is the continued risk of fire particularly due to pyrotechnic exercises, blank training exercises, cigarette smoking, cookstoves/fires at bivouac sites, and other accidental or unforseen ignition sources. All of the occurrences are found in fire vulnerability areas identified as moderate and where use levels are considered to be moderate. The threat from fire to the 13 individuals of *Tetraplasandra gymnocarpa* at KLOA will be reduced to low with the implementation of the relevant minimization measures and standard operating procedures contained within the WFMP. One fire occurred in 2000, burning 125.5 ha (310 ac), and is believed to have been started by blank ammunition or a muzzle flash (U.S. Army 2003a). Minimization measures for fire from all ignition sources are outlined in the project description, including implementation of the WFMP. The WFMP includes the following actions for KLOA that will reduce the risk of fire at this installation: implementing a Fire Danger Rating System that will restrict training according to weather and fuel conditions and will be monitored hourly by range control; fuel load reduction as appropriate; use of the dip pond at DMR; maintaining roads to fuel break standards, and reinitiating this consultation should a fire escape the installation boundary, or starts or spreads within 521 m (1,771 ft) of a listed species (U.S. Army 2003b). However, the latest fires at SBMR (July and August 2003) indicate that full control of fire is not possible, even with all of these precautions and restrictions in place, and therefore the Service believes the risk to all species is higher than the Army indicates in the Biological Assessment. Additional restrictions, such as prohibiting smoking on site, are identified in the Standard Operating Procedures and the Biological Assessment for KLOA (U.S. Army 2003a). With these measures in place the threat from fire to these individuals will be minimized; however, the potential for a wildland fire can never be totally eliminated.

The threat from trampling to *Tetraplasandra gymnocarpa* varies with the location of the individuals. The 13 individuals occur in low or moderate use areas where activities are constrained by the extreme topography found in the KLOA action area. No individuals occur within 10 m (32 ft) of a road or trail; however, six individuals occur within 40 m (130 ft) of a road or trail. For these plants, depending upon the terrain, the potential threat of trampling ranges from low to moderate. The remainder of the individuals are located between 140 and 900 m (455 and 2,925 ft) from any road or trail. The closest individual to Drum Road is 500 m (1,625 ft) away. The open landing or drop zone closest to an individual *T. gymnocarpa* ("House") is approximately 500 m (1,625 ft) from an occurrence, with several other occurrences approximately 1,000 m (3,250 ft) from an open landing and/or drop zone (Puu Kapu, Black, and Red). The threat, therefore, from downdraft and trampling which would result from air assault activities is considered to be low. As mentioned in KTA, any loss of seedlings at this point could have a lasting effect on the ability of the species to survive long-term because of the already

limited genetic variability. The minimization measures for *T. gymnocarpa* in KTA are the same as described above for individuals in KLOA action area, and will reduce the threat from trampling.

The ongoing threat from increased non-native plant invasion is always prevalent within and adjacent to training facilities. There are several potential sources of non-native plant introduction into KLOA, as mentioned above for KTA. The non-native plant threat from Army training and SBCT Transformation is low where *Tetraplasandra gymnocarpa* is found in KLOA. The minimization measures for *T. gymnocarpa* in KLOA are the same as described above for individuals in KTA action area, and will reduce the threat from non-native plants.

SBER

At least 27 individual *Tetraplasandra gymnocarpa* occur in training area ER-13 of the SBER action area. These individuals are located in an area characterized by the Army as low use, which includes the following: dismounted maneuvers, foot reconnaissance, bivouac, helicopter aviation training, and air assault. Within the training area, it is estimated that there will be one to two operations a month of company size moving through the area in squad (9 soldiers) or platoon (35 soldiers) units for a duration of two to five days, but for battalion-size (500 soldiers) and larger operations, the duration may be 10 to 14 days. Based upon data compiled for Legacy training for the years 1998-2002, the average number of troops using this area annually was 5,067 with the average days of use per year being 47. Foot maneuvers will be focused on and around trails, bivouac activity will be limited in area due to the extreme terrain in the SBER action area, and helicopter and air assault activities will be restricted to open landing and drop zones. Blank ammunition and ground pyrotechnics are used in this area during foot maneuvers (U.S. Army 2003a).

One of the effects to this species from ongoing and SBCT training activities is the continued risk of fire particularly due to pyrotechnic exercises, blank training exercises, cigarette smoking, cookstoves/fires at bivouac sites, and other accidental or unforseen ignition sources. The fire threat is low for *Tetraplasandra gymnocarpa* in the SBER action area in the mid elevation sites where it occurs. Despite the low vulnerability of the fuels to fire, the relatively heavy training load of SBER justifies a moderate vulnerability to fire. In the periods 1994 to 1998 and 2000 to 2002, a total of 14 fires were reported in SBER, impacting approximately 9 ha (23 ac). The most common cause was pyrotechnics of various types (U.S. Army 2003a). Minimization measures for fire from all ignition sources are outlined in the project description, including implementation of the WFMP. The WFMP includes the following actions for SBER that will reduce the risk of fire at this installation: implementing a Fire Danger Rating System that will restrict training according to weather and fuel conditions and will be monitored hourly by range control; fuel load reduction as appropriate, use of the dip pond at DMR; maintaining roads to fuel break standards, and reinitiating this consultation should a fire escape the installation boundary, or starts or spreads within 521 m (1,771 ft) of a listed species (U.S. Army 2003b). However, the latest fires at SBMR (July and August 2003) indicate that full control of fire is not possible, even with all of these precautions and restrictions in place, and therefore the Service believes the risk to

all species is higher than the Army indicates in the Biological Assessment. Additional restrictions, such as prohibiting smoking on site, are identified in the Standard Operating Procedures and the Biological Assessment for SBER. With these measures in place the threat from fire to these individuals will be minimized; however, the potential for a wildland fire can never be totally eliminated. In addition, the Army will implement any additional minimization actions determined necessary by the Oahu Implementation Team (U.S. Army 2003a).

Trampling from foot maneuvers could result in direct, adverse effects to seedlings of *Tetraplasandra gymnocarpa*. All of the individuals in SBER occur in moderate use areas and within 60 m (195 ft) of a road or trail. As such, the threat of trampling is considered to be moderate to high. The minimization measures for *T. gymnocarpa* in SBER are the same as described above for individuals in the KTA action area, and will reduce the threat from trampling to low.

The effect of non-native species from Army training to *Tetraplasandra gymnocarpa* within SBER is low, based on the minimization measures, which are the same as described above for *T. gymnocarpa* in the KTA action area.

All Installations

Feral ungulates are found throughout all of the installations and are a continued additional pressure for *Tetraplasandra gymnocarpa*. Pigs are particularly destructive as they trample, root and eat native vegetation and can introduce invasive species through fecal matter. These rooting sites are another avenue for establishment of invasive plants. Pig control measures will be considered by the Oahu Implementation Team (U.S. Army 2003a).

Tetraplasandra gymnocarpa is also threatened by the two spotted leafhopper, an introduced insect that causes feeding damage on leaves resulting in yellowing and wilting around the feeding area. In addition to this feeding damage, the insect may introduce a plant virus. This insect causes severe dieback in some native ferns and appears to feed on almost all plant species, native and introduced. Some exploratory work to search for natural enemies of this pest has been conducted with little or no success.

Tetraplasandra gymnocarpa does not require stabilization because 50 percent of the known individuals do not occur in the Army action areas, and there are at least three stable populations units of greater than 25 mature, reproducing individuals.

Summary

The risk to *Tetraplasandra gymnocarpa* from Legacy and Transformation training has been reduced through the restrictions the Army has made to its routine training activities and the development and implementation of its WFMP. This species is considered stable at this time and the stabilization actions developed for other species in the Oahu IP will benefit the species so that potential impacts associated with military training activities will be minimized in the short-term.

Based on the actions and issues outlined in the Project Description and the Effects of the Action on the Listed Species sections above and the benefit to this species from the species stabilization actions of other species within KTA, KLOA, and SBER as described in the Biological Assessment and the Makua IP, the Service believes that the Army's proposed action is outweighed by the long-term benefits to this species.

Viola chamissoniana* ssp. *chamissoniana

Seventeen individuals of *Viola chamissoniana* ssp. *chamissoniana* from one occurrence are known from within the SBMR action area (see Figure 10b in the Biological Assessment). These plants are found at Puu Kumakalii and located immediately off of a trail at the action area boundary approximately 900 m (2,925 ft) away from the impact area and 500 m (1,625 ft) from an offsite cellular tower site. There are no Army actions proposed for the areas where *V. chamissoniana* ssp. *chamissoniana* is found within SBMR, as mounted and dismounted maneuvers are restricted by the presence of unexploded ordnance. While most of the high explosive rounds fired during live-fire training at SBMR land within the designated impact area, numerous rounds can be found on the ground above the fire break road which forms the boundary of the impact area. This demonstrates that some rounds either ricochet out of the impact area or exceed their expected range. Fire can also carry from within the impact area out of the fire break road into habitat of listed species. Live-fire ammunition includes tracers and various types of high explosive rounds, both of which are highly incendiary. Live-fire training exercises currently occur within the impact area an average of 220 days per year, utilizing over 29,000 rounds of tracers and various types of high explosive ammunition. Transformation will result in the reduction in 5.56 mm ball and tracer munition use and increases in other small arms ball and munition use. There will be an increase in the use of grenades and mortar ammunition, which are more likely to land outside of the current fire break road and have been responsible for starting previous fires. Of note is the addition of the mobile gun Stryker-mounted system that shoots 155 mm munition, which behave similarly to mortar rounds. Mortar rounds are currently limited to a charge of three to ensure that they do not land above the upper elevation boundary of SBMR, but this charge does not limit the ability of the round to land outside of the fire break road (U.S. Army 2003a).

The primary effect to this species in SBMR from ongoing and SBCT training activities is the continued risk of fire, particularly due to use of live-fire ammunition. A fire can start either from a round igniting vegetation within the impact area and the fire jumping the fire break road or a round that lands outside the impact area and starts a fire outside the fire break road. Therefore, additional use of these weapons systems under SBCT will increase the risk of fire in the areas where this species occurs. There is also the potential for ignition caused by catalytic converters and construction equipment. The area where *V. chamissoniana* ssp. *chamissoniana* occurs is mesic forest which is variably vulnerable to fire and is at least 900 m (2,925 ft) up slope of the fuel break road (U.S. Army 2003a). Minimization measures for fire from all ignition sources are outlined in the project description, including implementation of the WFMP. The WFMP includes the following actions for SBMR that will reduce the risk of fire at this installation: implementation

of a Fire Danger Rating System that will restrict training according to weather and fuel conditions and will be monitored hourly by range control; construction of a 1,136 cubic meter (300,000 gallon) dip pond in fiscal year 2004; relocating targets that are close to the fire break road further into the impact area to reduce the likelihood of overshot rounds landing outside the fire break; improvement of the fire break road around the McCarthy Flats ranges to the same standards as the existing fire break roads; and managing the fuels on the ridge leading to Puu Pane (U.S. Army 2003b). Additional restrictions, such as prohibiting smoking on site, are identified in the Standard Operating Procedures and the Biological Assessment for SBMR (U.S. Army 2003a). However, the latest fires at SBMR (July and August 2003) indicate that full control of fire is not possible, even with all of these precautions and restrictions in place, and, therefore, the Service believes the risk to all species is higher than the Army indicates in the Biological Assessment. With these measures in place the threat from fire to these individuals will be minimized; however, the potential for a wildland fire can never be totally eliminated.

There is a low threat from a round unintentionally landing outside of the impact area and exploding on or near the occurrence of *Viola chamissoniana* ssp. *chamissoniana* in south Mohiakea Gulch under Legacy training. However, there will be an increase in the use of grenades and mortar ammunition under SBCT Transformation, which are more likely to land outside of the current fire break road, and therefore more likely to impact this species (U.S. Army 2003a).

Not only is there the potential for the direct loss of *Viola chamissoniana* ssp. *chamissoniana* due to fire, but a fire may open up the habitat allowing for the invasion of non-native plant species. The ongoing threat from increased non-native plant invasion is always prevalent within, and adjacent to, high disturbance areas such as military training facilities. There are several additional potential sources of non-native plant introduction in SBMR. Invasive plants could be spread within the installation by mounted maneuvers, range construction and maintenance, and especially after a fire. Some non-native invasive plants can also spread into undisturbed areas once they have become established in a disturbed area. Invasive plant encroachment will also be a possibility after a major disturbance event such as a fire and this threat would have a significant effect should a fire occur in the vicinity of these plants. The non-native plant threat from Army training and SBCT Transformation is low for the *V. chamissoniana* ssp. *chamissoniana* in the area where it is found. To minimize this threat the Army will prevent secondary non-native plant spread from fire by monitoring and eradicating newly dispersed non-native plants; implementing all minimization actions described in the project description for this threat; and supporting development of detailed methods for the monitoring and eradication of non-native invasive plants by the Oahu Implementation Team. In addition, if a fire does occur and native habitat is lost, the Army will work with the Service regarding their restoration of the damaged area to prevent the spread of additional invasive plant species (U.S. Army 2003a).

In addition to all of the minimization actions described in the effects section, an Implementation Plan has been developed and will be implemented for the Makua and other Oahu action areas, which includes a stabilization plan for *Viola chamissoniana* ssp. *chamissoniana*. The

stabilization plan includes those actions listed in the Conservation Needs in the Action Areas section, along with any additional measures that will be identified by the Oahu Implementation Team. The implementation team will consider additional sites for reintroduction, since the Puu Kumakalii population unit was not considered part of the action area in the Makua IP.

Summary

The risk to *Viola chamissoniana* ssp. *chamissoniana* from Legacy and Transformation training has been reduced through the restrictions the Army has made to its routine training activities and the development and implementation of its WFMP. This species is not considered stable at this time, but the high priority stabilization actions the Army is currently implementing (see the Ongoing Conservation Actions section) and the stabilization actions developed for the Makua IP will benefit the species so that potential impacts associated with military training activities will be minimized in the short-term and the species will be stabilized in the long-term. The Service had final approval of the Makua IP and will have final approval of the Oahu IP to assure the Army's minimization and stabilization actions will stabilize the species and increase the environmental baseline of the species. Based on the actions and issues outlined in the Project Description and the Effects of the Action on the Listed Species sections above and the species stabilization actions as described in the Biological Assessment and the Makua IP, the Service believes that the Army's proposed action is outweighed by the long-term benefits from stabilizing this species.

Viola oahuensis

All extant *Viola oahuensis* are found in the Koolau Mountains of Oahu. Here 329 individuals are found in eight occurrences. One hundred and seventy-nine individuals occur in two of the Oahu action areas: KLOA and SBER (see Figures 7b and 9c in the Biological Assessment). These represent 54 percent of the known individuals of *V. oahuensis.*

KLOA

A total of 157 individuals of *Viola oahuensis* are found as five occurrences in the Koolau Mountains in lowland wet forest and shrubland habitat at the western edge of the action area in training areas KA-1, KA -2, KB-1, and KB-3 (J. Lau, HINHP, pers. comm. 2003; K. Kawelo, U.S. Army, pers. comm. 2003). Identified actions in these areas include dismounted maneuvers, foot reconnaissance, bivouac, helicopter aviation training, and air assault. These operations take place one to two times per month for an average of two to five days at a time at company level (120 soldiers) size. These operations have the potential of lasting up to 10 days in length. The companies move through the area in squad (9 soldiers) or platoon (35 soldiers) units. Based upon data compiled for Legacy training for the years 1998-2002, it is estimated that the average number of troops that will use this area will range between 13,450 and 19,200 over an average of 90 to 193 days per year. Mounted (vehicle) maneuvers will be restricted to existing roads, most of which are far from any existing endangered species occurrences; foot maneuvers will be focused on and around trails; bivouac activity will be limited in area due to the extreme terrain found in much of the KLOA action area; and helicopter and air assault activities will be restricted to open landing and drop zones. Blank ammunition and ground pyrotechnics are used in this area during foot maneuvers (U.S. Army 2003a).

One of the effects to this species from ongoing and SBCT training activities is the continued risk of fire particularly due to pyrotechnic exercises, blank training exercises, cigarette smoking, cookstoves/fires at bivouac sites, and other accidental or unforseen ignition sources. The majority of the occurrences of *Viola oahuensis* occur in an area ranked as low vulnerability to fire due to distance from fire ignition sources and/or vegetation. Individuals occur areas where training use is low. The closest open landing or drop zones are greater than 4,800 m (15,600 ft) from the closest individual of *V. oahuensis*. One fire occurred in 2000, burning 125.5 ha (310 ac), and is believed to have been started by blank ammunition or a muzzle flash (U.S. Army 2003a). Minimization measures for fire from all ignition sources are outlined in the project description, including implementation of the WFMP. The WFMP includes the following actions for KLOA that will reduce the risk of fire at this installation: implementing a Fire Danger Rating System that will restrict training according to weather and fuel conditions and will be monitored hourly by range control; fuel load reduction as appropriate; use of the dip pond at DMR; maintaining roads to fuel break standards, and reinitiating this consultation should a fire escape the installation boundary, or starts or spreads within 521 m (1,771 ft) of a listed species (U.S. Army 2003b). However, the latest fires at SBMR (July and August 2003) indicate that full control of fire is not possible, even with all of these precautions and restrictions in place, and therefore the Service believes the risk to all species is higher than the Army indicates in the Biological Assessment. Additional restrictions, such as prohibiting smoking on site, are identified in the Standard Operating Procedures and the Biological Assessment for KLOA (U.S. Army 2003a). With these measures in place the threat from fire to these individuals will be minimized; however, the potential for a wildland fire can never be totally eliminated.

The threat of trampling from foot traffic is very low or non-existent for trees and shrubs, unless the plants are in the seedling stage or the trampling occurs close to the root system, causing compaction of the soil and decreasing the plant's ability to take up water and nutrients. All 157 individuals of *Viola oahuensis* occur in areas of low use and low to moderate foot traffic. Foot reconnaissance and bivouac activities away from trails is constrained by the extreme topography found in the KLOA action area. At least 25 individuals (27 percent) are found along either the Peahinaia or Schofield-Waikane trails. Most of these are found at distances greater than 30 m (98 ft) from either trail, but two individuals are found within 10 m (32 ft). To minimize the threat to seedlings the Army will educate each set of new soldiers on avoidance of trampling of endangered species; fence the individuals near trails; establish long-term conservation trend analysis (ITAM) plots to monitor impact of foot traffic trampling by infantry soldiers; and establish signage to identify areas that are off limits due to the presence of federally listed species. Additional measures, such as fencing of additional occurrences most in danger of trampling, will be considered by the Oahu Implementation Team (U.S. Army 2003a).

The ongoing threat from increased non-native plant invasion is always prevalent within, and adjacent to, high disturbance areas such as military training facilities. There are several potential sources of non-native plant introduction in KLOA. Invasive plants could be spread within the installation by dismounted and mounted maneuvers, range construction and maintenance, and especially after a fire. Some non-native invasive plants can also spread into undisturbed areas

once they have become established in a disturbed area. Invasive plant encroachment will also be a possibility after a major disturbance event such as a fire and this threat would have a significant effect should a fire occur in the vicinity of these plants. The non-native plant threat from Army training and SBCT Transformation is low for the occurrences of *Viola oahuensis* in the wet forest and shrubland where the individuals are found. To minimize this threat the Army will prevent secondary non-native plant spread from fire by monitoring and eradicating newly dispersed non-native plants; implementing all minimization actions described in the project description for this threat; and supporting development of detailed methods for the monitoring and eradication of non-native invasive plants by the Oahu Implementation Team. In addition, if a fire does occur and native habitat is lost, the Army will work with the Service regarding their restoration of the damaged area to prevent the spread of additional invasive plant species (U.S. Army 2003a).

SBER

Within the action area for SBER one occurrence of 22 individuals of *Viola oahuensis* are found at Konahuanui, within training area ER-13. These individuals are located in an area characterized by the Army as low use, which includes the following: dismounted maneuvers, foot reconnaissance, bivouac, helicopter aviation training, and air assault. Within the training area, it is estimated that there will be one to two operations a month of company size moving through the area in squad (9 soldiers) or platoon (35 soldiers) units for a duration of two to five days, but for battalion-size (500 soldiers) and larger operations, the duration may be 10 to 14 days. Based upon data compiled for Legacy training for the years 1998-2002, the average number of troops using this area annually was 5,067 with the average days of use per year being 47. Foot maneuvers will be focused on and around trails, bivouac activity will be limited in area due to the extreme terrain in the SBER action area, and helicopter and air assault activities will be restricted to open landing and drop zones. Blank ammunition and ground pyrotechnics are used in this area during foot maneuvers (U.S. Army 2003a).

One of the effects to this species from ongoing and SBCT training activities is the continued risk of fire particularly due to pyrotechnic exercises, blank training exercises, cigarette smoking, cookstoves/fires at bivouac sites, and other accidental or unforseen ignition sources. *Viola oahuensis* occurs in the eastern area where ignition source and fire hazard potential are considered to be very low. Despite the very low vulnerability of the fuels to fire, the relatively heavy training load of SBER justifies a low vulnerability to fire for this species. In the periods 1994 to 1998 and 2000 to 2002, a total of 14 fires were reported in SBER, impacting approximately 9 ha (23 ac). The most common cause was pyrotechnics of various types (U.S. Army 2003a). Minimization measures for fire from all ignition sources are outlined in the project description, including implementation of the WFMP. The WFMP includes the following actions for SBER that will reduce the risk of fire at this installation: implementing a Fire Danger Rating System that will restrict training according to weather and fuel conditions and will be monitored hourly by range control; fuel load reduction as appropriate, use of the dip pond at DMR; maintaining roads to fuel break standards, and reinitiating this consultation should a fire escape the installation boundary, or starts or spreads within 521 m (1,771 ft) of a listed species (U.S. Army 2003b). However, the latest fires at SBMR (July and August 2003) indicate that full control of

fire is not possible, even with all of these precautions and restrictions in place, and, therefore, the Service believes the risk to all species is higher than the Army indicates in the Biological Assessment. Additional restrictions, such as prohibiting smoking on site, are identified in the Standard Operating Procedures and the Biological Assessment for SBER. With these measures in place the threat from fire to these individuals will be minimized; however, the potential for a wildland fire can never be totally eliminated. In addition, the Army will implement any additional minimization actions determined necessary by the Oahu Implementation Team (U.S. Army 2003a).

The threat of trampling from foot traffic is moderate for the *Viola oahuensis* within SBER as it is found near a main trail. The 22 individuals occur approximately 120 m (390 ft) off of the Schofield-Waikane trail. The minimization measures for *V. oahuensis* in SBER are the same as described above for individuals in the KLOA action area, and will reduce the threat from trampling to low.

The ongoing threat from increased non-native plant invasion is always prevalent within and adjacent to training facilities. There are several potential sources of non-native plant introduction into SBER, as mentioned above for KLOA. The non-native plant threat from Army training and SBCT Transformation is moderate for the one occurrence of *Viola oahuensis* in SBER. The minimization measures for *V. oahuensis* in SBER are the same as described above for individuals in the KLOA action area, and will reduce the threat from non-native plants to low.

All Installations

Feral ungulates are found throughout all of the installations and are a continued additional pressure for *Viola oahuensis*. Pigs are particularly destructive as they trample, root and eat native vegetation and can introduce invasive species through fecal matter. These rooting sites are another avenue for establishment of invasive plants. However, the fencing that will occur to avoid trampling from foot maneuvers will also protect the occurrences within the action area from ungulates. Additional measures will be considered by the Oahu Implementation Team (U.S. Army 2003a).

In addition to all of the minimization actions described in the effects section, the Makua IP has been finalized which includes stabilization actions for *Viola oahuensis*. These stabilization actions include the actions as discussed in the Conservation Needs in the Action Areas section of this opinion and in the Biological Assessment. The Oahu Implementation Team will reassess the current status of the stabilization actions for *V. oahuensis* to assure that conservation needs of this species are being met pursuant to the Makua IP. The Oahu stabilization plan will include those actions listed in the Conservation Needs in the Action Areas section, along with any additional measures identified by the Oahu Implementation Team.

Summary

The risk to *Viola oahuensis* from Legacy and Transformation training has been reduced through the restrictions the Army has made to its routine training activities and the development and

implementation of its WFMP. This species is not considered stable at this time, but the stabilization actions to be developed for the Oahu IP will benefit the species so that potential impacts associated with military training activities will be minimized in the short-term and the species will be stabilized in the long-term. Because *V. oahuensis* occurs within both the MMR and the Oahu action areas, the Oahu Implementation Team will consider this species a high priority and address any urgent actions that need to be implemented so that conservation needs of this species are not undermined prior to the completion of the Oahu IP. The Service has final approval of the Oahu IP to assure the Army's minimization and stabilization actions will stabilize the species and increase the environmental baseline of the species. Based on the actions and issues outlined in the Project Description and the Effects of the Action on the Listed Species sections above and the species stabilization actions as described in the Biological Assessment, the Service believes that the risk of the Army's proposed action is outweighed by the long-term benefits from stabilizing this species.

EFFECTS OF THE ACTION ON LISTED SPECIES

Oahu Tree Snails

Currently, for the Oahu tree snail species covered in this consultation, there are approximately 1,745 individuals known from approximately 53 post-1981 occurrences in the Koolau and Waianae Mountains (Tables 1 and 2). Eight of these tree snail species occur at KLOA; four species at SBER; and one species at SBMR. Approximately 79 percent of all post-1981 occurrences of these snails are within the Oahu action areas, and approximately 54 percent of all post-1981 observations of individual snails are within the action areas. As indicated in Table 2, there are 8 snail species found at KLOA at 28 occurrences for a total of 746 snails; SBMR has 1 snail species at 11 occurrences for a total of 175 snails; and SBER has 4 snail species at 3 occurrences for a total of 16 snails.

Introduction of Alien Plant and Animal Species. Oahu tree snails and other native snails are highly vulnerable to the direct effects of alien predators, especially rats (*Rattus* sp.) and the predatory snails *Euglandina rosea* (Hadfield and Mountain 1980, Hadfield 1986, Hadfield and Miller 1989, Kinzie 1992; Hadfield, Miller and Carwile 1993). Disposal of food associated with military troop activities or from hikers and hunters in areas where tree snails occur may contribute to an increase in local rat populations because of additional food resources. Observations of MRE (meals, ready-to-eat) containers and other trash and food items along trails that support tree snail occurrences indicate that this may be a problem (S.E. Miller, in litt. 1988; M.G. Hadfield, pers. comm. 1988). As directed in the Army's Standard Operating Procedures, all food and trash will be carried out. Therefore, any impacts from this effect will be minimum.

Oahu tree snails are dependent on native vegetation and are not generally known to establish viable occurrences on non-native plant species (Service 1993). Non-native plants are spread via seeds on boots, equipment, or clothing, or in the fur and feces of pigs and goats. These effects are especially intense along trails or in areas that may be used for camping or bivouacs. These are the same areas that often support many of the known tree snail occurrences. The introduction

of non-native plant species to habitats currently considered suitable for Oahu tree snails will limit the snails ability to establish new occurrences and will eventually lead to an overall decline in tree snail abundance. The risk and potential effects of non-native plant introductions vary among different portions of the action areas at SBMR, SBER, and KLOA, depending on the degree of troop and vehicle activities. However, once introduced into an area, these invasive plants can spread along trails or throughout the forest understory. The threat of non-native plants spreading from military activities will be reduced by the Army's proposed conservation measures which include cleaning boots, clothing, equipment, and vehicles prior to entering areas with native vegetation, and controlling non-native plants along trails. Thus the overall threat from these invasive plants to the *Achatinella* tree snails covered in this consultation is considered to be moderate.

Impacts from Dismounted Troop Movement. Impacts from dismounted troop movement along trails and through the forested areas of KLOA, SBER, and SBMR are a significant threat to Oahu tree snail occurrences. Troop movement along trails and through forested areas that support tree snails may result in trampling of tree snails and their host plants, removal of these plants in areas that are set up for bivouacs, or inadvertently knock tree snails out of their host plants. These threats will be reduced by the Army's proposed fencing and marking of areas that support tree snails so that troop movement activities can avoid the tree snails and their host trees. Based on these conservation actions, the overall threat from dismounted troop movements to the *Achatinella* tree snails covered in this consultation is considered to be low.

Restrictions on Access for Resource Management. The Army's Biological Assessment addresses the encroachment of training activities on natural resource management actions for *Achatinella mustelina* and other federally listed species at SBMR west range. In this area, the threat of habitat degradation by feral pigs and non-native plants, and predation by rats and predatory snails require regular management in order to sustain the populations of *A. mustelina,* other federally listed species, and their habitats at SBMR. For reasons of human safety, management of natural resources in areas of the SBMR west range that support tree snails, endangered plants, and elepaio can only be conducted on days when there is no live-fire training. The Army has committed to provide a minimum of 45 days per year for monitoring and resource management by their Natural Resource staff at SBMR. The effect of limiting the number of days to manage resources for the snails will likely result in reduced effectiveness of managing the threats. With adequate management of rats, predatory snails, non-native plants, and pigs, the 11 sites (50 percent of all known *A. mustelina* populations) and approximately 175 snails (18 percent of all known individuals) within the SBMR action area could be stabilized. Based on the Army's commitment (in their Biological Assessment and in the Makua IP) to stabilize this species, the Service believes that the threat to *A. mustelina* from restricting access to 45 days per year for conservation actions in the area above SBMR west range is low.

Direct Impact from Live-Fire Training. High explosive munitions fired during live-fire training at SBMR mostly land within the designated impact area. However, high explosive munitions occasionally do land outside the impact area where there is a greater chance of affecting listed

species. The likelihood that a high explosive munition will land above the fire break road is very low but it is expected to occur, given the high annual volume of high explosive munitions that will be fired at SBMR (7,444 rounds of 155 mm high explosive munitions, 3,708 rounds of 105 mm high explosive munitions, 10,434 rounds of 81 mm high explosive munitions, and 7,829 rounds of 60 mm high explosive munitions). These munitions have a "kill radius" of up to 50 m (164 ft), and any tree snails within or near this 50-m (164 ft) radius would probably be harmed or killed.

There are 11 known occurrences of *Achatinella mustelina* on the slopes of the Waianae Mountains that are within the SBMR action area. Based on information presented in the Biological Assessment, all of these populations fall within the surface danger zones for live-fire at SBMR. Many of these occurrences are within 1,000 m (3,281 ft) of the impact zone. Three of the occurrences are well within the valley and the remaining occurrences are along action area boundary. Some or perhaps all of these tree snail populations could potentially be impacted by errant high explosive munitions. The total down-range area where high explosive impacts to *A. mustelina* could occur (presented as the part of the surface danger zones above the designated impact zone in the Army's Biological Assessment) is approximately 959 ha (2,370 ac). Using the 50-m kill radius of a 155 mm high explosive munition as a worst case scenario, the total area where the impact of such a munition would kill *A. mustelina* is 8.6 ha (21.3 ac)(a 50-m (165 ft)) radius area is 0.785 ha (1.9 ac); multiplied by 11 sites equals 8.6 ha or 21.3 ac). These 11 sites represents 50 percent of all known *A. mustelina* populations and approximately 18 percent of all known individuals (175 snails). The 11 sites in the action area occupy are about one percent of the total down-range area. Thus, while there is a low probability that a high explosive impact would affect *A. mustelina*, the significance of a high explosive impact is moderate due to the substantial number of *A. mustelina* occurrences on SBMR. Similar estimates could be made for other high explosive munitions, and the effects of all high explosive munitions would be cumulative. For all high explosive munitions that may overshoot the impact area as SBMR, the impact on *A. mustelina* is expected to be moderate with the loss of one tree snail occurrence, which may result in the loss of between 10 and 40 individual snails. Monitoring the known occurrences will enable the Service to evaluate adverse effects from this action.

Live-fire training at SBER is limited to small caliber weapons, so the potential direct impacts of live-fire training on Oahu tree snails in these areas is very low or none. There is no live-fire at KLOA.

Fires from Current Military Training and Transformation Training. Likely sources of fire ignition associated with military training are live-fire actions, pyrotechnics, military vehicles, discarded cigarettes, and other equipment used during training, construction, and maintenance. As indicated in the Army's Biological Assessment, fuel load and fire risk are high inside the SBMR impact area due to an abundance of ignition sources, dry conditions, and an abundance of fine fuels such as grasses. Fires occur annually outside the impact area at SBMR because they either are ignited outside the impact area (from aerial pyrotechnics or high explosives) or because they cross the fire break road. Fire fuel load and the number of ignition sources are lower outside of the impact

area, and fire risk declines with elevation due to increases in orographic rainfall and moisture content of the soil and vegetation. Because of these conditions, the Service believes that fire risk in the wetter sections of SBER and KLOA that support tree snail occurrences is very low.

One of the major effects of fire on *Achatinella* tree snails is the loss of habitat that is needed to support the stabilization of this snail species. Host plant abundance is reduced and forest conditions become dryer, which may increase the mortality of new born snails (Hadfield *et al.* 1993). These changes in habitat may also affect the availability of the fungal food used by the snails. Fires also facilitate the spread of non-native plants, which are not used by Oahu tree snails as host plants. Many of these invasive non-native plants recover more quickly than native plants following a fire. The amount of suitable tree-snail forest habitat at SBMR has already been substantially reduced by fires, and future fires outside of the fire break road are likely to continue this process. Recent fires at SBMR during the Summer of 2003 are examples of this process.

Fires pose a significant threat to *Achatinella mustelina* in the Waianae Mountains, but are less of a threat to other Oahu tree snail species in the Koolau Mountains were conditions are generally too wet to carry fire. The direct effects of fire are most likely to occur in dry to mesic forest areas where wildland fires can easily burn during dry periods. Four of the 11 *A. mustelina* occurrences at SBMR occur in mesic forest and shrubland close to where this forest type transitions into non-native vegetation. All four of these occurrences occur in habitats currently rated by the Army as having a low fire vulnerability. However, all four occurrences occur near habitats dominated by non-native plants and rated as having moderate fire vulnerability (U.S. Army. 2003b). These more fire-prone habitats have been created by successive burning of mesic forest areas that are then taken over by the non-native plants that are more likely to carry fire. Future fires above the fire break road at SBMR may eventually lead to the loss of these occurrences due to the direct effects of fire. Thus, fire constitute a moderate direct threat to these four populations of *A. mustelina* at SBMR. The fire threat to *A. mustelina* will be reduced to low by the implementation of an adequate WFMP, which includes a fired danger rating system that will set standards for when live-fire exercises can proceed.

Achatinella mustelina occurrences in the northern Waianae Mountains may also be threatened by wildland fires that could originate from pyrotechnic training or other military activities at DMR. Several tree snail occurrences occur in mesic forest up slope of DMR. Fire breaks will be constructed at DMR and the WFMP will be implemented. These actions will minimize fire risk to the snails that reside above the DMR.

Summary. The risk to *Achatinella* tree snails from Legacy and Transformation training has been reduced through the restrictions the Army has made to its routine training activities and the development and implementation of its WFMP. These tree snail species are not considered stable at this time, but the stabilization actions to be developed for the Oahu IP will benefit the species so that potential impacts associated with military training activities will be minimized in the short-term and the species will be stabilized in the long-term. The Service has final approval of

the Oahu IP to assure the Army's minimization and stabilization actions will stabilize the tree snail species and will increase the environmental baseline of the species overall. Based on the actions and issues outlined in the Project Description and the Effects of the Action on the Listed Species sections above and the species stabilization actions as described in the Biological Assessment, the Service believes that the risk of the Army's proposed action is outweighed by the long-term benefits from stabilizing these tree snail species.

EFFECTS OF THE ACTION ON LISTED SPECIES

Oahu Elepaio

Direct Impact from Live-Fire Training. Most high explosive rounds fired at SBMR land within the designated impact area, but numerous 155 mm, 105 mm, and other rounds are present on the ground above the fire break road, demonstrating that some rounds either ricochet or exceed their expected range. These rounds may be either high explosive rounds that did not detonate, or practice rounds that were not designed to detonate. It is likely that additional high explosive rounds land above the fire break road, but detonate and leave little evidence. The probability that any given round will land above the fire break road may be low, but large numbers of rounds are fired every year at SBMR (7,444 155 mm high explosive rounds, 3,708 105 mm high explosive rounds, 10,434 81 mm high explosive rounds, and 7,829 60 mm high explosive rounds; Biological Assessment). Munitions fired at SBMR have a "kill radius" of up to 50 m (164 ft), meaning that any elepaio or elepaio nests within a 50-m (164 ft) radius of the impact site would be destroyed. The number of elepaio potentially affected by direct impacts from high explosive rounds cannot be evaluated without data on the frequency with which rounds land outside the impact area, and this information was not provided in the Biological Assessment. The number of elepaio affected by high explosive impacts each year is likely to be low because elepaio have not declined rapidly despite many years of training at SBMR, but it is possible that elepaio are taken by impacts and that this effect may be causing a slow drain on an already declining population. The Service believes that data on the number of rounds that land above the fire break road, the locations in which they land, and the status of elepaio in areas potentially affected must be collected in order to fully evaluate the potential effect on elepaio. If elepaio continue to decline at SBMR and data indicate that high explosive rounds are landing in elepaio territories, this would constitute new information that elepaio are affected by the action to an extent not considered in the biological opinion, thus requiring that the consultation be reinitiated.

Only a single elepaio territory is known within the impact area, in Banana Gulch just below the fire break road. The chance of a round landing in this territory is high because it is located within the designated impact area, but because there is only one elepaio territory inside the impact area, the potential threat to the species from the direct effects of live-fire training within the impact area is high. This threat value would not be reduced by conservation measures because the impact area is intentionally targeted during training.

There are approximately 71 elepaio territories in areas adjacent to the impact area where the threat from munitions impact is regarded to be low. Using the 50-m (164 ft) kill radius of a 155 mm round, the cumulative area where the impact of such a round would kill elepaio is 55.8 ha (138 ac)(71 sites, each with a radius of 50-m (164 ft)), which represents 10 percent of the total area occupied by elepaio at SBMR (VanderWerf et al. 2001). Similar calculations could be made for other munitions, and the effects of all munitions would be cumulative. It is difficult to determine whether elepaio have been affected even if a round lands within their territory because elepaio may be located anywhere within their territory at a given time. The fact that this type of effect has not been observed on elepaio or elepaio nests by Army Natural Resource staff is not adequate evidence that elepaio have not been affected by impacts. Monitoring of elepaio at SBMR is infrequent, the locations of most elepaio nests are unknown, and the chances of finding the remains of an adult elepaio or nest that has been destroyed by an impact are very low. It is possible that elepaio already have been killed by such impacts.

The potential threat to elepaio from direct impacts during live-fire training outside the impact area must be regarded as at least moderate. This analysis is not in agreement with the Biological Assessment, which assigned the direct effect of munitions impacts outside the impact area a threat value of low. During artillery training with 155 mm and 105 mm ammunition, the maximum propellant charge allowed is three powder bags to prevent rounds from going over the ridge line of the Waianae Mountains, but this does not prevent rounds from landing above the fire break road. The Service believes that the potential effect to elepaio from direct impacts during live-fire training can be reduced by the following conservation measures: 1) moving targets within the impact area so they are farther from the fire break road, if data indicate that current target placement is causing rounds to land above the fire break road; and 2) when consistent with training objectives, lowering the maximum propellant charge from three powder bags to two, so there is less chance a round will land outside the impact area. Whether these conservation measures will reduce the potential impact to low will depend on how many high explosive rounds continue to land above the fire break road and whether the elepaio population continues to decline, and this will require additional analysis.

Noise. Many types of military training are noisy, particularly live-fire artillery and mortar training and mounted maneuvers with Stryker and other large vehicles conducted at SBMR. A study of the effects of noise from military training on elepaio at SBMR showed that noise levels at elepaio nests during artillery training typically ranged from 81-112 decibels (VanderWerf et al. 2000), which is quite loud. However, VanderWerf et al. (2000) also demonstrated that elepaio at SBMR rarely responded to even the loudest noises, and that such noises did not result in nest disturbance or decreased nest success, probably because the elepaio at SBMR have become habituated to noise. This does not imply that elepaio in other locations would not be disturbed by similar noises. The potential threat to elepaio from the effects of noise during military training at SBMR is very low.

Fires from Current Military Training and Transformation. Fires pose a serious direct and indirect threat to elepaio. Adult elepaio are likely to flee from a fire and would not be directly killed, but

eggs and nestlings are incapable of escaping a fire and would be killed directly. Even if a nest was not directly destroyed by a fire, adult elepaio are likely to abandon a nest following a fire, causing the nest to fail. The indirect long-term effects of fire on adult elepaio are more serious. Fires destroy forest needed by elepaio for foraging and nesting, reducing the amount of forest habitat available to elepaio and limiting their population. Fires also facilitate the spread of alien plant species not used by elepaio, such as *Casuarina* spp. and *Eucalyptus robusta*, because these species burn readily and grow back more quickly than native plants following a fire.

The most likely source of fire ignition is live-fire training, but other potential ignition sources include cigarette smoking, clearing of helicopter landing zones with explosives, and sparks and catalytic converters from vehicles and equipment, construction, and maintenance. Fuel load and fire risk are highest inside the impact area at SBMR due to the abundance of ignition sources, dry conditions, and abundance of fine fuels such as grasses. Fine fuel load and the number of ignition sources are lower outside the impact area, and fire risk currently declines with elevation due to increases in orographic rainfall and moisture content of soil and vegetation. Fire risk is very high within the impact area, and moderate in areas adjacent to the impact area. Fire risk is lower at SBER and KLOA.

The territory of one elepaio pair at SBMR is entirely within the impact area, in Banana Gulch near the top edge of the impact area. Because fire risk in this area is very high and no effort would be made to suppress fires below the fire break road, the potential threat to this pair of elepaio from the direct and indirect effects of fire inside the impact area is very high. This threat might be reduced if controlled burns are used to reduce the amount of fine fuel within the impact area, but the threat still would be very high after implementation of conservation measures, as stated in the Biological Assessment.

Approximately 71 elepaio territories are known from non-target portions of the action area at SBMR where the fire risk currently is regarded to be low. However, fires have occurred regularly in this area, because they either were ignited outside the impact area or because they crossed the fire break road. In July-August 2001, at least five fires burned a total of 26.9 ha (66.5 ac) of forest above the fire break road, including 20.7 ha (51.1 ac) that were proposed as critical habitat for the elepaio at that time. Since the fires occurred, 12.1 ha (30 ac) of that area has been designated as critical habitat for the elepaio. One of the 2001 fires burned an area known to comprise part of an elepaio territory, resulting in partial loss of their foraging area, and a juvenile elepaio was observed immediately adjacent to the burn. In July 2003, a fire likely ignited by a parachute flare burned 3.4 ha (8.4 ac) above the fire break road adjacent to designated critical habitat. In September 2003, a fire burned 2.8 ha (7.0 ac) above the fire break road, including portions of three elepaio territories and 1.2 ha (3.0 ac) of designated critical habitat. This fire likely was ignited by propellant from a rocket-propelled grenade that was inappropriately used when fire risk was high. During an inspection of the damage caused by the fire, four parachute flares were observed above the fire break road.

Most fires at SBMR primarily burn areas that have burned previously, but each new fire also extends a short distance into previously unburned areas of mesic forest, resulting in expansion of dry forest and shrubland dominated by alien plant species and a reduction in amount of forest habitat suitable for elepaio. From 2001-2003, an average of 1.33 elepaio pairs per year have been affected by fires at SBMR (one in 2001, zero in 2002, and three in 2003). The Service believes that this level of take is likely to continue until an adequate WFMP is effectively implemented as a conservation measure. The elepaio population at SBMR can withstand this level of take for a few years, but not indefinitely. Restoration of forest destroyed by fire in Hawaii is very difficult and costly. If the current fire regime continues indefinitely, it can be expected that areas currently supporting mesic and wet forest will be converted to dry forest consisting of fire adapted alien plants not used by elepaio, ultimately resulting in the destruction of most if not all of the forest at SBMR suitable to elepaio and causing the local extinction of elepaio at SBMR. For elepaio to persist at SBMR in the long-term, loss of suitable forest habitat by fires must eliminated. Loss of forest habitat can be prevented with an adaptive WFMP that is effectively implemented.

Introduction of Alien Plant Species. Elepaio generally are adaptable in habitat use and are able to forage and nest in alien plant species (VanderWerf et al. 1997, VanderWerf and Smith 2002), but they do not use certain species of alien plants, such as *Casuarina* spp and *Eucalyptus* spp. Introduction or spread of these plants to areas where they currently are not found would inhibit the ability of elepaio to forage and nest which would ultimately result in a loss of elepaio habitat that would reduce the number of elepaio. The risk and potential effects of alien plant introduction vary among different portions of SBMR, SBER, and KLOA, but the overall potential threat to elepaio from the indirect effects of alien plant species introduction is moderate. This will be reduced to low when adequate conservation measures are successfully implemented.

Introduction of Alien Animal Species. Elepaio and other Hawaiian forest birds are highly vulnerable to and directly threatened by alien predators because they have no prior experience with them. Alien predators including rats (*Rattus* sp.), mongoose (*Herpestes auropunctatus*), and feral cats (*Felis silvestris*) have decimated bird population in Hawaii (Atkinson 1977, VanderWerf and Smith 2002). Perhaps the most dangerous alien predator that could be introduced to Hawaii is the brown treesnake (*Boiga irregularis*). This nocturnal snake is native to Australia, New Guinea, and adjacent islands, and was accidently introduced to Guam in the late 1940s or early 1950s during military operations (Savidge 1987). The brown treesnake is a serious threat to birds because it climbs exceptionally well and preys opportunistically on a wide variety of vertebrates, including birds and their eggs, reptiles, and mammals (Rodda *et al.* 1999a). It has few competitors and no known predators on oceanic islands, and can reach population densities of up to 80-120 snakes per ha (2.47 ac) (Rodda *et al.* 1999b). On Guam, predation by the brown treesnake decimated the avifauna, causing the local extirpation or complete extinction of 10 of the 13 native forest bird species on the island (Savidge 1987, Conry 1988, Rodda et al. 1999a). Declines in bird populations on Guam occurred extremely rapidly once the brown treesnake became established (Savidge 1987, Wiles *et al.* in press). If the brown treesnake were introduced to Oahu, immediate action would be required to prevent the rapid

decline and possible extinction of the Oahu elepaio and all other native bird species on the island. It is therefore vitally important to detect and eradicate any incipient populations of brown treesnakes before they become established. Since 1981 there have been at least seven confirmed records and other unconfirmed reports of brown treesnakes on Oahu (Fritts *et al.* 1999). Most records are from Hickam Air Force Base, but the most recent record, 20 December 1994, occurred at Schofield Barracks, when a snake was captured alive in a military warehouse. These records highlight the need for effective interdiction and rapid response to all reports of brown treesnakes on Oahu. The potential threat to elepaio from the direct effects of predation by alien animal species introduction is high, but will be reduced to low by implementation of the conservation measures described in the Biological Assessment.

Nest Disturbance. Various actions associated with military training on Oahu installations have the potential to directly disturb nesting elepaio and possibly cause nest abandonment, including mounted and dismounted maneuvers, foot patrols, use of helicopter landing zones, construction, and maintenance of training areas. Elepaio are relatively tolerant of noise and other disturbance, but activities that persist for a long period of time in the immediate vicinity of a nest could result in disturbance. Nest disturbance could occur only at SBMR because no nesting pairs occur at the other installations covered in this biological opinion.

According to the Biological Assessment (p. 258, 271), mounted and dismounted maneuvers will be conducted on the South Range of SBMR, and the remainder of SBMR would be used for weapons qualification, live-fire training, and Military Operations on Urban Terrain training. If actions including mounted maneuvers, unmounted maneuvers, and foot patrols are conducted only in areas away from the forest inhabited by elepaio, then no nest disturbance or other direct effect to elepaio are expected. If the forested area above the fire break road at SBMR is used for dismounted maneuvers or foot patrols, then the duration of these actions must not exceed one hour in the same location, to allow adult elepaio to resume nest attendance if disturbed.

Nine helicopter landing zones exist at SBMR, all of which are located at least 860 m (1118 ft) from the nearest known elepaio territory. No nest disturbance or other direct or indirect effects to elepaio are expected from use of existing helicopter landing zones because they are not located near elepaio territories.

Six construction projects related to the Transformation are planned. The locations of these projects have not yet been determined, but it is anticipated that all will occur in lower elevation areas in the eastern portion SBMR that are not forested. No nest disturbance or other direct or indirect effects to elepaio are expected from these construction projects, because they will occur in the eastern portion of the action area away from forested areas occupied by elepaio.

Restrictions on Access for Resource Management. Another effect on natural resources not considered in the Biological Assessment is lack of access for resource management. Some of the threats at SBMR, such as habitat degradation by feral pigs and nest predation by black rats, require continual management in order to prevent declines of elepaio and other listed species.

Without rat control, elepaio populations can be expected to decline by 24 percent per year (VanderWerf and Smith 2002). However, for human safety reasons, management of natural resources on the West Range of SBMR can only be conducted on days when there is no training.

Without rat control, the annual survival rate of female elepaio is 0.50 and the reproductive rate is 0.33 fledglings per pair per year (VanderWerf and Smith 2002). If rats are controlled, survival of female elepaio increases to 0.83 and reproduction increases to 0.70 fledglings per pair (VanderWerf and Smith 2002). Currently about 18 elepaio pairs are protected from rats each year at SBMR using diphacinone bait stations (U.S. Army Garrison 2000), which is about 12 percent of the 155 pairs present on the installation (VanderWerf et al. 2001). In order for rat control to be effective, stations must be restocked with bait at least weekly during the first three to four weeks of the control program and biweekly thereafter. The current frequency of access to SBMR does not allow adequate maintenance of bait stations. The efficacy of the current rat control program is questionable and has not been verified through monitoring.

The Service believes that rats must be controlled in the territories of at least 75 elepaio pairs, roughly half of the approximately 155 pairs at SBMR, in order to prevent decline of the population. Areas where elepaio are managed may produce a surplus of young birds that will disperse in search of their own territories, creating sources that can help support areas where elepaio are declining due to lack of management (Service 2003). The average elepaio territory size on Oahu is approximately 1.5 ha (3.7 ac); VanderWerf and Smith 2002, The Nature Conservancy of Hawaii, unpubl. data), so approximately 113 ha (280 ac) must be managed to encompass 75 elepaio territories.

It will be difficult and costly to effectively control rats in 75 elepaio territories at SBMR using diphacinone bait stations due to the steep terrain and large areas that would have to be covered on foot in a short time, even if the number of days per year available for resource management at SBMR is increased to 45. A more cost effective method would be construction of fenced exclosures at SBMR in which it eventually should be possible to permanently remove feral ungulates and control rats through aerial broadcast of diphacinone. Fenced exclosures also would facilitate simultaneous management of endangered snails and plants.

It would be best if the 75 elepaio pairs were managed at SBMR, because the managed and unmanaged areas would be in close proximity, minimizing the distance young birds have to disperse between sources and sinks. If it is not possible to manage 75 elepaio pairs at SBMR, then management of elepaio in adjacent areas, such as Honouliuli Preserve, could be substituted, but because the source and sink areas would be farther apart, the chance that young birds would disperse between them would be lower. Support of the elepaio population at SBMR through off-site management at Honouliuli therefore would necessitate management of a larger number of pairs, perhaps twice as many, in order to produce an equivalent number of juveniles that disperse to SBMR.

The Service believes that the potential impact to elepaio from the indirect effects of restrictions on resource management imposed by military training is high, but that this impact can be reduced to low by controlling rats in the equivalent of 75 elepaio territories at SBMR. This can be accomplished through any or all of several alternative conservation measures, including: 1) increasing access for resource management at SBMR to 45 days per year to allow deployment of bait stations in a larger number of elepaio territories, more frequent maintenance of bait stations, and more effective ungulate removal; 2) construction of three fenced exclosures of 247 ha (610 ac) each in size to facilitate ungulate control in key portions of SBMR, and when the registration is approved, subsequent aerial broadcast of diphacinone to control rats in the resulting pig-free areas; or 3) if three such exclosures cannot be constructed at SBMR and it is not possible to control rats in 75 elepaio territories at SBMR, then managing the remaining number (75 less the number managed at SBMR) at an appropriate off-site location agreed upon by Army and Service biologists, such as Honouliuli Preserve, in order to produce an equivalent number of juveniles that disperse to SBMR.

Construction of fenced exclosures would require an initial investment of time and money, but in the long-term would increase the efficacy of management and decrease the cost of management. Ungulate control would be more cost-effective because once ungulates were removed from the exclosure it would remain ungulate-free (assuming fence maintenance) . Rat control could be conducted over an entire exclosure at much lower cost through aerial broadcast of rodenticide by helicopter. Approval of aerial broadcast of diphacinone for control of rodents is not yet complete, but is expected to be available within two years.

Effects of the Action to Elepaio Critical Habitat

The primary constituent elements required by the Oahu elepaio for foraging, sheltering, roosting, nesting, and rearing of young are undeveloped wet, mesic, and dry forest habitats with a closed canopy and a dense understory. In addition, the primary constituent elements associated with the biological needs of dispersal and genetic exchange among populations are undeveloped wet or dry shrub land and wet or dry cliff habitats (Service 2001). Any action that affects structure of the forest canopy or understory has the potential to adversely modify or destroy elepaio critical habitat. Actions that affect the size and distribution of forested areas needed by elepaio for foraging and nesting also have the potential to adversely modify the value of critical habitat for dispersal.

Fires from Current Military Training and Transformation. As discussed above, fires alter the primary constituent elements of elepaio critical habitat by burning forest altogether, opening the canopy, and removing the understory. Fires also facilitate the spread of alien plant species not used by elepaio, such as *Casuarina* spp. and *Eucalyptus* spp., because these species burn readily and grow back more quickly than native plants following a fire. *Eucalyptus* and *Casuarina* forests often prevent the formation of a dense understory.

Of the 774 ha (1,913 ac) of elepaio critical habitat at SBMR, at least 14.9 ha (2 percent; 30 ac) already have been destroyed by fires caused by military training since 2001. In July-August

2001, at least five fires burned a total of 20.7 ha (51.1 ac) that were proposed as critical habitat for the elepaio at that time. Since the fires occurred, 12.1 ha (30 ac) of that area has been designated as critical habitat for the elepaio. In September 2003, a fire burned 1.2 ha (3.0 ac) of designated critical habitat. This fire likely was ignited by propellant from a rocket-propelled grenade that was inappropriately used when fire risk was high. During an inspection of the damage caused by the fire, four parachute flares were observed above the fire break road.

Fires also destroyed forest in this area before it was designated as critical habitat for the elepaio, and each fire in the future will result in additional reductions in amount of critical habitat. Most fires at SBMR burn areas that have burned previously, but each new fire also extends a short distance into previously unburned areas of critical habitat, resulting in replacement of native plant species by fire tolerant alien species and expansion of fire prone habitats that do not contain the primary constituent elements needed by elepaio. If the current fire regime continues, it can be expected that most or all of the critical habitat at SBMR will be converted to dry, open forest or shrubland that does not contain the primary constituent elements needed by elepaio for foraging, sheltering, roosting, nesting, and rearing of young, thereby causing the destruction of most or all of the critical habitat. Elepaio may use dry shrub habitat for dispersal among populations, but they do not establish territories in shrub habitat and use it only transiently. If the areas containing the primary constituent elements needed for foraging and nesting are destroyed and no elepaio populations persist, then the function of areas containing the primary constituent elements needed for dispersal among populations also is destroyed. The potential threat to elepaio critical habitat from the direct and indirect effects of fires caused by military training is high, but is reduced to low by successful implementation of the WFMP.

Feral Ungulates. Feral ungulates can adversely modify elepaio critical habitat by destroying the understory and preventing recruitment of canopy trees and increasing the threat of non-native plant species. Areas of elepaio critical habitat already have been altered by feral ungulates, and this effect will become more serious and widespread if ungulate populations are not reduced. The Service believes the potential impact to elepaio critical habitat from the effects of feral ungulates is moderate, but is reduced to low by more effective control of ungulate populations. Increasing the number of days for natural resource management will help, but construction of fenced exclosures and removal of ungulates from the exclosures would provide a more cost-effective long-term solution.

CUMULATIVE EFFECTS

Cumulative effects are those impacts of future State and private actions that are reasonably certain to occur within the area of action subject to consultation. Future Federal actions will be subject to the consultation requirements established in section 7 of the Act and, therefore, are not considered cumulative to the proposed action. The Army is currently a partner in the Koolau Mountains Watershed Partnership. This is a non-Federal action expected to happen in the future, regardless of Army training, and should result in a net benefit to threatened and endangered

species. The Partnership was created in 1999 through a Memorandum of Understanding signed by Koolau Mountain landowners. The Koolau Mountains Watershed Partnership facilitates watershed protection and conservation projects, maximizes available resources, and optimizes information exchange and learning. Partners include the Hawaii Department of Land and Natural Resources, the Honolulu Board of Water Supply, the Waiahole Water System, Kamehameha Schools, The Queen Emma Foundation, the United States Army, the Department of Hawaiian Home Lands, Bishop Museum and the Service. The partnership is an initiative sponsored by the Hawaii Department of Land and Natural Resources. The Koolau Mountains Watershed Partnership consists of approximately 39,450 ha (97,500 ac). The partners agree that the proactive management of watershed is crucial in eliminating or reducing the threats of damage from weeds, insects, disease, feral ungulates, and human impacts. Partners will work together to develop watershed projects and cooperate to obtain funds for these projects. The Koolau Mountains Watershed Partnership partners meet monthly. Projects may combine one or more activities such as fencing, weed control, ungulate control, restoration and revegetation, stream health and water quality, vegetation monitoring, erosion and sediment control, and other elements. Future State actions in the action area include continued management of State lands according to their current designations as Forest Reserves or Natural Areas Reserves. The State will continue to manage the threatened and endangered species on their lands to the best of their ability. No specific future State, local, or private actions are proposed that have not been discussed as part of their current management actions in the Environmental Baseline section above.

CONCLUSION

After reviewing the current status, the environmental baseline, the effects of the proposed action, and the cumulative effects, it is our biological opinion that implementation of the proposed action discussed herein is not likely to jeopardize the continued existence of any species covered in this biological opinion or adversely modify or destroy Oahu elepaio critical habitat. This conclusion is based on the following factors for the *Achatinella* tree snails and Oahu elepaio.

1. The Service's finding of no jeopardy in this biological opinion is based in large part on the conservation measures and stabilization plan that will be developed for *Achatinella* tree snails by experts in natural resource management. Ten wild populations each containing 300 snails, will be stabilized for each of the 11 species covered in this consultation. These units will be geographically distributed throughout the range of the species and must include as much of the genetic diversity of the species as remains in the wild.

2. Although some or all of the *Achatinella* tree snail species are likely to be adversely affected by actions discussed in this consultation, the potential for direct injury or harassment of these tree snail species has been minimized by incorporating a range of actions into the project design that will protect extant tree snail occurrences from Army training activities.

3. Captive propagation is recognized as a critical element in the process of stabilizing *Achatinella* tree snails, and the establishment of field populations that can sustain these species in the wild is the long-term goal of the conservation measures described in this biological opinion and in the implementation process. *Achatinella mustelina* and *A. lila* have been successfully reared in captivity and translocated to new locations. In addition, captive propagation will protect representatives from all of the available species covered in this consultation.

4. The Service's finding of no jeopardy or adverse modification in this biological opinion for Oahu elepaio is based in large part on the conservation measures described in the proposed project. Measures that will offset adverse training impacts to Oahu elepaio include: a) control of rats in the equivalent of 75 elepaio territories at SBMR or at another site; b) moving targets within the impact area at SBMR so they are farther from the fire break road; and c) increasing the number of days per year available for resource management at SBMR to 45. Specific design of these conservation measures will be further developed by experts in natural resource management as part of the implementation of the conservation measures included in this biological opinion.

5. Although some Oahu elepaio will be taken and some critical habitat will be affected by actions discussed in this consultation, the potential effects on elepaio have been minimized by incorporating a range of actions into the project design that will protect elepaio from Army training activities. The elepaio population at SBMR can withstand the loss of the number of elepaio expected to be affected as avoidance and minimization measures offset adverse impacts from training.

6. Future actions required to prevent the long-term decline of the Oahu elepaio will be defined during the Oahu implementation process and will be based on the best available science with final approval by the Service.

7. Finalization and implementation of the WFMP will reduce the risk of fire escaping the impact areas at all Oahu training installations which will benefit both *Actatinella* tree snails, Oahu elepaio and elepaio critical habitat.

The Army training actions described in the Biological Assessment and in the biological opinion are not anticipated to compromise the conservation and recovery process described in the Oahu Tree Snail Recovery Plan (Service 1993). This recovery plan is based on 1) the presence of a functionally intact native forest with a close or closed canopy and an understory of native plants that can support tree snail populations; 2) a tree snail population structure that includes all age classes and supports reproductive rates that are high enough to sustain the population; 3) a landscape distribution of populations that preserves the remaining genetic diversity of each of the tree snail species within its natural range; and 4) ecological conditions that can support metapopulation dynamics where specific populations may decline or disappear over time while

new populations within the landscape become established and grow; and 5) management of the threats that currently prevent the recovery of the species. Consequently, the Service has determined that the adverse effects to Oahu tree snails that will result from Army training activities will not contribute to an appreciable reduction in the likelihood of survival or recovery of *Achatinella* tree snail species in the wild by reducing the number of snails or their reproduction or distribution.

The Army training actions described in the Biological Assessment and in the biological opinion are not anticipated to compromise the conservation and recovery process described for the Oahu elepaio in the Draft Revised Hawaiian Forest Birds Recovery Plan (Service 2003). Recovery of the Oahu elepaio is based on: 1) protection of viable, self-sustaining populations in the six existing core areas (Waikane/Kahana, southern Koolau, central Koolau, southern Waianae, Schofield Barracks West Range, and Makaha/Waianae Kai), or of viable metapopulations on both the windward and leeward sides of the Koolau and Waianae Mountains; 2) protection and management of sufficient habitat consisting of functionally intact forest with a closed canopy and dense understory to support these populations; and 3) identification and management of the threats that were responsible for the decline of the species. Consequently, the Service has determined that the adverse effects to Oahu elepaio that will result from Army training activities will not contribute to an appreciable reduction in the likelihood of survival and recovery of Oahu elepaio.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined (50 CFR 17.3) by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by the Service (50 CFR 17.3) as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are non-discretionary, and must be undertaken by the Army so that they become binding conditions in order for the exemption in section 7(o)(2) to apply. The Army has a continuing duty to regulate the activity covered by this incidental take statement. If the Army (1) fails to assume and implement the terms and conditions or (2) fails to require any

contractors to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to any permit or contract, then the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the Army must report the progress of the action and its impact on the species to the Service as specified in the incidental take statement [50 CFR § 402.14(i)(3)].

Sections 7(b)(4) and 7(o)(2) of the Act generally do not apply to listed plant species. However, limited protection of listed plants from take is provided to the extent that the Act prohibits the removal and reduction to possession of federally listed endangered plants or the malicious damage of such plants on areas under Federal jurisdiction, or the destruction of endangered plants on non-Federal areas in violation of State law or regulation or in the course of any violation of a State criminal trespass law (HRS 195D).

Amount or Extent of Take

This biological opinion anticipates the following forms of incidental take:

1. The Service anticipates that take will occur in the form of harm (due to the loss of habitat), harassment, and death as a result of Army activities described in this biological opinion. The Service anticipates that the loss of no more than one occurrence of *Achatinella mustelina* comprised of 10-40 individuals will occur over the next 10 years. The Service does not anticipate any take for *A. apexfulva*, *A. bulimoides*, *A. byronii*, *A. curta*, *A. decipiens*, *A. leucorraphe*, *A. lila*, *A. livida*, *A. pulcherrima*, and *A. sowerbyana* because the Army will mark all known tree snail locations and avoid these occurrences. For tree snail species with no known field occurrences, if any are found, the Army will cease all actions that may adversely affect the tree snails. *Achatinella caesia*, *A. casta*, *A. decora*, *A. dimorpha*, *A. elegans*, *A. juncea*, *A. lehuiensis*, *A. papyracea*, *A. rosea*, *A. spaldingi*, *A. swiftii*, *A. thaanumi*, and *A. valida* are known to have occurred in the action areas but were last seen sometime prior to 1982, and so are not a part of this consultation. If any of these species are rediscovered, the Service should be notified immediately and all adverse actions that may affect these species should cease.

2. The Service anticipates that take will occur in the form of harm (due to the loss of habitat), harassment, and death as a result of Army activities described in the biological opinion. The Service anticipates the take of no more than two (2) Oahu elepaio pairs or active elepaio nests per year over the first five years after implementation of the proposed action. Based on the recent fire history of SBMR, the Service also anticipates that an area equivalent to two elepaio territories (3 ha; 7.4 ac) will be lost per year over the first five years. We anticipate that the effective implementation of the WFMP would result in a reduction in the level of take to no more than one elepaio pair or nest per year and/or the loss of an area equivalent to no more than one elepaio territory (1.5 ha; 3.7 ac) per year. The Service believes that this level of take will not jeopardize the Oahu elepaio or adversely modify its critical habitat.

Effect of Take

In this biological opinion, the Service determined that this level and duration of anticipated take is not likely to result in jeopardy to the Oahu elepaio, *Achatinella* tree snail or destruction or adverse modification of Oahu elepaio critical habitat.

Reasonable and Prudent Measures

The reasonable and prudent measures given below, with their implementing terms and conditions, are designed to minimize the impacts of incidental take that might otherwise result from the proposed actions. If, during the course of the actions, the level of incidental take is exceeded, the action agency is required to reinitiate consultation and review the reasonable and prudent measures provided in this biological opinion. In addition, the Army must cease the activities that caused the taking; must immediately provide an explanation of the causes of the taking; and must review with the Service the need for possible modification of the reasonable and prudent measures. The Army will offset unavoidable impacts through the implementation of the conservation measures as described in the Project Description. The Army will implement the conservation measures as identified in the Project Description of this biological opinion.

The Service believes the following Reasonable and Prudent Measures are necessary and appropriate to minimize incidental take of *Achatinella* tree snails and Oahu elepaio. The measures described below are non-discretionary and must be implemented.

1. Minimize impacts of military activities and actions on survival and reproduction of *Achatinella mustelina* at SBMR.

2. Minimize direct impacts of military activities on survival and reproduction of Oahu elepaio within the action area at SBMR.

3. Minimize loss of Oahu elepaio habitat at SBMR, SBER, and KLOA.

4. Minimize threats of alien rats and feral ungulates to Oahu elepaio and Oahu elepaio habitat at SBMR, SBER, and KLOA.

Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the Act, the agency must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary.

1. Minimize impacts of military activities and actions on survival and reproduction of *Achatinella mustelina* within the action areas for SBMR.
   1.1 Begin implementation of the stabilization plan within three years of the issuance of the biological opinion.
   1.2 All enclosures of known tree snail occurrences must be completed within five years of the issuance of the biological opinion.
   1.3 The Army will report in writing on a semi-annual (twice per year) basis to the Service on the following items: 1) status of the known occurrences; 2) number and location of high explosives or pyrotechnics that land outside of the impact area; 3) the extent of damage or fires that result from these high explosives or pyrotechnics; and 4) how close to known tree snail occurrences were the high explosive impacts.
   1.4 The Service shall be notified within three (3) working days of any take of *Achatinella mustelina*.
   1.5 The depository designated to receive specimens of *Achatinella mustelina* or shells that are collected is the B.P. Bishop Museum, 1525 Bernice Street, Honolulu, Hawaii, 96817 (telephone: 808/547-3511). If the B.P Bishop Museum does not wish to accession the specimens, the permittee should contact the Service's Division of Law Enforcement in Honolulu, Hawaii (telephone: 808/541-2681; fax: 808/541-3062) for instructions on disposition.

2. Minimize direct impacts of military activities on survival and reproduction of Oahu elepaio within the action area at SBMR.
   2.1. The Army will report to the Service in writing at least semiannually (twice per year) the number of high explosive rounds that land above the fire break road, the locations where such rounds land, and whether these locations are within any known elepaio territories.
   2.2. The Army will notify the Service within 24 hours of any fires that burn any portion of a known elepaio territory and the number of elepaio territories affected.
   2.3. The Army will limit training actions in the forest above the fire break road at SBMR in the elepaio nesting season (January to May) to small numbers of troops (platoon or less) that remain in one location for short periods of time (one hour or less), to limit possible nest disturbance.
   2.4. The depository designated to receive specimens of any Oahu elepaio that are killed is the B.P. Bishop Museum, 1525 Bernice Street, Honolulu, Hawaii, 96817 (telephone: 808/547-3511). If the B.P Bishop Museum does not wish to accession the specimens, the permittee should contact the Service's Division of Law Enforcement in Honolulu, Hawaii (telephone: 808/541-2681; fax: 808/541-3062) for instructions on disposition.

3. Minimize loss of Oahu elepaio habitat at SBMR, SBER, and KLOA.
   3.1. The Army will report to the Service in writing on a semi-annual (twice per year) the number of fires above the fire break road, the area burned by each fire above the fire break road, including the amount of critical habitat burned, and how each fire was ignited or crossed the fire break road.
   3.2. The Army will notify the Service within 24 hours of any instance in which training was not conducted in accordance with the WFMP.

4. Manage threats to Oahu elepaio and Oahu elepaio habitat at SBMR, SBER, and KLOA.
   4.1. The Army will report to the Service in writing annually the number of elepaio territories in which rats were controlled, the location of each territory in which rats were controlled, the methods by which rats were controlled in each territory, the dates on which rat control activities were conducted in each territory, and the status of elepaio in each territory from the previous year.
   4.2 The Army, Service, and ornithological experts will formally reassess all impacts to Oahu elepaio and elepaio critical habitat that have occurred during the first five years following completion of this biological opinion. This formal review will occur before the end of calendar year 2008 and its purpose will be to reassess impacts from training exercises and, if necessary, correct any outstanding issues that are still impacting elepaio and resulting in the loss suitable elepaio habitat at SBMR. The feasibility of restoring critical habitat areas that have been lost also will be reassessed during this formal review.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. The recommendations provided relate only to the proposed action and do not necessarily represent complete fulfillment of the Army's section 7(a)(1) responsibilities for the species.

In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats, the Service requests notification of the implementation of any conservation recommendations.

1. Future surveys for Oahu tree snails should be exclusively focused on locating new occurrences of snails rather than an add-on activity for other surveys. Combining tree snail

surveys with other objectives does not allow for the time and intensity needed to adequately search and locate tree snails.

2. Whenever possible, field biologists familiar with tree snails and survey methodology should be included with Army Natural Resource staff during field surveys.

3. Establish two or more captive populations for each known tree snail species within the action areas with oversight from tree snail experts that have successfully carried out captive propagation.

4. When compatible with training objectives, reduce the maximum allowed propellant charge for 155 mm and 105 mm rounds from three powder bags to two, to reduce the chance of rounds landing above the fire break road.

REINITIATING-CLOSING STATEMENT

This concludes formal consultation on this action. If implementation of actions for stabilization have not been initiated by the end of calendar year, 2006, then the Army will be required to reinitiate formal consultation to allow for re-evaluation of project effects within the context of the environmental baseline for the plant and animal species covered in this biological opinion. As required in 50 CFR § 402.16, reinitiation of consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation of consultation.

The Army will coordinate with the Service if a fire due to military activities or actions occurs outside of any of the fire breaks or fuel breaks that have been established at any of the installations covered in this biological opinion. No military training activities with live-fire weaponry, except for those that are addressed in this consultation, may occur outside these fire breaks or fuel breaks. Similarly, the Army will reinitiate consultation if a fire due to military activities or actions affects any known occurrence of an federally listed species requiring stabilization prior to its being stabilized to ensure the species is not in jeopardy of extinction. As stated in the Conclusion of the Effects of the Action on Listed Species (above), the Service's finding of no jeopardy is based in large part on the conservation measures built into the project by the Army. Should there be a failure to carry out any or all of the described measures, or if the measures are not effective, or if these measures are modified in any way beyond that accepted through the Oahu Implementation Team review process, reinitiation of consultation will be required.

If you have any questions regarding this biological opinion, please contact Ms. Patrice Ashfield of my staff at (808) 792-9400.

Sincerely,

Gina M. Shultz
Acting Field Supervisor

Attachments

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Appendix 1. Endangered Species Occurrences on Oahu Army Installations and Stabilization Requirement		
Species	Stabilization Required	Installation
Plants		
Abutilon sandwicense	X	SBMR, MMR
Alectryon macrococcus var. *macrococcus*	X	SBMR, MMR
Alsinidendron trinerve	X	SBMR
Chamaesyce rockii	X	KLOA, SBER
Cyanea acuminata	X	KLOA, SBER, SBMR
Cyanea crispa	X	KLOA
Cyanea grimesiana ssp. *obatae*	X	SBMR, MMR
Cyanea humboldtiana		KLOA
Cyanea koolauensis	X	KTA, KLOA, SBER
Cyanea st.-johnii	X	KLOA
Cyrtandra dentata	X	KLOA, MMR
Cyrtandra subumbellata	X	SBER
Cyrtandra viridiflora	X	KLOA, SBER
Delissea subcordata	X	SBMR, MMR

Appendix 1. Endangered Species Occurrences on Oahu Army Installations and Stabilization Requirement		
Species	Stabilization Required	Installation
Diellia falcata		SBMR, MMR
Eugenia koolauensis	X	KTA
Flueggea neowawraea	X	SBMR, MMR
Gardenia mannii	X	KTA, KLOA, SBER,SBMR
Hesperomannia arborescens	X	KLOA, SBER, SBMR
Isodendrion longifolium		SBMR, SBER
Labordia cyrtandrae	X	SBMR
Lepidium arbuscula		SBMR, MMR
Lobelia gaudichaudii ssp. *koolauensis*	X	SBER
Melicope lydgatei	X	KLOA
Myrsine juddii	X	KLOA
Phlegmariurus nutans	X	KLOA, SBER
Phyllostegia hirsuta	X	KLOA, SBER, SBMR
Phyllostegia kaalaensis	X	SBMR, MMR
Phyllostegia mollis	X	SBMR
Plantago princeps	X	SBMR, MMR

Appendix 1. Endangered Species Occurrences on Oahu Army Installations and Stabilization Requirement		
Species	Stabilization Required	Installation
Pteris lidgatei	X	KLOA, SBER
Sanicula purpurea	X	KLOA, SBER
Schiedea hookeri		SBMR, MMR
Schiedea kaalae	X	SBMR, MMR
Tetraplasandra gymnocarpa		KTA, KLOA, SBER
Viola chamissoniana ssp. *chamissoniana*	X	SBMR, MMR
Viola oahuensis	X	KLOA, SBER
Invertebrates		
Achatinella apexsulva (Oahu tree snail)	X	KLOA
Achatinella bulimoides	X	KLOA
Achatinella byronii	X	KLOA, SBER
Achatinella curta	X	KLOA
Achatinella decipiens	X	KLOA, SBER
Achatinella leucorraphe	X	SBER
Achatinella lila	X	KLOA
Achatinella livida	X	KLOA
Achatinella mustelina	X	SBMR
Achatinella pulcherrima	X	KLOA
Achatinella sowerbyana	X	KLOA, SBER
Vertebrates		

Appendix 1. Endangered Species Occurrences on Oahu Army Installations and Stabilization Requirement		
Species	Stabilization Required	Installation
Chasiempis sandwichensis ibidis (Oahu elepaio)		SBMR, SRAA

Appendix 2. Scientific and Common Nomenclature for Plant and Animal Species Mentioned in the Biological Opinion	
Abutilon sandwicense (end)[1]	no common name
Acacia confusa (nat)[2]	Formosa koa
Acacia koa (end)	koa
Adoretus sinicus (nat)	Chinese rose beetle
Ageratina adenophora (nat)	Maui pamakani
Ageratina riparia (nat)	Hamakua pamakani
Alectryon macrococcus var. *auwahiensis* (end)	mahoe
Alectryon macrococcus var. *macrococcus* (end)	mahoe
Aleurites moluccana (pol)[3]	kukui
Alsinidendron obovatum (end)	no common name
Alsinidendron trinerve (end)	no common name
Alyxia oliviformis (end)	maile
Andropogon virginicus (nat)	broomsedge
Antidesma platyphyllum (end)	hame
Antidesma pulvinatum (end)	hame
Antidesma sp. (end)	hame
Araucaria columnaris (nat)	Norfolk Island pine
Ardisia elliptica (nat)	shoebutton ardisia
Artemisia australis (end)	ahinahina
Arthrostema ciliatum (nat)	no common name
Astelia sp. (end)	painiu
Asplenium kaulfussii (end)	kuau
Asplenium sp. (end, ind)	no common name

Athyrium arnottii (end)	hoio
Athyrium sandwichianum (end)	akolea
Axonopus fissifolius (nat)	narrow-leaved carpet grass
Bidens macrocarpa (end)	kookoolau
Bidens torta (end)	kookoolau
Bidens sp. (end, nat)	kookoolau
Blechnum appendiculatum (nat)	no common name
Bobea brevipes (end)	ahakea lau lii
Bobea elatior (end)	ahakea lau nui
Bobea sp. (end)	ahakea
Boehmeria grandis (end)	akolea
Broussaisia arguta (end)	kanawao
Buddleia asiatica (nat)	butterfly bush
Canavalia sp. (nat, end)	awikiwiki
Capra hircus (nat)	goats
Carex meyenii (ind)	no common name
Carex wahuensis (end)	no common name
Carex sp. (ind, end)	no common name
Casuarina equisetifolia (nat)	ironwood
Chamaesyce clusiifolia (end)	akoko
Chamaesyce herbstii (end)	no common name
Chamaesyce multiformis (end)	akoko
Chamaesyce rockii (end)	akoko
Chamaesyce sp. (end, nat)	akoko
Charpentiera obovata (end)	papala
Charpentiera sp. (end)	papala

Cheirodendron platyphyllum (end)	olapa
Cheirodendron trigynum (end)	olapa
Cheirodendron sp. (end)	olapa
Christella cyatheoides (end)	kikawaio
Christella parasitica (nat)	no common name
Cibotium chamissoi (end)	hapuu
Cibotium glaucum (end)	hapuu
Cibotium spp. (end)	hapuu
Claoxylon sandwicense (end)	poola
Clermontia fauriei (end)	haha aiakamanu
Clermontia kakeana (end)	oha wai
Clermontia oblongifolia (end)	oha wai
Clermontia persicaefolia (end)	oha wai
Clidemia hirta (nat)	Koster's curse
Coprosma foliosa (end)	pilo
Coprosma longifolia (end)	pilo
Coprosma ochracea (end)	pilo
Coprosma sp. (end, ind)	pilo
Cordyline fruticosa (pol)	ki
Cyanea acuminata (end)	haha
Cyanea angustifolia (end)	haha
Cyanea calycina (end)	haha
Cyanea crispa (end)	haha
Cyanea grimesiana ssp. *grimesiana* (end)	haha
Cyanea grimesiana ssp. *obatae* (end)	haha
Cyanea humboldtiana (end)	haha

Cyanea koolaluensis (end)	haha
Cyanea longiflora (end)	haha
Cyanea membranacea (end)	haha
Cyanea spp. (end)	haha
Cyanea st.-johnii (end)	haha
Cyanea superba ssp. *superba* (end)	haha
Cyrtandra calpidicarpa (end)	haiwale
Cyrtandra dentata (end)	haiwale
Cyrtandra grandiflora (end)	haiwale
Cyrtandra laxiflora (end)	haiwale
Cyrtandra subumbellata (end)	haiwale
Cyrtandra viridiflora (end)	haiwale
Cyrtandra waianaeensis (end)	hahala
Cyrtandra spp. (end)	haiwale
Delissea sinuata (end)	no common name
Delissea subcordata (end)	no common name
Dichanthelium koolauense (end)	no common name
Dicranopteris linearis (ind)	uluhe
Diellia falcata (end)	no common name
Diellia unisora (end)	no common name
Dioscorea sp. (pol)	yam
Diospyros hillebrandii (end)	lama
Diospyros sandwicensis (end)	lama
Diospyros sp. (end)	lama
Diplazium sandwichianum (end)	hoio
Diplopterygium pinnatum (end)	uluhe lau nui

Dodonaea viscosa (ind)	aalii
Doodia kunthiana (end)	okupukupu
Doodia lyonii (end)	no common name
Dryopteris sandwicensis (end)	no common name
Dryopteris unidentata (end)	akole
Dryopteris sp. (end, ind)	no common name
Dubautia laxa (end)	naenae pua melemele
Dubautia plantaginea (end)	naenae
Dubautia sherffiana (end)	naenae
Dubautia spp. (end)	naenae
Elaeocarpus bifidus (end)	kalia
Elaphoglossum crassifolium (end)	hoe a Maui
Elaphoglossum sp. (end)	ehaka
Eragrostis grandis (end)	no common name
Eragrostis variabilis (end)	kawelu
Erigeron karvinskianus (nat)	daisy fleabane
Eucalyptus sp. (nat)	gum tree
Eugenia koolauensis (end)	nioi
Eugenia reinwardtiana (ind)	nioi
Ficus macrophylla (nat)	Moreton bay fig
Ficus microcarpa (nat)	Chinese banyan
Flueggea neowawraea (end)	mehamehame
Freycinetia arborea (ind)	ieie
Gahnia beecheyi (end)	no common name
Gardenia mannii (end)	nanu
Grevillea robusta (nat)	silk oak

Gunnera sp. (end)	apeape
Hedyotis acuminata (end)	au
Hedyotis fosbergii (end)	manono
Hedyotis schlechtendahliana (end)	kopa
Hedyotis terminalis (end)	manono
Hedyotis sp. (end, nat)	no common name
Heliocarpus popayanensis (nat)	moho
Hesperomania arborescens (end)	no common name
Hibiscus arnottianus (end)	kokio keokeo
Hibiscus sp. (end, ind, nat)	aloalo
Hyptis pectinata (nat)	comb hyptis
Ilex anomala (ind)	kawau
Ipomoea sp. (end, ind, nat, pol)	morning glory
Isachne distichophylla (end)	ohe
Isachne pallens (end)	no common name
Isodendrion longifolium (end)	aupaka
Juncus planifolius (nat)	rush
Kalanchoe pinnata (nat)	air plant
Labordia cyrtandrae (end)	kamakahala
Labordia kaalae (end)	kamakahala
Labordia sessilis (end)	kamakahala
Labordia sp. (end)	kamakahala
Lantana camara (nat)	lantana (lakana)
Lepidium arbuscula (end)	no common name
Leptecophylla tameiameiae (ind)	pukiawe
Leptospermum scoparium (nat)	tea tree

Leucaena leucocephala (nat)	koa haole
Liparis hawaiiensis (end)	awapuhikanaloa
Lipochaeta tenuis (*Melanthera tenuis*) (end)	nehe
Lobelia gaudichaudii ssp. *koolauensis* (end)	no common name
Lobelia hypoleuca (end)	kuhiaikamoowahie
Lycopodium sp. (ind, end)	wawaeiole
Lysimachia hillebrandii (end)	kolokolo kuahiwi
Machaerina angustifolia (ind)	uki
Machaerina sp. (ind)	uki or ahaniu
Melia azedarach (nat)	Chinaberry
Melicope clusiifolia (end)	kukaemoa
Melicope lydgatei (end)	alani
Melicope spp. (end)	alani
Melinis minutiflora (nat)	molasses grass
Metrosideros polymorpha (end)	ohia
Metrosideros rugosa (end)	lehua papa
Milax gagetes (nat)	slugs
Montanoa hibiscifolia (nat)	tree daisy
Morella faya (nat)	firetree
Morinda trimera (end)	noni kuahiwi
Musa sp. (pol)	banana
Myoporum sandwicense (ind)	naio
Myrsine fosbergii (end)	kolea
Myrsine juddii (end)	kolea
Myrsine lanaiensis (end)	kolea
Myrsine lessertiana (end)	kolea lau nui

Myrsine sandwicensis (end)	kolea lau lii
Nephrolepis exaltata (end)	kupukupu
Neraudia melastomifolia (end)	maaloa
Neraudia sp. (end)	no common name
Nestegis sandwicensis (end)	olopua
Nothocestrum longifolium (end)	aiea
Nothocestrum sp. (end)	aiea
Nothoperanema rubiginosa (end)	no common name
Oplismenus hirtellus (nat)	basketgrass
Panicum maximum (nat)	Guinea grass
Paspalum conjugatum (nat)	Hilo grass
Passiflora laurifolia (nat)	yellow granadilla
Passiflora ligularis (nat)	sweet granadilla
Passiflora suberosa (nat)	huehue haole
Pennisetum clandestinum (nat)	kikuyu grass
Peperomia membranacea (end)	alaala wai nui
Peperomia sp. (end, ind, nat)	alaala wai nui
Perrottetia sandwicensis (end)	olomea
Phlegmariurus nutans (end)	no common name
Phyllostegia grandiflora (end)	no common name
Phyllostegia hirsuta (end)	no common name
Phyllostegia kaalaensis (end)	no common name
Phyllostegia mollis (end0	no common name
Phyllostegia sp. (end)	no common name
Pimenta dioica (nat)	allspice
Pipturus albidus (end)	mamaki

Pipturus sp. (end)	mamaki
Pisonia sandwicensis (end)	papala kepau, aulu
Pisonia umbellifera (ind)	papala kepau
Pisonia spp. (end, ind)	papala kepau
Pittosporum glabrum (end)	hoawa
Pittosporum sp. (end, nat)	hoawa
Plantago pachyphylla (end)	laukahi kuahiwi
Plantago princeps (end)	ale
Pleomele halapepe (end)	hala pepe
Pleomele sp. (end)	hala pepe
Pouteria sandwicensis (end)	alaa
Pritchardia martii (end)	loulu hiwa
Psidium cattleianum (nat)	strawberry guava
Psidium guayava (nat)	guava
Psychotria hathewayi (end)	kopiko
Psychotria mariniana (end)	kopiko
Psychotria sp. (end)	kopiko
Psydrax odorata (ind)	alahee
Pteralyxia sp. (end)	kaulu
Pteris lidgatei (end)	no common name
Pterolepis glomerata (nat)	no common name
Rattus rattus (nat)	black rat
Rattus sp. (nat)	rats
Rauvolfia sandwicensis (end)	hao
Reynoldsia sandwicensis (end)	ohe
Rivina humilis (nat)	coral berry

Rubus argutus (nat)	prickly Florida blackberry
Rubus rosifolius (nat)	thimbleberry
Rumex albescens (end)	huahuako
Rumex sp. (end, nat)	dock
Sacciolepis indica (nat)	Glenwood grass
Sadleria pallida (end)	amau
Sadleria squarrosa (end)	apuu
Sadleria spp. (end)	amau
Sanicula purpurea (end)	no common name
Sapindus oahuensis (end)	lonomea
Scaevola gaudichaudiana (end)	naupaka kuahiwi
Scaevola gaudichaudii (end)	naupaka kuahiwi
Scaevola glabra (end)	ohe naupaka
Scaevola mollis (end)	naupaka kuahiwi
Scaevola sp. (end, ind)	naupaka
Schefflera actinophylla (nat)	octopus tree
Schiedea hookeri (end)	no common name
Schiedea kaalae (end)	no common name
Schiedea ligustrina (end)	no common name
Schiedea nuttallii (end)	no common name
Schiedea pentandra (end)	no common name
Schiedea sp. (end)	no common name
Schinus terebinthifolius (nat)	Christmas berry
Selaginella arbuscula (end)	lepelepe a moa
Setaria palmifolia (nat)	palmgrass
Setaria parviflora (nat)	yellow foxtail

Sida fallax (ind)	ilima
Sophona rufofascia (nat)	two-spotted leafhopper
Sophora chrysophylla (end)	mamane
Sphenomeris chinensis (ind)	palaa
Streblus pendulinus (ind)	aiai
Sus scrofa (nat)	pigs
Syzygium cumini (nat)	Java plum
Syzygium sandwicensis (end)	ohia ha
Tetraplasandra gymnocarpa (end)	oheohe
Tetraplasandra oahuensis (end)	ohe mauka
Thelypteris sp. (end, ind, nat)	no common name
Tibouchina herbacea (nat)	glorybush
Toona ciliata (nat)	Australian red cedar
Touchardia latifolia (end)	olona
Trematolobelia macrostachys (end)	kolii
Urera glabra (end)	opuhe
Vaccinium dentatum (end)	ohelo
Vaccinium sp. (end)	ohelo
Viola chamissoniana (end)	pamakani
Viola oahuensis (end)	no common name
Wikstroemia oahuensis (end)	akia
Wikstroemia sp. (end)	akia
Xylosandrus compactus (nat)	black twig borer
Xylosma hawaiiense (end)	maua
Xylosma sp. (end)	maua
Zanthoxylum kauense (end)	ae

Zingiber zerumbet (nat)	awapuhi
[1]endemic; [2]naturalized; [3]Polynesian introduced	