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 HAWAII

Haplostachys haplostachya

December 23, 2003
(1-2-2003-F-02)

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United States Department of the Interior

FISH AND WILDLIFE SERVICE
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Honolulu, Hawaii 96850

TAKE PRIDE IN AMERICA

In Reply, Refer To:
1-2-2003-F-02

DEC 23 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 Hawaii (1-2-2003-F-02)

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 to December 23, 2003, due to the complexities of this consultation. At issue are the impacts that proposed actions may have on threatened and endangered species and their habitats on the U.S. Army Garrison Hawaii (Army) installation called Pohakuloa Training Area (PTA) on the island of Hawaii (Figure 1). Species included in this consultation include 15 plants: *Asplenium fragile* var. *insulare*, *Haplostachys haplostachya*, *Hedyotis coriacea*, *Isodendrion hosakae*, *Lipochaeta venosa*, *Neraudia ovata*, *Portulaca sclerocarpa*, *Silene hawaiiensis*, *Silene lanceolata*, *Solanum incompletum*, *Spermolepis hawaiiensis*, *Stenogyne angustifolia*, *Tetramolopium arenarium*, *Vigna o-wahuensis*, *Zanthoxylum hawaiiense*; one mammal, the Hawaiian hoary bat (*Lasiurus cinereus semotus*); and designated critical habitat for one avian species, palila (*Loxioides bailleui*). Since palila and akiapolaau (*Hemignathus munroi*) have not been observed within the action area for almost 20 years, these species will not be addressed further in this biological opinion. Biological surveys to determine the status and abundance of nene (*Branta sandvicensis*), Hawaiian dark-rumped petrel (*Pterodroma phaeopygia sandwichensis*) and io or Hawaiian hawk (*Buteo solitarius*) will be conducted as part of your Project Description. This additional information will assist us in determining if these three species may be affected by Legacy and/or Stryker Brigade Combat Team Transformation (SBCT) training actions. If you determine and we concur there is a may affect to any or all of these avian species, then the Army will reinitiate this consultation to address potential effects to these species.

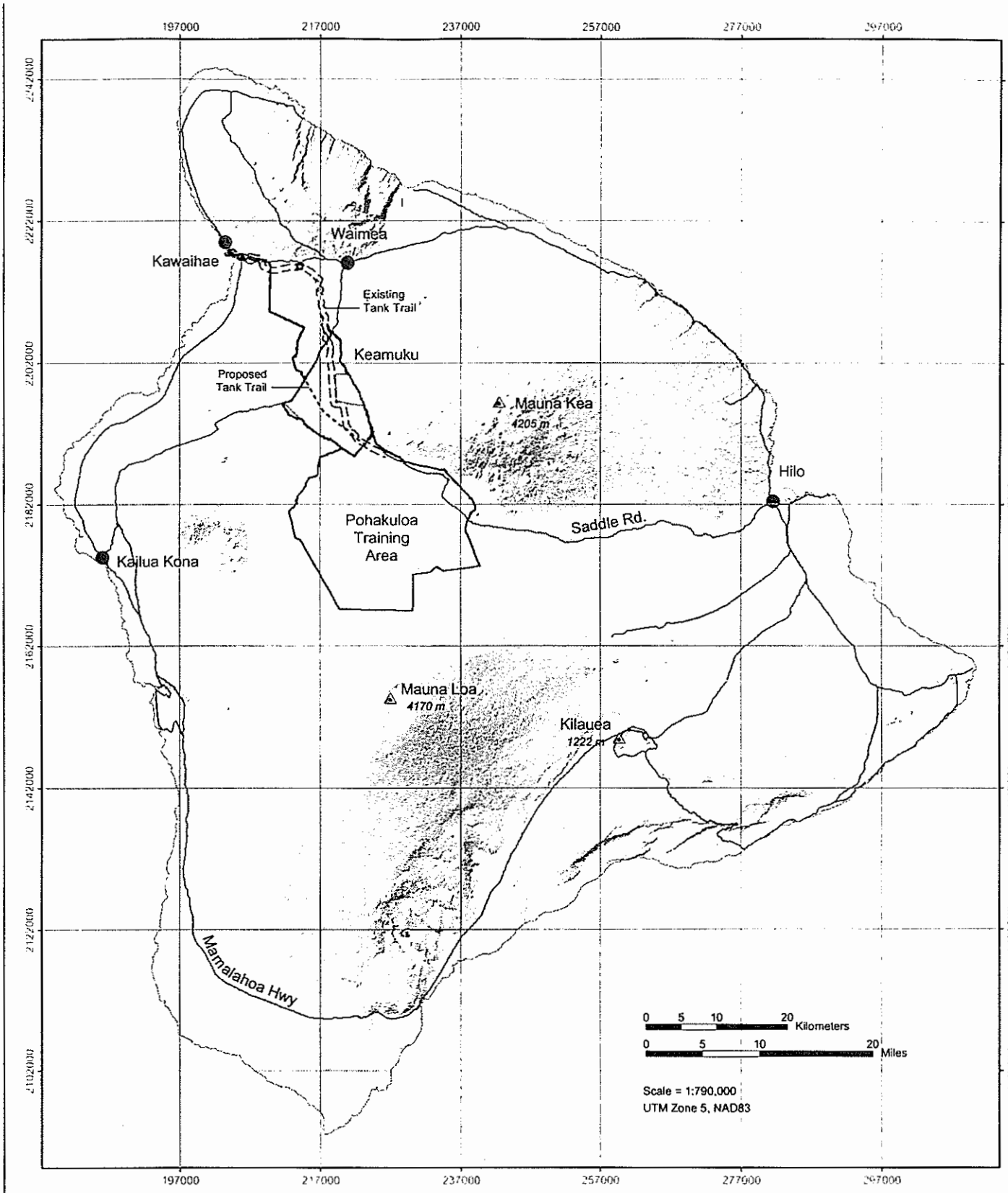
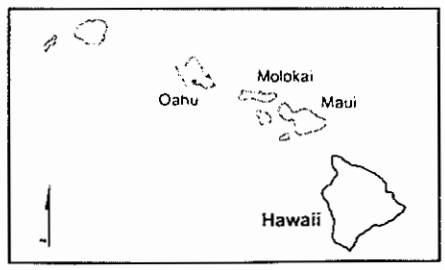


Figure 1 - PTA Installation - Island of Hawaii

- Volcanoes
- Major Towns
- Major Roads
- Existing Tank Trail
- Proposed Tank Trail
- Action Area
- Keamuku
- Pohakuloa Training Area



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

Two Biological Assessments were used to complete this biological opinion. The Pohakuloa Training Area, Biological Assessment for Programmatic Section 7 Consultation on Routine Training and Related Activities, 25th Infantry Division (Light) and U.S. Army, Hawaii, (Routine Biological Assessment) addressed the ongoing or Legacy training presently conducted at PTA. The second Biological Assessment entitled Programmatic Biological Assessment for Transformation of the 2nd Brigade 25th Infantry Division (Light), U.S. Army, Island of Hawaii (Transformation Biological Assessment) addressed the Transformation of the 2nd Brigade in Hawaii which will modify and increase several of the training impacts under Legacy. When discussed jointly, the documents are referred to as the Biological Assessments. In addition, on December 8, 2003, we received a letter signed by Colonel Floyd Quintana, and dated December 5, 2003, that outlined several updated measures to further avoid and minimize the effect of Army training on listed species and palila critical habitat.

This biological opinion was prepared using the following information: 1) Routine Biological Assessment; 2) Transformation Biological Assessment; 3) Pre-Final Draft Wildland Fire Management Plan Pohakuloa and Oahu Training Areas (WFMP), June 2003; 4) information from our files; 5) Army letter dated December 5, 2003; and, 6) discussions and informal consultation between the Army and the Service.

For the most part, scientific nomenclature was used for native and non-native plant species throughout this document and common names were used for vertebrate species. Common names were used for habitat types and primary constituent elements when discussing palila critical habitat. For identification or reference of a species' common or scientific name see Appendix A. Troop size or element is referred to throughout the biological opinion. Table 1 depicts the typical size and composition of each element.

Table 1. Structure of Army Forces (U.S. Army 2003a)

Element	**Number of Soldiers**	**Leader**
Squad	8-10	Non-commissioned officer
Platoon	16-44	Lieutenant
Company	62-190	Captain
Battalion	300-1,000	Lieutenant Colonel
Brigade	3,000-5,000	Colonel

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 throughout the State of Hawaii for many years.

These early consultations for activities at PTA have relevancy to this consultation:

- A formal section 7 consultation that included palila critical habitat (Figure 2) was completed in 1978 and readdressed in 1981 (1-2-81-F-211) and 1983 (1-2-83-F-39). The 1978 formal consultation analyzed possible effects of military training activities on the welfare of the palila and the part of its critical habitat that lies within Areas 1 and 6 of PTA. The consultation established a "Special Restriction Use" of the area (Appendix B; Area Specific Restrictions, Palila Critical Habitat). In 1983 the Army requested, and we consulted on an increase in troops authorized to move through and bivouac in palila critical habitat, and to increase the number of artillery units from one battery to four.

- The Service concurred in a letter dated May 27, 1986, that the construction and use of a Multi-Purpose Range Complex would not adversely affect any threatened or endangered species. The Multi-Purpose Range Complex is located in the southern portion of Kipuka Alala (see Figure 2). The only listed species at that time addressed in the informal section 7 were the Hawaiian hoary bat and the Hawaiian hawk. In a letter dated April 20, 1990, the Service concurred with the Army's determination that the enlargement of the Multi-Purpose Range Complex was not likely to adversely affect any threatened or endangered species. An Environmental Assessment was completed in 1990, and mitigation to comply with the National Environmental Policy Act included construction of the southern portion of the Kipuka Alala fence unit (see Figure 2).

- A formal section 7 consultation was completed on July 23, 1997, for the expansion of Range 8 on the east side of PTA. The threatened species affected by the expansion was *Silene hawaiiensis*. To offset impacts to this species the Army enclosed approximately 50 *S. hawaiiensis* in the Kipuka Kalawamauna fence unit.

- In July 27, 1998, the Service issued a biological opinion (1-2-98-F-01) to the U.S. Department of Transportation, Federal Highway Administration, for the Saddle Road Realignment and Improvement Project (see Figure 2). After the consultation, the Army continued its use of the area under previously established environmental restrictions as stipulated in the U.S. Army Regulation, No. 210-11, Pohakuloa Ranges and Training Area Regulations, Section II Palila Critical Habitat, November 23, 1981.

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 the Pohakuloa Training Area
- Draft Environmental Assessment for the Ecosystem Management Plan at PTA
- Draft Endangered Species Management Plan for the Pohakuloa Training Area
- Draft Fire Management Plan for Pohakuloa Training Area
- Draft Outdoor Recreation Plan for U.S. Army Training Areas in Hawaii

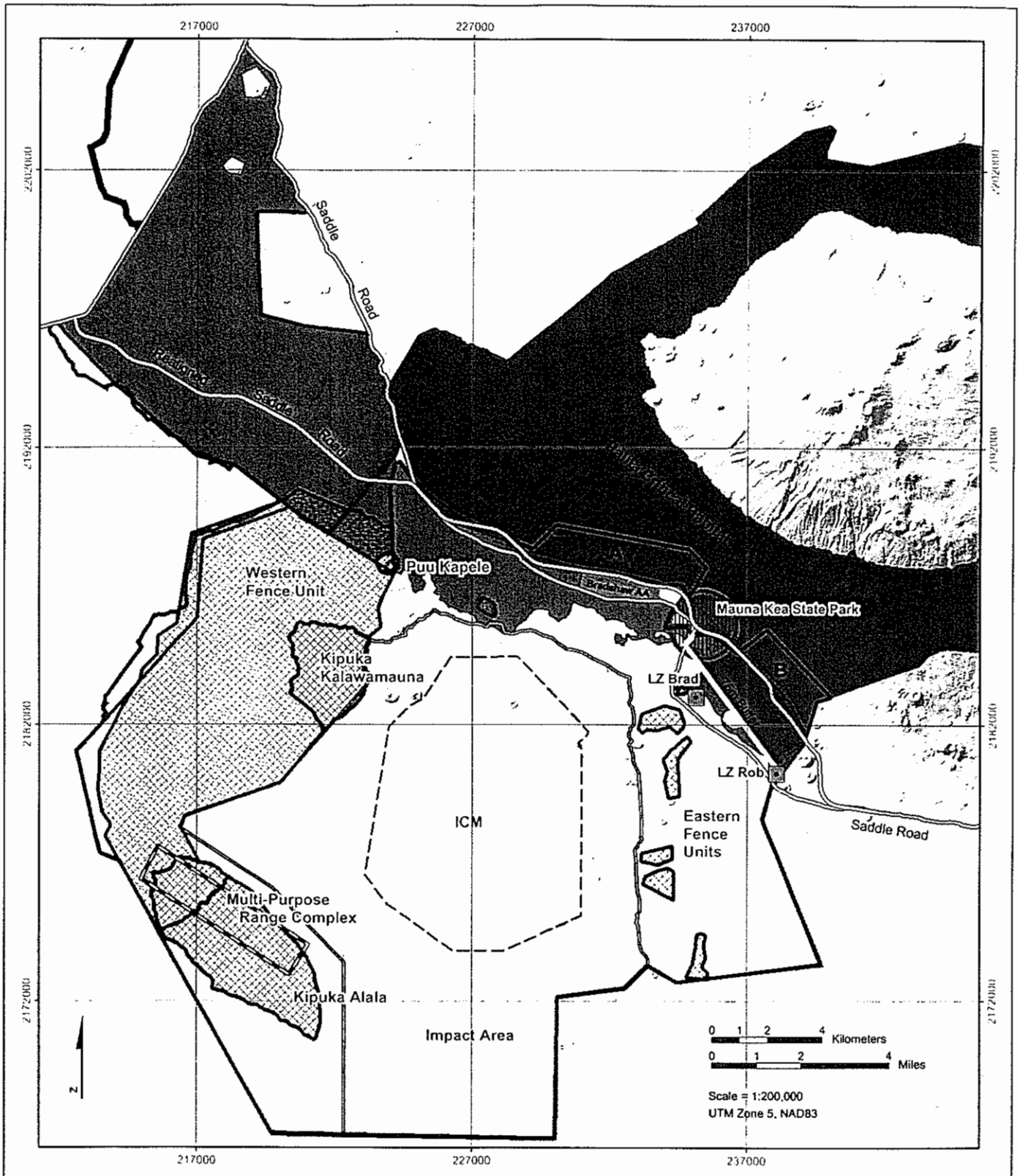
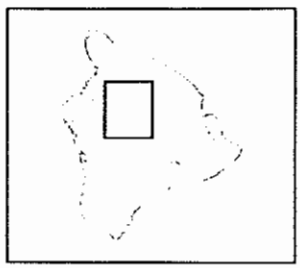


Figure 2 - Palila Critical Habitat

- Landing Zone
- 75-meter Buffer
- Off-road Vehicle Maneuver Areas
- Impact Area
- ICM
- Action Area
- Keamuku
- PTA Boundary
- Palila Critical Habitat
- Existing Fence Units
- Future Fence Units



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

The Service provided comments on the above documents on September 12, 1997.
On February 2, 1999, the Army wrote to the Service regarding their determination of the species to be included in the biological assessment for PTA.

In a letter dated March 5, 1999, the Service concurred with the Army that Hawaii akepa (*Loxops coccineus coccineus*), Hawaiian creeper (*Oreomystis mana*), and Hawaiian crow (*Corvus hawaiiensis*) were not likely to be affected by the Army's actions at PTA.

On December 15, 1999, the Service received the Preliminary Draft Biological Assessment for Programmatic Section 7 Consultation on Routine Military Training and Other Current Activities at PTA.

Representatives from the Service and the Army participated in four meetings held on February 16, October 31, November 22, and December 11, 2000; to discuss basic aspects of the consultation and the action area.

In a letter dated May 26, 2000, the Service provided the Army with an 18-page comment letter regarding the Preliminary Draft Biological Assessment for Programmatic Section 7 Consultation on Routine Military Training and Other Current Activities at PTA.

Between January 8 and 10, 2001, the Service and Army met to determine the distribution and specific threats for plant and vertebrate species and to examine potential management strategies to improve the baseline condition of threatened and endangered species at PTA. Several measures were discussed in order to minimize and offset project impacts to listed species.

On February 16, 2001, the Service and Army met to discuss the distribution and threats for listed vertebrate species that may be affected by military actions at PTA.

On March 21, 2001, the Service and Army discussed fuel management within PTA and on Mauna Kea. Specifically, much of the discussion focused on the use of corridors to control fire from potentially spreading from one management unit to the next. Options for maintaining the corridors were also discussed.

On April 18, 2001, the Service and Army discussed potential plant stabilization guidelines, wildland fire management, and how the Biological Assessment should address bats, the Impact Area, and the involvement of Range Division (oversees range maintenance, planning and training lands management). The Army and Service also discussed the upcoming PTA site visit to discuss fire management corridors.

From May 21 to 22, 2001, the Service, Army, Hawaii Department of Land and Natural Resources - Division of Forestry and Wildlife, and Hawaii County Fire Department conducted a site visit to PTA to address the development of fuel management measures. Fuel management

corridors and ingress of *Pennistum setaceum* and other invasive plants increasing the fuel load on PTA were discussed.

The Service met with Army personnel on July 25, 2001, to discuss fuels management, the schedule of the Routine Biological Assessment, the impact of upcoming plant critical habitat designation, prioritizing urgent actions at PTA, and the action area for the PTA consultation.

On October 24, 2001, the Service and Army discussed the October 2001 Kipuka Kalawamauna fire. Two illumination rounds potentially served as the ignition sources for the fire.

On February 6, 2002, the Service and Army met to discuss the potential changes in policy regarding surveys within the Impact Area of PTA. The proposed construction activities to support Transformation at PTA include entering the Impact Area to conduct surveys and training construction. This is inconsistent with the previously discussed policy of not entering the Impact Area due to safety concerns.

On February 8, 2002, the Service and Army met to discuss various issues associated with the consultation and the timeline for the projects associated with proposed SBCT Transformation.

In a letter dated April, 1, 2002, the Army requested that the Service review a revised Draft Biological Assessment for Routine Training at PTA.

On July 1, 2002, the Service met with the Army to determine how the Army should address proposed plant critical habitat in the Biological Assessments and section 7 consultations for Legacy and Transformation training.

On May 10, 2002, the Service faxed a 24-page comment letter outlining our concerns and recommendations pertaining to the Draft Biological Assessment for Routine Training at PTA.

On September 17, 2002, the Service met with the Army to discuss: 1) the wildfire and fuel management program; 2) how safety danger zones are calculated and how they affect federally listed species; and 3) the current status of the Biological Assessments.

In a letter dated December 6, 2002, the Army submitted the Pre-final Biological Assessment for Programmatic Section 7 Consultation on Army Transformation of the 2nd Brigade, 25th Infantry Division (Light) to a Stryker Brigade Combat Team, Island of Hawaii for review and comment.

On January 10, 2003, a letter from the Army to the Service submitted the final Biological Assessment for Programmatic Section 7 Consultation on Routine Military Training at PTA and requested initiation of consultation for Routine training impacts only.

On January 28, 2003, the Service sent a 17-page letter to the Army with comments and recommendations regarding the Final Draft Biological Assessment, Programmatic Section 7 Consultation on Transformation of the Second Brigade to a Stryker Brigade Combat Team.

On February 4, 2003, representatives from the Service and the Army met to discuss the PTA action area, proposed critical habitat and the inclusion of Army lease lands into the Integrated Natural Resource Management Plan, fuel management, and the military vehicle trail.

On February 10, 2003, a draft non-concurrence letter regarding initiation of formal consultation was hand-delivered to representatives from the Army. The letter outlined our need for additional information prior to initiating consultation. We also recommended that the Army combine Legacy and Transformation training into one consultation.

In a letter dated February 12, 2003, the Army withdrew their section 7 formal consultation initiation request for the Programmatic Section 7 Consultation on Routine Military Training at PTA. The Army considered combining the Routine Biological Assessment with the SBCT Transformation Biological Assessment in order to submit as a single document at a later date.

On February 19, 2003, the Service and the Army met to discuss Transformation training at PTA. They also discussed fuel management corridors, palila critical habitat and the action area configuration.

On February 26, 2003, the Army sent the Service a letter stating that future leased or purchase property (Keamuku Parcel) would be incorporated into PTA's Integrated Natural Resource Management Plan to assure adequate protection to plants and their habitats since plant critical habitat had been obviated from Army installations.

On February 27 and 28, 2003, Service and Army biologists met to review and discuss the current status of threatened and endangered species' distribution, population numbers, and trends in relation to Routine and SBCT training at PTA. Conservation actions for each species were also identified for incorporation into the Final Biological Assessment.

Two Service biologists toured PTA on March 11 and 12, 2003, in order to get an overview of the installation and discuss all the various training actions including fuel modification with the PTA Natural Resources staff.

The Army submitted an Addendum to the Biological Assessment for Routine Training at PTA, dated March 19, 2003, that addressed several issues including fence exclosures, plant monitoring, invasive plant and rodent control, fuel modification issues and palila critical habitat.

In a letter dated March 20, 2003, the Army explained that they cannot commit to the reintroduction of species to unoccupied areas; however, the Army will coordinate with the Service to determine ways to protect these areas and encourage re-occupation.

On March 25, 2003, representatives from the Service and the Army met to discuss several general consultation issues.

On March 26, 2003, then Field Supervisor, Paul Henson, and Service staff met with Colonel Anderson and Colonel Quintana to discuss the section 7 timeline, conservation and baseline improvement measures, and minimization measures such as constructing a large western fence unit to reduce impacts to listed species from training and browsing from ungulates. It was also clarified at this meeting that the Colonel would agree to reintroduction of listed species in unoccupied habitats contrary to a statement in a previous letter.

On April 1, 2003, representatives from the Service and Army met to discuss fence units at PTA, public hunting, invasive plant control, off-road maneuver areas and baseline improvement strategies.

On April 15, 2003, the Service received notification from the Army that two small wildfires had occurred within palila critical habitat at PTA that impacted approximately 0.11 hectare (0.27 acre).

On April 16, 2003, the Service provided a 13-page comment letter on the PTA Final Draft of the Biological Assessment for Endangered Species, Section 7 Consultation on Transformation of the Second Brigade to a Stryker Brigade Combat Team.

On April 24, 2003, the Service and Army met to discuss the adequacy of the proposed fence units to minimize and avoid impacts to listed plants at PTA.

On April 25, 2003, the Army provided the Service with copies of the Final Biological Assessment for Routine Military Training and Transformation for PTA and requested initiation of formal consultation.

On May 28, 2003, the Service sent a letter to the Army agreeing to initiate formal consultation on Legacy and Transformation training at PTA with the caveat that the Project Description must be completed by June 10, 2003, in order to maintain the regulatory section 7 timeline for completion of the biological opinion.

Representatives from the Army and the Service met on May 28, 2003, to discuss several outstanding issues regarding the Project Description and minimization and avoidance measures for the PTA action.

On June 17, 2003, the Army sent a letter with the final species list for inclusion into the section 7 consultation.

A meeting was held on June 17, 2003, with Colonel Anderson and Field Supervisor, Paul Henson, to discuss a resolution to the fencing issue and maneuver corridor for Stryker vehicles at PTA. On June 24, 2003, we received a copy of the Pre-Final Draft of the Integrated Wildland Fire Management Plan for review and comment.

In a letter dated July 14, 2003, the Service reiterated to the Army that a final Project Description for Legacy and Transformation actions at PTA was still outstanding and not having this information would delay the completion of the biological opinion.

On September 17, 2003, the Service sent a letter to the Army again reiterating our need for a final Project Description and that the consultation was on hold until we received the requisite documentation.

On September 18, 2003, the Army hand-delivered a letter modifying the Project Description to include fencing design for PTA enclosing approximately 9,307 hectares (23,000 acres) of habitat. The Army stated that this fence design was the best option to balance their training mission on PTA and their responsibilities pursuant to the Act.

Two Service biologists from the Pacific Islands Ecological Service office and a fire ecologist from the Regional Office, visited PTA on September 22 and 23, 2003, to view proposed fuel corridors, fire breaks and fuel breaks.

On December 5, 2003, biologists from the Service and the Army discussed final conservation measures via a phone conference.

On December 8, 2003, the Service received a letter from the Army that extended the biological opinion due date until December 23, 2003. In addition, the letter modified the original Project Description to include the following measures: construction of eastern and western fence units (approximately 9,307 hectares; 23,000 acres); additional surveys for listed plant species on the Keamuku Parcel; additional surveys for the Hawaiian goose, hawk, hoary bat and dark-rumped petrel; removal off-road training activities within Kipuka Kalawamauna Endangered Plants Habitat area; and a slight alteration in the western boundary of the installation due to a mapping error.

DESCRIPTION OF THE PROPOSED ACTION

Introduction

As previous outlined, two separate Biological Assessments were submitted to the Service; one addressed ongoing or Legacy training and the second outlined future SBCT Transformation actions at PTA. A third document, a letter dated December 5, 2003, and received December 8,

2003, contained modified or additional project information that shall supercede or supplement portions of the original Biological Assessments. These three documents submitted by the Army, and taken together; provide the basis for the Project Description of Army training actions within the action area (see Figure 1).

PTA History, Location and General Environment

PTA is located in a saddle between the volcanos of Mauna Kea and Mauna Loa approximately 40 kilometers (27 miles) south of Waimea and approximately 58 kilometers (36 miles) west of Hilo (see Figure 1). The United States first used the lands in this area in 1942 for military maneuvers during World War II. During the next several decades, PTA grew into the largest U.S. Army holding in the State of Hawaii consisting of approximately 44,030 hectares (108,801 acres). The majority of the land or 34,324 hectares (84,817 acres) was acquired through both Governor or Presidential Executive Orders. Another 9,303 hectares (22,988 acres) were added through a 65-year lease with the State of Hawaii, which expires in 2029. The Army leases 409 hectares (1,011 acres) from the Parker Ranch and another 9 hectares (22 acres) are held through a variety of sources (U.S. Army 2003a). PTA is bordered by Mauna Kea State Park and Parker Ranch to the north, Hawaii State lands to the east and south, and Kamehameha School lands plus State lands along the western edge of PTA.

PTA consists primarily of a sub-alpine tropical dryland ecosystem with upper montane to alpine elevations of 1,228 to 2,637 meters (4,029 to 8,652 feet). The cool-tropical climate is characterized by a 12.8° Celsius (55° Fahrenheit) average annual hightemperature and a 10.6° Celsius (51° Fahrenheit) average annual low temperature. PTA experiences a greater diurnal temperature fluctuation than a seasonal fluctuations. The soil consists of approximately 80 percent lightly weathered pahoehoe and aa lava and about 20 percent consists of volcanic ash derived soils. There are no surface streams, lakes or bodies of water within PTA due to low rainfall and porous substrates. Rainfall, fog drip and occasional frost are most likely the main sources of water that sustain the plants and animals in the dryland habitat of PTA (U.S. Army Garrison 2002). Existing vegetation is a complex mosaic of 24 plant communities, including 10 native Hawaiian plant communities.

Areas of Special Concern

Military training use of PTA expanded rapidly from the late 1940s through the 1970s. During this time the natural resources of the area were only sparsely studied and the unique biology of the land was not fully recognized. However, a surge of fieldwork in the 1980s and 1990s revealed that PTA harbors a high density of rare plant and animal species living in a relatively native ecosystem. Today, many scientists consider the sub-alpine tropical dryland ecosystem as being one of the rarest on the planet (U.S. Army Garrison 2002). Recognizing a strong need to protect and enhance the natural resources of PTA, the Army now provides funding and supports a staff to support environmental programs. Several areas have been fenced (Figure 3) to protect listed plant species from ungulate browsing and/or inadvertent impacts from training maneuvers, and other areas have either State or Federal designation:

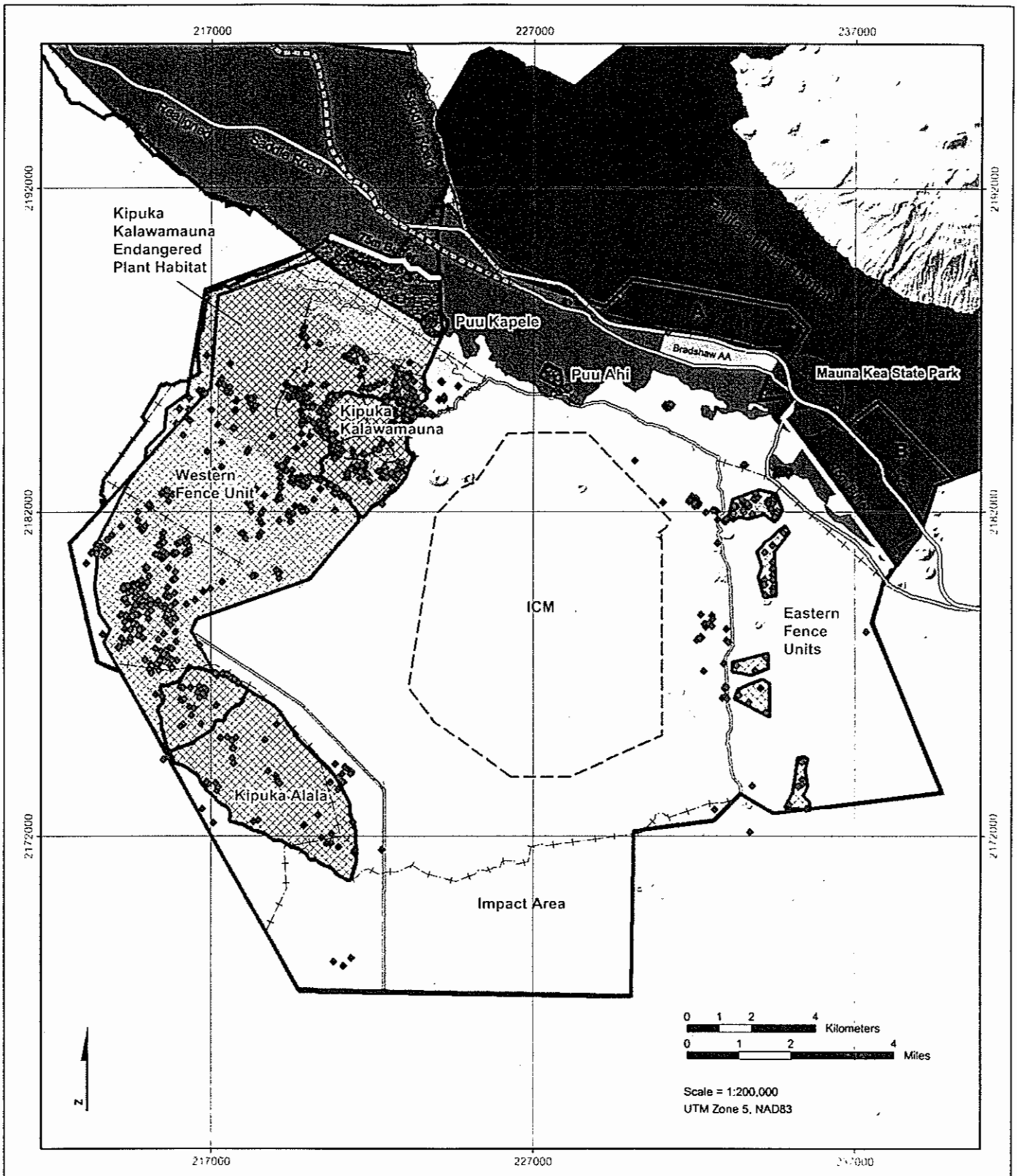
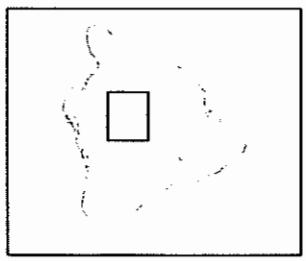


Figure 3 - Existing and Future Fence Units

- 75-meter Buffer
- Proposed Fuel and Fire Breaks
- Tank Trail
- Off-road Vehicle Maneuver Areas
- Impact Area
- ICM
- Action Area
- Keamuku
- PTA Boundary
- Palila Critical Habitat
- Kipuka Kalawamauna
- Existing Fence Units
- Future Fence Units



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

1. Critical habitat was designated in 1977 (42 FR 40685) for the federally endangered palila (*Loxioides bailleui*). Two non-contiguous areas comprise the critical habitat along the north-northeastern border of the installation labeled A and B (see Figure 2). Critical Habitat Area A consists of 670 hectares (1,656 acres) vegetated with *Dodonea viscosa* shrubland and pockets of *Sophora chrysophylla* and *Myoporum sandwicense*. Critical Habitat Area B is approximately 1,037 hectares (2,563 acres) and is predominantly open *Sophora chrysophylla* and *Myoporum sandwicense* with a non-native grassland understory. Critical Habitat A and the northern portion of B have been excluded from the action area due to a previous formal consultations that addressed Legacy training activities within these areas. Transformation will not alter any of the ongoing training activities in the excluded areas. The southern portion of Critical Habitat Area B (south of Saddle Road) will be affected by Transformation and shall be addressed in greater detail in a subsequent section of this biological opinion.

2. Kipuka Kalawamauna Endangered Plants Habitat is located in the northwest portion of PTA (see Figure 2) and consists of approximately 3,178 hectares (7,853 acres). This area was designated as sensitive by the U.S. Army when two rare plants (*Haplostachys haplostachya* and *Stenogyne angustifolia*) were discovered during a floristic survey in 1977. These species were subsequently listed as endangered. A portion of Kipuka Kalawamauna was fenced in 1998 to include 754 hectares (1,863 acres) and the Army is in the process of removing the remaining ungulates within this fenced exclosure.

3. Kipuka Alala is located in the southwest portion of the installation (see Figure 2) and consists of two contiguous fenced areas that total 2,080 hectares (5,140 acres). The northern portion was constructed in March 1999 to protect federally protected plants and their habitat from feral ungulates. A second, much larger fence unit was completed in January 2001 to offset impacts to palila critical habitat for the realignment of Saddle Road. The Army assisted with the funding of the Alala fence unit and ungulate removal is currently being conducted. A Memorandum of Understanding-Regarding Implementation of the Saddle Road Palila Critical Habitat Impact Mitigation, 1998, details the agreement between the Army, the Federal Highway Administration, and the Service regarding Kipuka Alala.

4. Puu Kapele (see Figure 2) fence unit consists of 202 hectares (499 acres) and was completed in 1981 by the Department of Land and Natural Resources to protect a large population of *Haplostachys haplostachya*. One-third of this fence unit is located on Army land while the remainder is on land leased from Parker Ranch (U.S. Army 2001).

5. A small *Silene hawaiiensis* fence unit is located close to Saddle Road in the northwestern portion of PTA (see Figure 3). Approximately 14 hectares (35 acres)

were fenced in 1999 to protect the largest population of *S. hawaiiensis* at PTA (U.S. Army 2001).

U.S. Army Overview in Hawaii

Three infantry brigades, along with an aviation brigade, division artillery, a division support command, and a complement of separate battalions comprise the 25th Infantry Division (Light). Two infantry brigades (2nd and 3rd) are based at U.S. Army Hawaii, and one (1st) at Fort Lewis, Washington. For this consultation, two main actions are proposed: 1) the existing training activities of two Legacy brigades, and 2) the continuance of one Legacy brigade and the Transformation of the other to a SBCT force. Actions associated with maintaining two Legacy brigades are ongoing. Both actions include training military personnel in the execution of live-fire munitions, maneuver, and bivouac. The mission of these infantry battalions (approximately 500 soldiers each) is to engage with and capture, neutralize, or destroy the enemy with fire and by maneuver. A third aspect of this action includes the implementation of conservation measures to improve the status and habitat of federally listed species and critical habitat occurring in the action area.

Generally, the Transformation to SBCT would have additional effects that include: 1) use of new or modified weapon systems, armored vehicles, and equipment; 2) construction, renovation, and demolition of buildings, training facilities, and infrastructures; 3) land transactions; 4) deployment of forces and specific training development; 5) mission readiness training; and 6) a net increase in troops and vehicles.

Legacy Training

PTA is the largest live-fire range and training installation in Hawaii, and is a main tactical training area for military Mission Essential Task List training. PTA assets are geared toward live-fire range training, maneuver live-fire (*e.g.*, moving and shooting at targets, including combined arms live-fire exercises) on ranges, dismounted maneuver training outside live-fire ranges with no live-fire (at PTA), mounted non-live-fire maneuver on other leased lands, and artillery live-fire. PTA supports infantry brigades, division artillery, aviation brigade, and other divisional combat support and combat service support units. Legacy Force training activities are shared between Army facilities on the islands of Oahu and Hawaii. The 25th Infantry Division (Light) is the primary user of the PTA. Non-Army units that also utilize PTA include the Hawaii Army National Guard, U.S. Marine Corps Units, and other Allied Forces.

Training at PTA takes place on approximately 44,000 hectares (about 108,726 acres). Approximately 120 personnel (civilian and military) are assigned to PTA on a permanent basis. PTA comprises three geographic areas: the cantonment (*i.e.*, developed area), airfield, and training lands (including the Impact Area) (Figure 4). The cantonment area is about 229 hectares (566 acres) and consists of some 120 structures (mostly Quonset huts) used largely for billeting, food preparation, storage, facilities maintenance, and administration. The maximum capacity of the

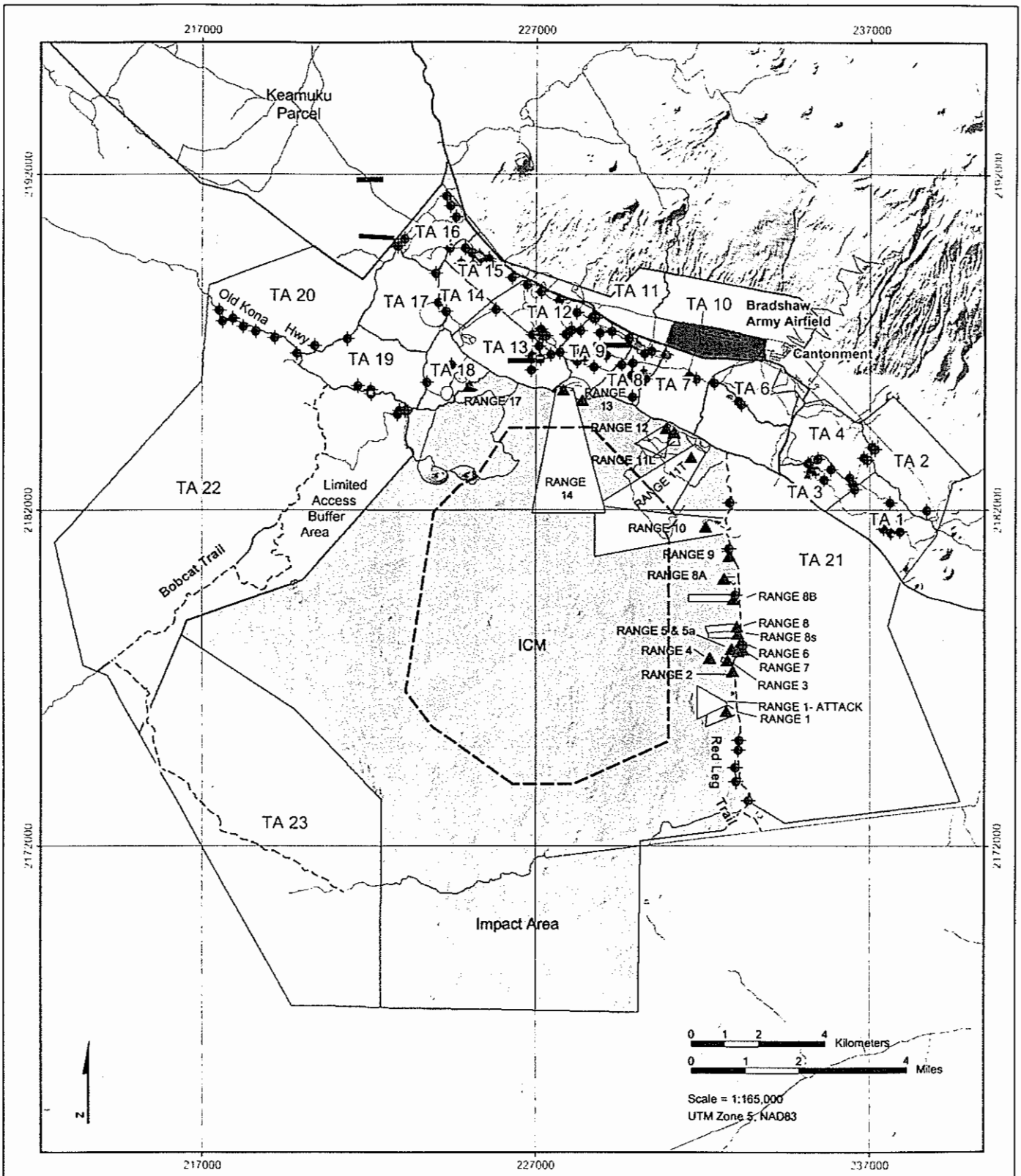


Figure 4 - PTA Firing Points and Ranges

- Firing points
- Ranges
- Trails
- ICM
- Keamuku
- Training Areas
- Impact Area
- Landing Zones
- Drop Zones
- Bradshaw Army Airfield
- Cantonment

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

cantonment area during training deployments for transients is 2,000 soldiers. Bradshaw Army Airfield comprises 211 hectares (521 acres). The central Impact Area is approximately 20,640 hectares (51,003 acres). Access is restricted to the Impact Area because of the presence of unexploded ordnance.

Existing Ranges, Firing Points, and Facilities

PTA has 22 live-fire and 4 non-live-fire ranges, 113 firing points, 23 training areas, a centrally located Impact Area, and airfield (see Figure 4). The ranges and firing points in the northern and eastern training areas surrounding the Impact Area are oriented so weapon fire is directed into the central Impact Area. An exception is the two rifle ranges that are oriented to the east of Redleg Trail. There are two landing zones and four airborne drop zones (two on PTA, two on leased lands) that support personnel and equipment airborne operations (see Figure 4).

Firing points are discrete points on the ground used to reference artillery fire. Firing positions are a 200-meter (656-foot) radius around a named firing point. Position areas support up to six field artillery guns. Position areas are not fixed and can be located in many locations, except where restricted (due to environment or historical restraints). The area of disturbance rarely exceeds 100 by 100 meters (328 by 328 feet).

Firing points with the exclusion of those occurring in palila critical habitat are also used as landing zones. While infrequent (about twice a year), other non-designated areas may be used as landing and pickup zones with permission from Range Control (oversees access to the ranges, Standard Operating Procedures and training soldiers) and the Natural Resources Office.

The central Impact Area is the primary danger area for all indirect fired weapon rounds (not in line of sight) and it is off-limits to unauthorized personnel due to munitions hazards. The portion of the Impact Area where high explosive rounds have landed, but have not detonated (duds) is termed a dedicated, or dudded, impact area. At PTA, an improved conventional munitions area is located in the center of the Impact Area, with munitions delivered by anti-personnel, anti-material, and/or anti-armor submunition warheads or projectiles (see Figure 4). The combined impact area and dudded areas comprise approximately 20,640 hectares (51,003 acres). There is no access to this area.

Training Activities

Principal training activities include: weapons live-fire, maneuver exercises (mounted and dismounted), reconnaissance, bivouac, deployment, aviation, aviation training (primarily for attack helicopters), landing and drop zone training, combined-arms live-fire training, major force-on-force training, and combat service/service support training operations. Units constantly rotate between training activities except only aviation units conduct aviation training. Generally, maneuver battalions deploy to PTA annually for approximately 30 training days. Troop movement between the islands provides a unique training opportunity. A training exercise to PTA involves deployment via land, sea, and air. Most large size cargo is shipped on assigned Army vessels. The balance of

a battalion moves from Hickam Air Force Base on Oahu to Kona or Hilo on Hawaii. Upon arrival, troops move by ground transportation to PTA. Equipment and vehicles move over public roads or by off-road trails from Kawaihae Harbor to PTA (see Figure 1).

All units must plan and execute training activities in accordance with PTA *External Standing Operating Procedures* (U.S. Army Garrison 2002). The Standing Operating Procedures address all aspects of planning and scheduling, range use, environmental restrictions, and required policies and procedures for all supported units (see Appendix B).

Live-Fire Training

Firepower is the capacity of an individual or unit to deliver effective weapons fire on a target or area and to kill or suppress the enemy in its position, deceive the enemy, and/or support tactical maneuver. Live-fire training requirements depend on individual and unit mission, weapons assigned, and ammunition available. The individual soldier qualifies with an assigned weapon and then progresses through squad, platoon, and company level live-fire exercises. Each weapon system and soldier has an assigned annual or semiannual live-fire training requirement that must be met.

Various military weapons and ammunition are used at PTA. A single weapon may have several different munitions of the same caliber and different uses. Normally, military weapons are designed for a specific target type (*e.g.*, anti-tank, anti-aircraft, and personnel). Weapons are designated as small arms (up to 0.50 caliber) and heavy weapons (larger than 0.50 caliber). Weapons are classified as individual (weapon operated by one individual) or crew-served (operated by two or more individuals). Lasers are normally treated as weapons.

Maneuver Training

About 29,826 hectares (73,702 acres) of the total 44,040 hectares (108,825 acres) of PTA are suitable for maneuver training because of the extreme roughness of the lava flows and administrative and environmental considerations. Maneuver training is a tactical exercise that can include the following activities: movement to contact, offensive operations, defensive operations, withdrawing under enemy pressure (retrograde), and reconnaissance and security. Maneuver training exercises are conducted at all levels (squad to brigade). Combat effects, such as smoke and obscurants, noise, and simulated nuclear, biological, and chemical conditions are integrated into training events. At PTA, traffic in the training areas is confined to well-traveled road networks and firing position areas and off-road driving is not authorized.

Unit movement may consist of soldiers in tactical (contact with an enemy is likely) and non-tactical (contact with an enemy is not likely) formations moving in a predetermined direction to accomplish a mission. Individual infantry soldiers move in non-tactical formations using vehicles (mounted maneuvers), walking in formations on roads or trails often in a dispersed fashion overland (dismounted maneuvers), or by helicopter. Soldiers can move in loose tactical formations, walking in designated directions to accomplish assigned missions. Direction of movement is terrain and

scenario-dependent. Due to a risk of ambush, tactical formations often do not follow roads or trails. If engagement with an enemy happens or is likely, soldiers seek cover from enemy fire. Paratroopers parachute from transport Air Force aircraft into designated drop zones under administrative and tactical scenarios.

Maneuver entails the set-up of temporary defense positions to repel an enemy's attack. Defensive positions may consist of soldiers lying in concealed positions and designating fire zones. More complex maneuver defenses entail digging individual fighting positions and trenches with hand tools or digging-in larger crew-served weapons with excavators. At PTA mechanical excavation is limited to specified firing points.

During maneuver soldiers may sleep in the field. To avoid detection and allow for quick movement, tents are not set up during light infantry maneuvers which is a different training scenario from bivouac (see below). Soldiers normally eat prepackaged meals and training units carry out all trash to avoid detection. Units may use blank ammunition and multiple integrated laser engagement system equipment. Field artillery and mortar fires and grenades are simulated by pyrotechnics, providing sound and visual effects, and are restricted to specific areas at PTA.

Typical reconnaissance training operations involve small groups, squad to platoon strength (3 to 50 soldiers). This type of training may take place in all types of terrain, but may 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 may also involve a squad being dropped by helicopter in a remote location and having to find their way to a strategic rendevous point.

Bivouac

Bivouac consists of setting up camp for rest, resupply/refit, maintenance, and/or to provide support. Training Units conduct vehicle/weapons maintenance, fuel and ammunition resupply, medical operations, helicopter landings, and field cooking/messing operations in bivouac areas. Bivouac is normally not done when in direct or indirect contact with an enemy force and sites vary depending on unit size and mission. Tactical operations may be staged from a bivouac area. Depending on unit size, bivouac sites can contain a vehicle and weapon 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. Tents provide sleeping/living areas, maintenance shops, supply storage, medical facilities, operations/communication areas, and meal preparation sites. Meals are normally prepared in mobile field kitchens. Bivouac is normally done on level or gently rolling areas that provide vehicle and/or aircraft access. Sites are located to accommodate the unit support element, provide communication links and concealment from the enemy, and support maneuver operations. Open fires are not allowed during bivouac. The use of tent heaters

(enclosed) and generators is permitted. Munitions used to defend bivouac sites typically consist of grenade and artillery simulators and blank ammunition.

Deployment Training

Deployment training principally involves moving troops and equipment from Schofield Barracks Military Reservation to other subinstallations/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 PTA from Hickam Air Force Base or Wheeler Army Airfield using C-17 or C-130 aircraft. Deployed equipment to PTA uses approximately 30 Logistics Support Vessels round trips from Oahu to Hawaii per year. Hickam Air Force Base is required to meet all Federal and State carrier requirements for agricultural, horticultural, and other pests.

Aviation Training

Aviation training consists of aircrew training, maneuver training, and aerial gunnery. Aircrew training pertains to normal aviation flight skills, including take-off and landings; nap-of-the-earth (low-level flight that follows the contours of the terrain to minimize visibility and evade ground fire), and low level flights; confined and high altitude area landing/take-off; and navigation for helicopters. Air Force and Naval aviation high performance tactical and transport aircraft practice similar tactics at higher altitudes. Aircrew training tasks include all tactical maneuvers in accordance with each aircraft's standard aircrew training manual and unit Standard Operating Procedures. 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 live-fire training follows the standard Army training methodology. Aviation live-fire training is supported by designated ranges and ground targets, along with scoring systems to determine weapon accuracy and weapon effects. Aerial gunnery is a live-fire task accomplished at fixed ranges. Aerial gunnery pertains to the ability (Army attack helicopters, cavalry units, and Air Force/ Naval tactical aircraft) to successfully engage targets with bullets, cannon rockets, missiles, or bombs.

Army and Marine Corps aviation units each utilize PTA for major deployment exercises about two to four times annually. The average number of aircraft varies from 15 to 25 per event, but can range up to 50 to 60. The number of sorties (combat training flight missions) at PTA averages 50 to 100 annually (U.S. Army 2003a). Nighttime aerial gunnery by the aviation brigade occurs semi-annually. Night flying includes high-altitude training at an average of 10 flights per month.

Landing and Drop Zone Activities

The aviation brigade and other aviation units support infantry training through transport support via landing and pickup zones (see Figure 4) and parachute drop zones. Helicopters collect soldiers at

pickup zones and carry them to tactical landing zones. At PTA, landing and pickup zones are used for moving artillery pieces, Medevac operations, troop transport, and airborne assault lifts. Troop numbers vary from platoon (40 personnel) to company (150 personnel) size units per event. These events (combined) take place approximately 20 to 30 times a year.

Standard aircraft support packages consist of: 1) 2 UH-60 (Blackhawk) or 1 CH-47 (Chinook) and OH-58D (Kiowa Warrior) for platoon support; 2) 4 UH-60 or 2 CH-47 and 2 OH-58D for company support; and 3) 12 to 18 UH-60, 4 to 8 OH-58D, and 2 to 4 CH-47 for battalion support. Primary users of landing zones are Army and Marine Corps units.

Drop zones are used for troop and equipment parachute drops typically with C-130 aircraft. Cargo drops take place approximately two to four times per year and personnel drops once a year (if at all) (U.S. Army 2003a). A drop zone team on the ground, typically consists of two to four personnel to retrieve the cargo with a Humvee vehicle.

Personnel and equipment drops take place at other approved drop zones, including firing points and position areas outside of palila critical habitat. In addition to firing points helicopters may land at Landing Zone Rob (Training Area 1), Landing Zone Brad (Training Area 3), all ranges, on Puu Ahi, Puu Keekee, Puu Kailua, Puu Menehune, the Forward Rearming and Refueling Points, and other locations with permission from Range Control and the Natural Resources office. Vehicle support associated with landing zone exercises is confined to existing roads and trails.

Combined Arms Live-Fire Maneuver Training

Infantry companies are required to conduct at least one Combined Arms Live-fire Maneuver exercise (CALFEX) annually. Squad, platoon, and battalion CALFEXs are also conducted at varying time intervals. At PTA, CALFEX training occurs on Range 10 and integrates the use of combat systems over a five-day period and troops bivouac (see Figure 4). The first two days pop-up targets and blast simulators are sometimes placed in the training area to replicate contact with the enemy. On the third and fourth days, unit personnel conduct an actual training exercise. Upon seizing objectives, units must prepare for counterattacks.

Company-level scenarios can be modified to include additional training opportunities and combat elements. Helicopters may be used for air assault and artillery support is an integral part of combined arms training. The size of the howitzer (155mm or 105mm), a cannon that combines certain characteristics of guns and mortars, depends on the range being used. A typical exercise involves at least two gun sections. Scenarios are typically conducted both day and night to complete a training evaluation to Army standard.

On the final day, units remove exercise-related target equipment, gather spent-round brass casings, remove litter, and restore the range to its condition prior to use. Explosive ordnance disposal specialists destroy all unexploded ordnance. Ordnance normally is destroyed where found, whether from the training being conducted or from earlier exercises. No known dud rounds are left in place at the conclusion of a training exercise.

Major Force-on-Force Training

In a major force-on-force scenario, a battalion or brigade engages an opposing force in a non-live-fire maneuver over a relatively large area, typically for an extended period (10 or more days) and with the involvement combat service support forces. The elements of a force-on-force training scenario are tailored to fit available resources. A brigade commander would attempt to expose subordinate units to phases that would be encountered in actual operations, such as pre-deployment, low intensity conflict, mid-intensity conflict, and evaluation, inspection, and cleanup. In a brigade-sized operation, the battle zone develops into a linear configuration divided into three areas of operations: the forward area or security zone, the main battle area, and the brigade rear.

Specific military activities in a force-on-force exercise normally include cross-country vehicle maneuvers, blackout driving, using pyrotechnics and artillery simulation devices, building hasty/limited defensive positions, emplacing obstacles, and establishing forward/rear support areas or field hospitals. Vehicles are moved on hardened and improved all-weather roads with limited use of unimproved roads and trails. Cross-country travel by Humvee and other wheeled vehicles is not allowed on PTA proper except at approved firing positions. Cross-country travel by wheeled vehicles does occur on leased lands such as the Keamuku parcel.

Combat Service Support Operations and Training

Support operations consist of setting up camp for rest, resupply/refit, and maintenance, or to provide other services. Units establish support areas under field conditions to stabilize logistics and provide a common site for support operations. Support areas vary depending on unit size and mission. Tactical operations may be staged from a support area. Depending on unit size, support areas can contain a vehicle and weapon maintenance area, vehicle parking area, general supply area, munitions supply area, medical area, helicopter landing zones, and vehicle off-loading area. A support area typically consists of a series of tents and other temporary structures and equipment covered with camouflage nets. Tents provide sleeping and living areas, maintenance shops, supply storage, medical facilities, operations and communication areas, and meal preparation areas. Support areas are normally established in level or gently rolling areas that provide vehicle and aircraft access. Sites are chosen to accommodate the unit support element, to provide communication links, to provide concealment from the enemy, and to support maneuver. Open fires are not allowed. Enclosed tent heaters and generators are permitted.

Training Area Overview

The following section gives a brief synopsis of the types of training activities that occur in each of the specific training areas.

Training Areas 1, 2, 3, and 4 (see Figures 2 and 4)

Training Areas 1, 2, 3, and 4 comprise 1,775 hectares (4,386 acres) and contain 40 kilometers (25 miles) of bordering and interior roads and trails. Training Areas 2 and 10, and parts of Training Areas 1, 4, and 11 are located in palila critical habitat (Training Areas 10 and 11 are included here because these areas are within designated palila critical habitat and the rules listed

below also apply to these areas). Specific rules governing training in these areas include:

1. Live-fire is not permitted.
2. A maximum of 24 artillery pieces may be deployed for dry fire exercises only.
3. No more than 500 troops may bivouac within the palila critical habitat.
4. Aircraft are restricted to an elevation of 610 meters (2,000 feet) above ground level and 1,500 meters (4,921 feet) from Mauna Kea.
5. No maneuver or firing of blanks within 1,500 meters of Mauna Kea State Park.
6. Use only well-defined roads and trails south of Infantry Trail and Mauna Kea Road.
7. No fires are allowed.
8. No refueling operations, food preparation, or vehicle maintenance.
9. A maximum of seven helicopters is allowed in palila critical habitat at any given time.
10. Vegetation will not be cut.
11. Use of pyrotechnics or simulators is not allowed.
12. Smoking allowed in designated areas only.

Maneuver, bivouac, and artillery live-fire occurs in Training Areas 1, 2, 3, and 4. Battalion-sized units utilize the area for two to four weeks, up to four times a year. Platoons to company-sized units average five days, 20 to 40 times per year. These training areas contain 19 artillery firing points. Five are used for live-fire training and the other 14 firing points, located in palila critical habitat, are used for non-live-fire training. The two landing zones in the area are located outside of the critical habitat area. Landing Zone Brad is located in Training Area 3 and Landing Zone Rob is located in Training Area 1 (see Figure 2).

As with all training areas within PTA, units request use and Range Control determines if the area meets training needs. In the case of the palila critical habitat, Range Control limits training to those activities and densities specified in the installation's Standard Operating Procedures (see above). Soldiers are provided with field cards during their safety briefing to remind them of training restrictions.

Training Areas 5, 6, 7, and 8 (see Figure 4)
These training areas comprise 1,769 hectares (4,371 acres) and contain 56 kilometers (35 miles) of bordering and interior roads and trails. Maneuver, bivouac, and live-fire for company to battalion-sized units take place. There are 16 artillery firing points. During battalion-sized exercises, upwards of 24 artillery howitzers are deployed. Mechanized ground excavation for artillery positions is allowed at four of the firing points. Training Area 5 contains a Forward Arming and Refueling Point (Range 18). Range 18 averages 120 helicopter landings per year. In addition, 20 to 40 helicopter landings per year take place at firing points to insert howitzers and supplies.

Training Areas 10 and 11, Cantonment Area, and Bradshaw Army Airfield (see Figure 4)
Training Areas 10 and 11 and the built-up portion of PTA comprise 1,296 hectares (3,203 acres) and contain 16 kilometers (10 miles) of bordering and interior roads and trails. Company to

battalion-sized units use the training areas for maneuver and bivouac about four times a year. No live-fire is permitted in these areas. Large areas of level ground immediately west of the airfield are frequently used for staging of field gear and tactical equipment. About 15-20 times per year, one to two helicopters take part in transporting sling loads into and off the summit area of Puu Maau which is located outside of the palila critical habitat. During training exercises, communications stations may deploy to the summits of Puu Alekoi and Puu Maau (Figure 5).

Bradshaw Army Airfield supports about 30 fixed-wing aircraft flights per year. Planes approach from the west, following Saddle Road by Puu Keekee (Route Blue) to the airfield, and depart along the opposite route (see Figure 4 in the Transformation Biological Assessment). Presently, aircraft do not use the eastern flight corridor over the base camp. An alternate route (Route Red) directs aircraft along Lava Road to the north side of Puu Ahi. Aircraft are required to travel 610 meters (2,001 feet) above the highest obstacle and 457 meters (1,499 feet) laterally. Standard Operating Procedures advise military pilots to avoid the area around Mauna Kea State Park (see Figure 3) below 2,743 meters (8,999 feet) mean sea level. Helicopters typically approach from and exit the airfield to the south and do not fly over palila critical habitat at elevations less than 610 meters (2,001 feet) above ground level.

Training Areas 9, 12, 13, 14, 15, and 18 (see Figure 4)
These training areas comprise 1,315 hectares (3,249 acres) and contain 37 kilometers (23 miles) of bordering and interior roads and trails. Company to battalion-sized units use the areas for maneuver, bivouac, and live-fire about 250 days per year. There are 30 firing points, of which 26 are actively used for artillery or mortar fire. Mechanized ground excavation for artillery positions is allowed at three firing points. Fixed-wing aircraft and helicopters frequently overfly the area at low, above-ground altitudes in support of various training missions. The only aviation restriction is no landing on Puu Kapele (see Figure 3) which is located in Training Areas 14 and 17. Training Area 18 contains a Forward Arming and Refueling Point (Range 17). At the Forward Arming and Refueling Point, ammunition is transferred to and from helicopters in cargo configuration only and refueling may occur. A portion of Training Area 18 is in the Kipuka Kalawamauna Endangered Plants Habitat (see Figure 3).

Training Areas 16, 17, 19, and 20 (see Figure 4)
These training areas comprise 607 hectares (1,500 acres) and contain 17 kilometers (11 miles) of bordering and interior roads and trails. Parker Ranch owns about 409 hectares (1,010 acres) on the western portion (Training Areas 16 and 17). The ranch lands were leased to the Army for many years, but in 1997 the lease expired, and currently a daily lease fee is applied as appropriate. The Army is examining the feasibility of a long-term lease or purchase of the Parker Ranch 1,010-acre parcel. Currently, about 235 hectares (581 acres) of the area is regularly used. The sector provides maneuver, bivouac, and live-fire opportunities and contains six firing points (Training Area 17 has no live-fire). A training restriction in Training Area 17 prohibits the landing of helicopters on Puu Kapele. Portions of Training Areas 19 and 20 are in the Kipuka

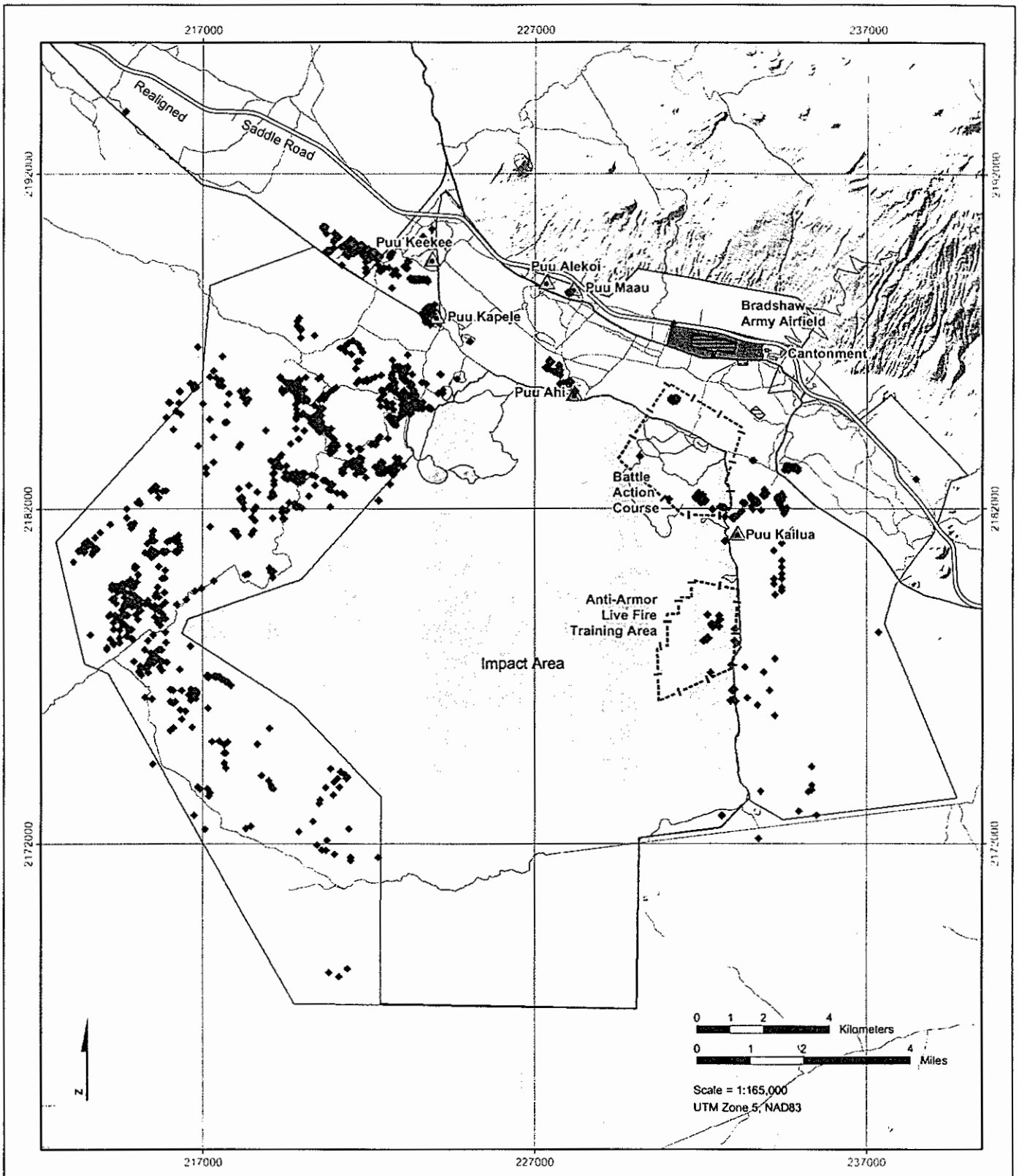
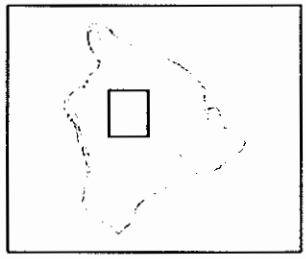


Figure 5 - Transformation Construction - Battle Action Course and Anti-Armor Live-Fire Training Range

- T & E Species
- Other Roads
- Major Roads
- SBCT Construction Projects
- PTA Boundary
- Keamuku
- Impact Area
- Bradshaw Army Airfield
- Cantonment
- Anti-Armor Live Fire Training Range and Battle Action Course



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

Kalawamauna Endangered Plants Habitat (see Figure 3) and are subject to the following training restrictions:

- No overnight bivouac is allowed within 2,000 meters (one mile) of Kona Highway.
- No fires or use of any type of pyrotechnic or incendiary munitions.
- Foot march is permitted.
- Rocky outcroppings and caves must be avoided.
- Vehicles are restricted to established roads and are not permitted in areas protected by gates.
- Two yellow gates on New Bobcat Trail are not to be crossed, even if found open.
- Firing points 701 and 703 are off limits.

In addition, only foot access is allowed in the Kipuka Kalawamauna fence unit for military personnel. Only the Natural Resources staff are allowed to use the roads within the fence unit. Like the rest of the Kipuka Kalawamauna Endangered Plants Habitat, live-fire and pyrotechnics are not allowed.

Training Area 21 (see Figure 4)
Training Area 21 comprises 4,864 hectares (12,019 acres) and contains 19 kilometers (12 miles) of bordering and interior roads and trails. This training area is used for maneuver, bivouac, and live-fire training. There are 10 firing points located along Redleg Trail. Approximately half of the points are occupied about 250 days per year for firing mortars into the Impact Area. Helicopters drop small observation groups onto the summit of Puu Kailua (see Figure 5). In 1998, there were 14 helicopter drops. Bivouac events occur approximately 15 nights per year in small areas adjacent to Redleg Trail.

Training Area 22 (see Figure 4)
Training Area 22 comprises 8,373 hectares (20,690 acres) and contains 63 kilometers (39 miles) of bordering and interior roads and trails. The training area is used for maneuver training. Ground-training is infrequent and limited to a few helicopter insertions, because this area supports natural resource management activities. Live-fire does not occur at the firing points in Training Area 22. The area bounded by Bobcat Trail and adjacent to the Impact Area is a buffer area with limited access and is classified as a "high hazard" area.

Training Area 23 (see Figure 4)
Training Area 23 comprises 4,656 hectares (11,505 acres) and contains 21 kilometers (13 miles) of bordering and interior roads and trails. The area is designated for ground maneuvers and bivouac outside of the Multi-Purpose Range Complex (see Figure 4). The area can support up to company size units about twice a year when facilities throughout the installation are full. The airspace above Training Area 12 is available for military training. Natural resource management activities also occur within Kipuka Alala.

Other Training Areas (see Figure 4)
Airspace Bradshaw Army Airfield includes a runway and terminal facilities (control tower, airfield operations, weather forecasting/reporting, and crash rescue) and supports transient aircraft for refueling, parking, and minor maintenance. There is a 27-by-1,127-meter (90-by-3,698-foot) paved runway with a 152-meter (499-foot) stabilized surface for over-runs. Airspace above PTA is known as Restricted Area 3103. This special use airspace is under the control of the PTA Range Office. Restricted Area 3103 extends from the ground surface to 9,144 meters (30,000 feet) above sea level, according to an agreement with the Federal Aviation Administration, the controlling agency of the airspace over Hawaii. A letter of procedure establishes PTA Range Division, Hawaii, as the using agency. During typical operations, Restricted Area 3103 is available for military use which includes airspace for firing small arms or field artillery projectiles and military aircraft. In addition, the U.S. Navy has constructed a high altitude, laser-guided, bombing target in the southern part of the Impact Area. The target is used for inert bombing.

SBCT Transformation
The SBCT Transformation would have a significantly different organization than the Army's current brigade configuration and would consist primarily of three infantry battalions, an artillery battalion, and a reconnaissance battalion. The SBCT Brigade would be a rapidly deployable, medium weight-force, which is more self-supported. This change would include: 1) the introduction and use of the Stryker armored vehicle; 2) an increase in off-road maneuvers at PTA; 3) construction of new support and training facilities; 4) increased live-range requirements; and, 5) long-term use of additional lands. Transformation of the 2nd Brigade would result in a net gain of approximately 810 soldiers and 346 vehicles for a total of 3,818 officers and soldiers and 1,005 vehicles. The number of Stryker vehicles is estimated at 291. SBCT will add 105mm Stryker-mounted cannons and 120mm mortar to the current weapon inventory. The munitions used by the mobile gun system and the 120mm mortar would have the same fire ignition potential as 105mm towed howitzer munitions and the 81mm mortars, respectively. On the island of Hawaii, an additional 9,074 hectares (22,422 acres) are expected to be added to PTA for military use on the Keamuku Parcel (see Figure 1). Much of the SBCT training requirements and scenarios would be the same as are currently in place. The brigade is projected to be mission capable by May 2007.

SBCT Training
SBCT training focuses on urban, close-in, and complex terrain exercises. Many missions would be very similar to light infantry training. Infantry activities would continue to center on movements and engagements, utilizing a variety of squad/platoon to company or larger exercises. The new SBCT would have integral engineer, military intelligence, and signal units. A significant change would include infantry battalion companies to combine arms teams, consisting primarily of infantry, mobile gun systems, and mortars.

The Stryker vehicle serves as the platform for the infantry carriers, mobile gun systems, mortars, reconnaissance, surveillance, and target acquisition elements, anti-tank carriers, engineer mobility support vehicles, as well as many of the command and control carriers within the Brigade. The

introduction and use of the Stryker vehicle is a significant change from Legacy training that restricts vehicle travel to established roads and trails and approved firing position areas. The Stryker vehicle is more heavily armored than the light infantry vehicles currently used. Off-road maneuver areas for Stryker training have been designated in the northern portion of PTA proper and in the Keamuku Parcel (Figure 6).

SBCT Transformation would include construction of the following projects:

1. Battle Area Course
   The project site is sited along Lava Road, approximately eight kilometers (five miles) from either entry point onto PTA and approximately three kilometers (two miles) south of Bradshaw Airfield (see Figure 5). The proposed Battle Area Course would overlay existing facilities at Ranges 11 and 12. The primary features of the Battle Area Course include: 1) course roads; 2) 22 stationary armor targets; 3) three moving armor targets; 4) 167 stationary infantry targets; 5) 27 moving infantry targets; 6) 16 machine gun bunkers; and 7) two breaching obstacles. The range would be designed to support gunnery training and qualification requirements for SBCT weapon systems including artillery, attack helicopters, and fixed-wing, close-air-support aircraft. It would provide simultaneous live-fire exercises for field artillery, aviation gunnery, close air support, infantry battalion, anti-tank, and reconnaissance, surveillance, and target acquisition units. Simulators and ground burst smoke grenades would be used in training on the Battle Area Course. The range would support dismounted infantry platoon tactical live-fire operations either independently of, or simultaneously with, support vehicles. The range could be used for training with sub-caliber and/or laser training devices.

   Standard support facilities associated with this range include an action review facility, covered mess, latrines, bleacher enclosure, unit staging area, operations/storage building, bivouac area and ammunition breakdown building. Infrastructure would include storm drainage, service roads, low water crossings, site improvements, and berms. The range would accommodate a full range of target practice and selected service munitions. Targets would be fully automated.

   Disturbance to the site would be extensive and impacts are considered permanent for the species and habitat within the project footprint. Construction and ongoing training at the Battle Area Course is anticipated to permanently impact 840 hectares (2,076 acres). The Battle Area Course would be used by combat (*i.e.*, Strykers and Humvees) vehicles 5 to 21 days per year, and support vehicles (*i.e.*, trucks) 4 to 8 days per year. The area currently supports several species of federally listed plants that will be impacted by the construction of this facility (Arnett 2002a).

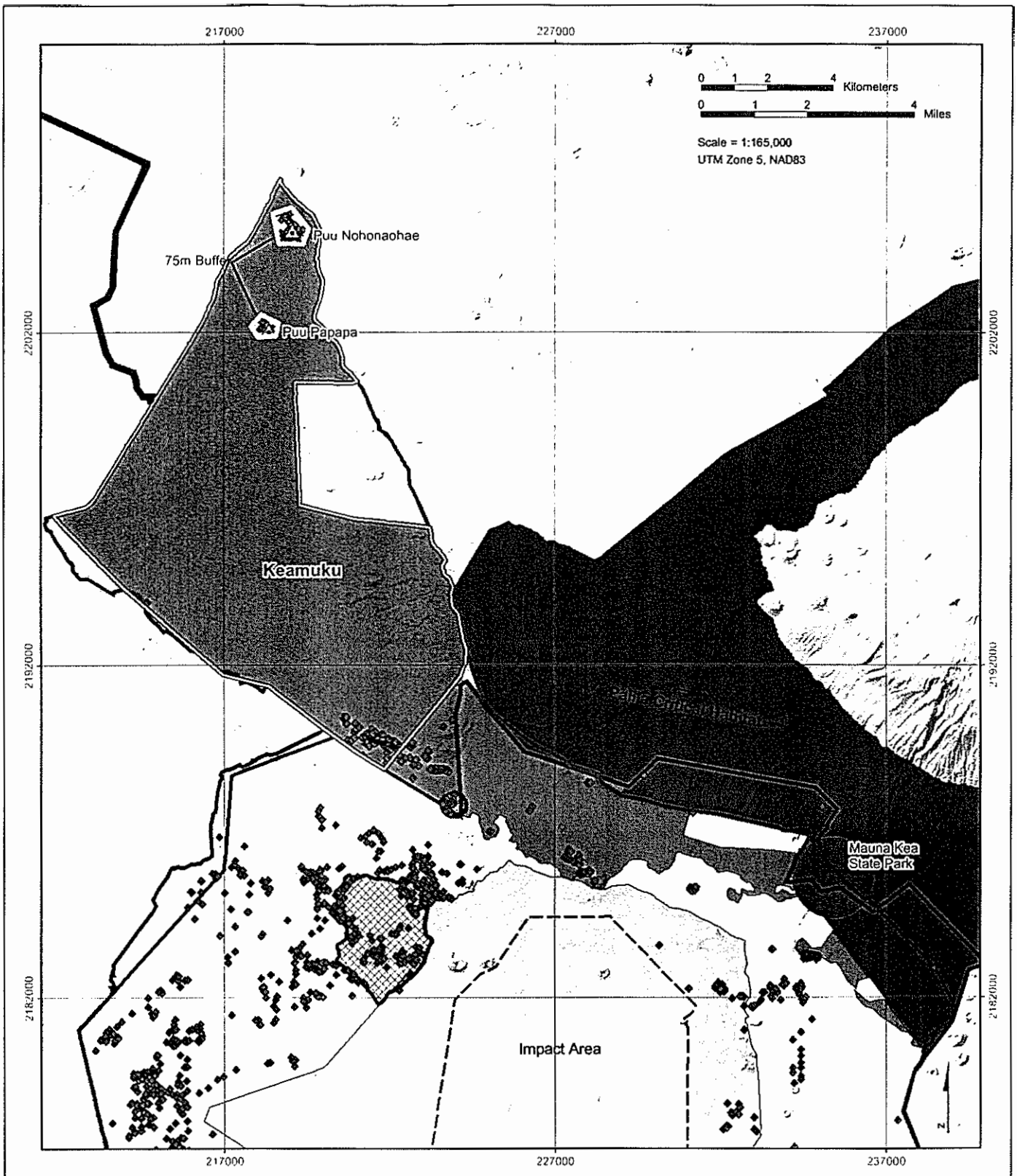
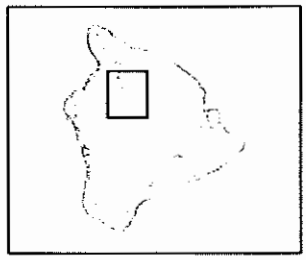


Figure 6 - Keamuku Parcel and Off-Road Maneuver Area

- T & E Plant Locations
- 75 Meter Buffer
- Off-road Vehicle Maneuver Areas
- ICM
- Existing Fence Units
- Action Area
- Keamuku
- PTA Boundary
- Impact Area
- Palila Critical Habitat



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

2. Anti-Armor Live-Fire Tracking Range
A modified standard Anti-Armor Live-Fire Tracking Range would be constructed on existing Ranges 3, 8, and 10, combining the three ranges and consolidating all the areas in between and west of Redleg Trail (see Figure 5). Range design would allow anti-armor forces to simulate enfilading fire, while moving along the flank of an opposing force before joining the larger force at the programmed Battle Action Course, much as would occur in actual battle. Primary features of the range include tracking roads, service roads, 21 stationary armor targets and 8 armor moving targets. The range would be used to train crews on the mobile gun system, Stryker vehicle, and reconnaissance armored vehicle, as well as anti-armor forces firing from Humvees. The range supports low-cost indirect-fire training round use, far reaching high-explosive capable fixed targets for high-explosive mortar, artillery, attack helicopter rockets, and close air support fire. The project would include a north-south road (or circle road) to allow linear movement between multiple linear firing points. Some areas would be conditioned (*i.e.*, mechanically smoothed and amended with crushed lava) to support dismounted Javelin maneuver and firing points. Each engagement area would have a baseline approximately 300 meters (984 feet) wide. All targets would be fully automated and the event-specific target scenario would be computer-driven and scored from the control towers. Other range features include baseline firing positions, primary and secondary power and data distribution systems, and heated and illuminated limit markers.

The Anti-Armor Live-Fire Tracking Range would be located on substrate that is mostly pahoehoe lava. Geotechnical analysis would be done to determine the locations of lava tubes. There are no ditches or existing culverts on the sites and the small amount of rain received is absorbed into the ground. Each range site is relatively flat and would require minimal line of sight grading for target visibility. The lava surface creates a hilly terrain and the tracking road may require moderate grading. Each of the three ranges would include a 100-by-200 meter (328-by-656-foot) firing area that would require lava conditioning. Each range would occupy approximately 260 hectares (643 acres); however, most of this area is located within the Impact Area (see Figure 5).

Facilities required at each range would include a control tower, an after action review facility, and a general instruction building. Range 8 facilities would also include an ammunition breakdown building, an ammunition loading dock, an operational/storage building, latrines, a covered mess, bleacher enclosure, and range maintenance building. Support facilities would include electric service, access roads, parking, maintenance area, unit staging area, earthwork, concrete tent pads, range flagpoles, fencing and gates, and information systems (telephones).

The training at the Anti-Armor Live-Fire Tracking Range is anticipated to be conducted 180 to 242 days per year. Three to 10 combat vehicles and 5 to 10 support vehicles would be on site during each exercise. Approximately 10 tube-launched, optically-tracked, wire-guided missiles, and 23 Javelin missiles would be fired per year. No range of this type currently exists in Hawaii. The Anti-Armor Live-Fire Tracking Range would be used as preparation for, and in conjunction with, scenarios that would be executed on the proposed Battle Action Course. Endangered plant surveys were conducted in the spring of 2002 (Arnett 2002a). Impacts to this area would be extensive and it is anticipated that all sensitive plant species located within the Anti-Armor Live-Fire Tracking Range footprint will be impacted.

3. Ammunition Storage
   Facility development of the Ammunition Storage Facility (see Figure 27 in the Transformation Biological Assessment) would require construction of three oval ammunition igloos, an ammunition holding area, and security lighting for a total area of 627 hectares (1,549 acres). The project is required to handle training ammunition for one Stryker Brigade, and to store loaded vehicles. Munitions storage areas would be equipped with intrusion detection systems and closed circuit television systems. This site is already disturbed and construction will not impact any natural resources.

4. Bradshaw Army Airfield Runway
   The runway upgrade would construct a 1,880-meter (6,168-foot) Class A aircraft runway canted five degrees south from the existing runway for C-17 and C-130 aircraft; aircraft taxiways and parking aprons for fixed wing and rotary wing aircraft; cargo loading and unloading pads; paved asphalt shoulders; one cargo pad; one hangar with overhead crane and fire sprinkler system; approach indicators on either end of the runway, lighting for runway, taxiways, and pad; emergency generator; and perimeter fencing. The runway would be 30 meters (98 feet) wide with 8-meter-wide (26-foot-wide) paved shoulders. All existing structures within 152 meters (500 feet) would be demolished. The disturbed area would be larger than the site plan footprint, but would be limited to the immediate surroundings of the existing airfield. The only species observed within the project footprint is the Hawaiian hoary bat which has been observed foraging around airfield lights at night (U.S. Army 2003a).

5. Installation Information Infrastructure
   The installation information infrastructure project provides connectivity to the training locations of the SBCT Transformation at PTA, Bradshaw Army Airfield, and other locations on the island of Hawaii. Actions include: 1) installation of fiber optic cabling from a new information systems facility to two new terminal equipment buildings, and 2) fiber optic and copper cabling to the consolidated command and range facility and ranges (see Figure 27 in the Transformation Biological Assessment). No listed species were observed within 200 meters (656 feet) of the project footprint.

6. Fixed Tactical Internet
   Eleven Fixed Tactical Internet support structures would support four antennas and would provide tactical communications infrastructure at home-station, enabling units to train using digital equipment at all times without the need for signal units to deploy to the field. When linked to the installation information infrastructure, the fixed tactical internet would enable command and control integration of virtual and simulation training with live-fire.

   The Fixed Tactical Internet would be a group of antennas strategically placed throughout the installation and in training areas. Military vehicle radios would be able to receive communication signals and process voice and data. Each support structure on the island of Hawaii would have four antennas installed. Existing antenna support structure sites would be utilized when possible. The antennas would be vertical whips approximately five centimeters (two inches) in diameter and would not have cables or support lines. The two antennae would be approximately two meters (six feet) long and two would be about three meters (10 feet) long. No red warning lights would be required. Each fenced site would be approximately six by eight meters (20 by 26 feet), enclosing a five-by-six-meter (16-by-20-foot) concrete pad for the support structure and shed. Sites would be accessed by existing roads. Personnel would visit the sites prior to and after Army training events. No security lighting would be installed at the sites. Existing roads will be used during construction. No listed plants or vertebrates were observed within 100 meters (328 feet) of the project sites.

7. Tactical Vehicle Wash
   The proposed tactical vehicle wash rack would be designed to accommodate a 4-by 18-meter (13-by-59-foot) vehicle and is located south of Bradshaw Army Airfield (see Figure 27 in the Transformation Biological Assessment). The facility would have four wash stations and be able to wash two heavy tracked vehicles, two large vehicles, and four small vehicles, or a similar combination of vehicles in an hour. The proposed wash system would utilize a high-pressure wash system. The used water would flow through a sediment basin, an equalization basin, and a secondary treatment area. Treatment would include oil and grease removal, grit removal, and organic control. An oil-water separator would be provided to treat any residual water that did not go through the main system. The proposed construction will not impact any listed species. This facility will assist in removing soil and seeds post-maneuver activity which will minimize the risk of alien plant dispersal.

8. PTA Trail
   A 42-kilometer (26-mile) long military vehicle trail would be constructed from Kawaihae Harbor to PTA (see Figure 1). The trail would be 7.3 meters (24 feet) wide, surfaced with gravel, and have 2.3-meter (7.5-foot) wide gravel shoulders for a total width of 12 meters (39 feet). Work requirements necessitate grading, paving,

drainage improvements, culverts at stream crossings, guardrails at drop-offs, storm drainage structures and lines to manage storm run-off. Work efforts would include provisions for telecommunication lines along the gravel road. Road grades steeper than 10 percent would be paved with asphalt or concrete. Supporting facilities would include provisions for shotcrete, guardrails, retaining walls, concrete swales, grass swales, drainage structures, signage, and information systems. No listed species were present along the right-of-way for this new trail and much of the area is heavily grazed by cattle.

The PTA Trail would make the existing tank trail unnecessary (see Figure 1). The existing military vehicle trail is difficult and potentially dangerous for wheeled vehicles to traverse, and has not been used by the Army for a number of years. The U.S. Marine Corps still uses the existing trail periodically and they are required to coordinate this activity through the Army. The Army is not anticipating any future use of the existing trail. However, if a future military convoy is considered, and it is determined the action may adversely affect critical habitat (*e.g.*, near Puu Papapa) or federally listed species, then the Army will address this issue in a separate section 7 consultation with the Service.

Keamuku Parcel Land Use and Training

The Keamuku Parcel is owned by the Richard Smart Trust (Parker Ranch), and is approximately 9,074 hectares (22,422 acres) of fee simple land. The parcel is located between PTA proper, the Mamalahoa Highway (SH 190), and Saddle Road (see Figure 1). The area would be used for maneuver to support training by the SBCT and Legacy forces. The proposed drop zone and brigade task force maneuver training area have no associated construction. The parcel would be used for company to battalion-size tactical operations. The Army currently uses the property on an interim basis for maneuver training. Keamuku Parcel requires the construction of road(s). A survey was conducted in the summer of 2002 and several federally listed plant species were identified within the Keamuku Parcel primarily relegated to two puu (Arnett 2002b). One of these puu is fenced to prevent cattle access.

Mounted and Dismounted Maneuver Training under SBCT

Small unit maneuvers and combat support training would include non-live-fire, mounted maneuver training with Strykers, Humvees, cargo trucks, trailers, as well as foot training. Where approved outside live-fire ranges, training exercises could involve vehicle movement, maneuvers and convoys, foot maneuvers, bivouac, and aviation training. Vehicle maneuvers are constrained by topography and vegetation (and other applicable constraints), whereas foot maneuvers would occur anywhere that safety or administrative restrictions permit including high probability off-road vehicle maneuver areas. Pyrotechnics use would occur anywhere that dismounted (and/or mounted) training occurs in accordance with rules for pyrotechnics at PTA. The proposed SBCT

requires 241 maneuver training events, while one light infantry brigade requires 192 maneuver training events.

"Training load" is a function of vehicle type, training activities, and quantity and severity of off-road vehicle impacts, quantified by maneuver impact miles. PTA vehicle maneuver training load estimates would increase approximately seven-fold compared to current training levels. A large proportion of the SBCT maneuver requirements would be met by the use of the Keamuku Parcel. Annual SBCT mileage per vehicle is estimated to be 1.3 times greater than Legacy vehicles. Transformation of one brigade (plus several small units) is anticipated to increase the training load on Army lands three-fold. The distribution and proportion of off-road SBCT use is not known at this time, but would likely be greater than current training. Whereas Legacy force vehicles are not permitted to drive off roads on most of PTA, SBCT vehicles would be allowed to travel off established roads and trails in approved areas. Stryker vehicles would generally stay close to dismounted units. The Stryker vehicle is expected to travel over rough surfaces not trafficable by Humvees and other Legacy force wheeled vehicles (U.S. Army 2003a).

Deployment Training under SBCT

Deployment training would principally involve moving troops and equipment from Schofield Barracks Military Reserve on Oahu to other training areas including PTA. As with Legacy training, transportation would use a combination of vessels and aircraft, depending on the type and location of training. SBCT deployment training would be similar to Legacy force training, except SBCT units would be deployed at least twice a year to PTA from Hickam Air Force Base or Wheeler Army Airfield using C-17 or C-130 aircraft. Troops transported to training load, incorporates factors related to vehicle type, training activities, and quantity and severity of off-road vehicle impacts, quantified by maneuver impact miles. Harbor would move by Strykers (up to 21) and trucks (up to 10) along the new PTA trail to the installation. The difference between SBCT strategic deployment and Legacy deployment is increased vehicle and troop numbers.

Aviation Training under SBCT

The frequency of aviation operations under SBCT would not differ from Legacy events. The aircraft C-130 currently supports Legacy troops and SBCT training would include use of the C-17 planes. The aviation brigade would support some SBCT training requirements. Pickup and landing zones would continue to be used for air assault operations by Legacy forces as well as Stryker units. Drop zones would be used by Legacy Forces only and not Stryker units.

Combined-Arms Live-Fire Training (CALFEX)

All CALFEX exercises would be carried out similar to Legacy training. The only increase in CALFEXs would be the introduction of the reconnaissance, surveillance, and target acquisition squadron, which could conduct up to three company CALFEXs per year.

Major Force-on-Force Training

Major force-on-force training would increase with the use of the Keamuku Parcel under the proposed action.

Live-Fire Maneuver Training

The principal training changes at PTA would involve increased range usage related to the Battle Action Course and Anti-Armor Live-Fire Tracking Ranges. Throughput requirements generally would increase for most ranges, and changes in amounts of usage vary by range and weapon system (see Table 8 in the Transformation Biological Assessment). Major changes to live-fire activities include the addition of direct-fire gunnery and collective live-fire by the mobile gun system and variants of the Stryker vehicle. Transformation would include an increase in ammunition (10 percent or more). Significant changes are anticipated for small arms blank/ball/tracer rounds, 81mm High Explosive and 120mm High Explosive/illumination/mortar rounds, 105mm mobile gun system cannon rounds (practice tracer rounds), Javelin and Dragon anti-tank munitions, demolition/pyrotechnic/smoke charges, and mines. Significant reductions (10 percent decrease or more) are anticipated for 40mm practice grenade machine gun cartridges, AT-4 Anti-tank missiles, and Hellfire/Stinger missiles. Indirect fire requirements by field artillery components would be unchanged (U.S. Army 2003a).

Effects from Training

Training impacts to habitat include physical disturbance from vehicles and foot traffic/trampling, site usage (waste wire, cartridges, petroleum, oil, and lubricants, hazardous spills; construction-camouflage and excavation; noise-vehicles, weapons, etc.), and munitions impacts. In the case of live-fire, wildland fire potential is an added factor. At PTA, Standard Operating Procedures are in place to minimize many training impacts. For example, open fires are not allowed during bivouac, and the use of pyrotechnics is specific to certain areas and under defined conditions (U.S. Army Garrison 2002). Installation Standard Operating Procedures will be reviewed by the Army Directorate of Public Works Environmental Division and updated for SBCT activities upon completion of the biological opinion. Any changes or additions of new or revised Standard Operating Procedure would require the approval of the Commander on PTA.

With adoption of the SBCT, more troops would move through the installation and new training opportunities would be available. Existing and future Standard Operating Procedures would minimize environmental impacts, reinforce the need to preserve and protect the vegetation, and identify and state restrictions in areas of environmental concern. New training activities would introduce new avenues for site disturbance (*e.g.*, Keamuku Parcel and installation off-road maneuvers), introduction of alien species (*e.g.*, movement of weeds from the Keamuku Parcel onto PTA proper), additional noise concerns (*e.g.*, larger aircraft), more dust sources (*e.g.*, vehicle movement along Redleg Trail, in the northern training areas, and on the Keamuku Parcel), and potential for soil erosion (*e.g.*, Keamuku Parcel and PTA Trail).

High-Probability Off-Road Vehicle Maneuver Areas

Off-road maneuver with Stryker vehicles, trucks, Humvees, and other vehicles and equipment can cause severe environmental damage. High probability off-road vehicle maneuver areas were delineated through a process of examining a variety of the criteria across the landscape. Dismounted maneuvers are generally unconstrained by terrain and are considered possible in most places outside of the Impact Area. Legacy and SBCT force vehicles climb and traverse slopes somewhat similarly. Rough lava surfaces at PTA cannot be traversed by Humvees and trucks, but may be negotiable by Stryker vehicles. SBCT vehicles would be allowed to travel off-road, whereas such travel is not permitted under current training External Standing Operating Procedures for Legacy forces. Maneuver planning and training are subject to Army range Standard Operating Procedures with approval by Range Division.

The following framework, developed cooperatively by Army Environmental Division, Army Integrated Training Area Management (ITAM) staff, Army Range Division, and the Army Transformation Office was used to map areas with a potential for SBCT vehicle traffic on PTA and the Keamuku Parcel. Slower speeds and foot escorts may identify areas that are maneuverable by Stryker vehicles. If additional mounted maneuver areas are identified, the Army would reinitiate section 7 consultation with the Service.

Legacy and SBCT vehicles can conceivably climb slopes of up to 60 percent (27 degrees), but this capability would be practiced on a very small proportion of land. These additional areas are not mapped, but would be minimal at PTA. The 30 percent slope cutoff is considered a real-world military representation of driving.

Only existing roads and trails will be used in palila critical habitat as identified by U.S. Army Support Command Hawaii and the Service, on August 9, 1978 (Memorandum For: Chief of Staff, *Overlap of Critical Habitat for the Endangered Palila With Areas I and VI, Pohakuloa Training Area (PTA), Island of Hawaii*).

Wildland Fire Management Plan

Over the past several years, the Army has been developing a Wildland Fire Management Plan for all installation lands for which they are responsible. The Army finalized that document in December 2003, however, the version used for the analysis in this biological opinion was the Pre-Final Draft Wildland Fire Management Plan (WFMP). The overall goal of the plan is to reduce the impact of fires by limiting their frequency, size, and severity while still allowing the Army to maintain a high level of combat readiness. The WFMP provides comprehensive documentation of the plans, policies, methods, and actions necessary to achieve this objective.

The WFMP 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. Detail is provided to describe fire prevention, preparedness planning, and suppression response. However, several topics account for most of the on-the-ground implications:

1. 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 (RAWS) placed at the installation. This information is immediately available to 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. At PTA, the WFMP Fire Danger Rating System breaks up the large expanse of training lands into several smaller fire danger rating areas. The fuels and weather of each of these areas are more homogenous than PTA as a whole, thus making fire danger rating more accurate.

2. The WFMP lays out locations and standards of fire breaks and fuel breaks. Fire breaks are similar to four-wheel-drive roads and are cleared of all vegetation to mineral soil. Fuel breaks are swaths of cut, burned, grazed or otherwise modified vegetation so that a fire's behavior is reduced. The fuel break widths are determined by fuels, topography, and prevailing winds. The frequency of a fuel break's upkeep is dependent on the speed of regrowth and/or colonization. Generally speaking, fuel and fire breaks in wetter locations require more frequent upkeep because vegetation will grow more rapidly than in dry locations. PTA will contain an extensive network of fire breaks, fuel breaks, and fuel management corridors, mostly on the north and west sides of PTA proper (Figure 7). The Keamuku Parcel, if acquired for long-term use, will be surrounded by fire/fuel break combinations.

3. Four fuel management corridors will be established and maintained providing areas through which fire will not carry (U.S. Army 2003b). These corridors will provide several distinct areas within PTA where fire may be contained in order to prevent a catastrophic fire event (see Figure 7). Each corridor will be approximately 100 to 300 meters (328 to 984 feet) wide, although terrain, safety concerns, or protected resources may constrain the width in some areas. Fuel specifications within the corridor require that canopy cover not exceed 20 percent. Division of the western portion of PTA into somewhat discrete Fuel Management Areas allows for the outplanting of listed plant species onsite and reduces the risk of species loss due to a large, catastrophic wildfire event.

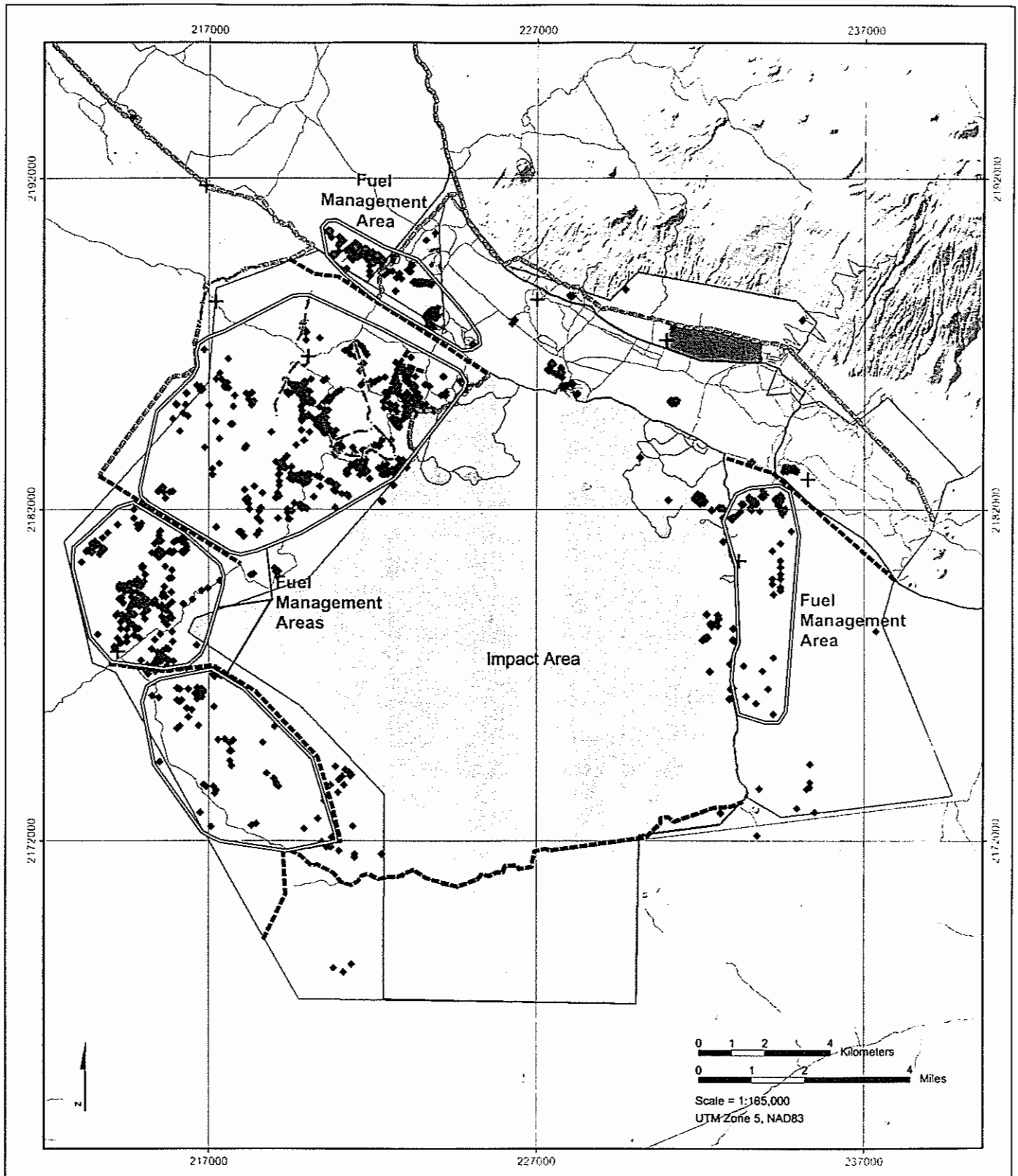
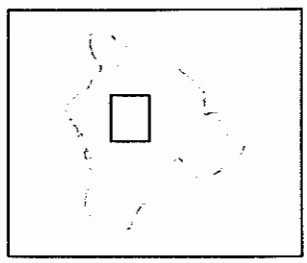


Figure 7 - Fuel Management

- T & E Locations
- Fire Facilities
- Other Roads
- Major Roads
- Fire break
- Fire Access Road/ Fuel Management
- Fuel Management Corridor
- Fuel break/Fire break
- Understory Fuel break
- Bradshaw Army Airfield Cantonment
- Fuel Management Area
- Keamuku
- PTA Boundary



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

4. A wildfire prevention analysis is included for all Army 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.

5. 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, fire breaks, and Fuel Management Areas.

6. 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. Grazing will be considered as a fuel management technique at PTA, especially in the Keamuku Parcel.

7. Range Control approval and guidance must be obtained prior to firing all pyrotechnics. Fire Department and Range Control personnel will have the authority to stop live-fire training for noncompliance with any training regulation and/or the WFMP Standard Operating Procedures.

8. Air support will include a military helicopter with a certified and trained aircrew capable of performing fire bucket operations. The air support will be onsite at PTA during live-fire training operations. In addition, a backup helicopter under contract service to the Army will be able to arrive at PTA within 90 minutes.

Fence Units

A western fence unit will be constructed to encircle Training Areas 19 and 22, and parts of Training Areas 17 and 20 (see Figure 3). The fence unit will be approximately 8,700 hectares (21,500 acres) and will connect with the northern section of the Kipuka Alala fence unit. It will be a solid hogwire fence, two meters (six feet) tall. If the Keamuku Parcel is acquired for long-term use, the western fence unit would be extended to include *Haplostachys haplostachya* plants in the southern parcel corner. The purpose of the western fence is to offset training impacts at PTA by excluding ungulates which will reduce the browsing pressure on all listed and native plants within the fence unit. The western fence unit will incorporate the remaining areas that contain the highest densities of listed plants. This in turn will also benefit the Hawaiian hoary bat by minimizing habitat degradation to *Sorphora* Woodland. The removal of ungulates from these fence areas will allow listed plant species and their habitats to regenerate naturally. The western fence unit will not change the current military use in the area.

The exact location of the fence will be agreed to by members of the Implementation Team (see Conservation Measures) and approved by the Army and the Service. The specific fence boundary location will be surveyed for federally listed endangered or threatened plant species. Care will be taken to not disturb or impact any listed plant species during construction and maintenance.

In addition to the western fence unit, five fence units encompassing approximately 607 hectares (1,500 acres) will be constructed on the eastern portion of PTA for the protection of *Silene hawaiiensis* and *Asplenium fragile* var. *insulare* from training actions and ungulates (see Figure 3). A sixth fence, in the eastern area surrounding *S. hawaiiensis* plants, will be maintained. Additional fencing/protection for *A. fragile* var. *insulare* at lava tubes in the east range will be constructed. Also, a more permanent fence will be constructed around a grouping of *Haplostachys haplostachya* near Puu Ahi where currently only a single-strand fence exists. The fence units will include a 75-meter (246-foot) buffer from listed plant occurrences, unless otherwise approved by the Implementation Team. In addition, dust studies will be conducted to determine the potential effect of dust on listed plant species and native habitats near high traffic and/or off-road areas.

Two fence units with buffers will be constructed on the Keamuku Parcel to protect *Isodendrion hosakae*, *Lipochaeta venosa*, and *Vigna o-wahuens*is (see Figure 6). A cattle fence currently surrounds Puu Papapa and this would be upgraded to preclude other types of ungulates and a second fence will be constructed to protect Puu Nohonaohae. The exact boundary for the fence on Puu Nohonaohae will be determined by the Implementation Team.

Installation Boundary

The PTA installation boundary was modified slightly along the western border and future Army maps and figures shall reflect this change. Updating the boundary will not change the action area; therefore, the federally listed species affected by the action remain the same.

Off-Road Mounted Vehicle Maneuver Area

The off-road mounted vehicle maneuver area is where vehicles, particularly Strykers, will be allowed to maneuver with only a few restrictions (see Figure 6). The designated off-road maneuver area is located in the northern portion of PTA proper and will extend into the Keamuku Parcel upon acquisition. Strykers will be allowed to traverse all other areas only on designated roads. This off-road area associated with SBCT training was modified and no longer includes the area in the Kipuka Kalawamauna Endangered Plants Habitat and Training Area 19 as depicted in the Transformation Biological Assessment. In addition, the off-road mounted vehicle maneuver area will not include lands in Mauna Kea State Park (see Figure 6). The off-road mounted vehicle maneuver area is estimated to be 11,685 hectares (28,874 acres), a reduction of 981 hectares (2,424 acres) from the area cited in the Transformation Biological Assessment. This acreage includes the Keamuku parcel. It is anticipated that all designated off-road maneuver areas will be permanently impacted by the training actions of Stryker vehicles.

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 the overall project impacts associated with Legacy and SBCT Transformation training activities by avoiding or minimizing specific Army actions on listed species. The following represent conservation measures as proposed by the Army as part of the overall action.

PTA Implementation Plan

The Implementation Team is responsible for a number of tasks that will be discussed in this biological opinion and a summary of their responsibilities is included in Appendix C. The Army will develop and implement an Implementation Plan in accordance with the following measures:

1. Many of the management actions that will be implemented by the Army are relatively new and untested; therefore, success cannot be ensured at this point. It is critical that the management actions the Army implements are 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 the PTA 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 PTA Implementation Plan be written and or reviewed by appropriate experts. The PTA Implementation Plan must be approved by the Service.

2. The Army, in coordination with the Service, will assemble an Implementation Team to determine measures necessary for the preservation and enhancement of federally listed endangered or threatened species and palila critical habitat at PTA. The Team will consist of Army, State, and Service representatives familiar with the species. Portions of the Implementation Plan may be written and/or reviewed by other appropriate experts. The Implementation Team shall be convened within 90 days following the issuance of the biological opinion.

3. The biological staff at PTA is currently using an Ecosystem Management Program Plan (U.S. Army 2003c) that directs their management and funding for natural resource work at PTA. The Implementation Team will incorporate the appropriate actions, ongoing management, and goals from the Ecosystem Management Program Plan into the Implementation Plan to consolidate planning documents for PTA. The Implementation Team shall resolve any inconsistencies between the objectives of the Implementation Plan and the existing Ecosystem Management Program Plan.

Currently the Ecosystem Management Program Plan addresses the following biological resource issues:

a. Rare plant conservation and management projects and goals, including monitoring protocols for federally listed endangered or threatened species, weed control, invasive plant inventory and documentation, and ungulate and ant control.

b. Rare plant augmentation and reintroduction, including planning, propagation, outplanting, *ex situ* genetic storage, and site management.

c. Rodent and invertebrate control programs to include the establishment of bait stations and snap-trap transects for rodents and the mapping and control of ants.

d. Avian surveys to detect changes in population demographics, vigor, and total population numbers.

e. Facilities maintenance and the establishment of additional plant propagation and support facilities as needed.

4. In addition, the PTA Implementation Plan must include, at a minimum, the following:

a. time frames for initiating various phases of the Implementation Plan;

b. identification of priority species, areas, and actions;

c. definitions of success for listed species population management and habitat management;

d. incorporation of the existing PTA Outplanting Plan into a comprehensive management strategy to address methods for plant collection, site selection and size, propagation, population reintroduction, outplanting density and habitat management for the listed plant species at PTA;

e. methods for monitoring, data tracking, analysis, and feedback;

f. a gross-scale estimate of minimum viable population for each species requiring outplanting;

g. a cost estimate for plan implementation;

h. updating Standard Operating Procedures to include pertinent environmental measures outlined in this biological opinion and Transformation Biological Assessment

to ensure that training actions at PTA avoid harming any listed plant or animal species; and,

i. the ultimate goal of increasing population density and abundance of listed plants in various Fuel Management Areas to avoid wide-scale species loss during a catastrophic event such as fire.

5. The PTA Implementation Team will review the progress of the Implementation Plan annually and make recommendations to the Army regarding adaptive changes in management strategy. The Service will have final approval regarding changes to the Implementation Plan to ensure they are consistent with the goals of the consultation and this biological opinion.

6. Plants and/or seeds for population augmentation offsite for *Isodendrion hosakae, Lipochaeta venosa, Vigna o-wahuensis,* and *Haplostachys haplostachya* will be provided to other agencies (public and private) working to recover these species. The Army Natural Resources staff will maintain a list of plants/seeds available and make the list available to other agencies. The Implementation Team will make recommendations as to which agencies should be notified on availability of propagules of these species.

7. The PTA Implementation Plan will be completed by December 31, 2004. Measures intended to minimize impacts to listed plants and critical habitat will begin within six months of the Service issuance date.

8. If concurrence on the final Implementation Plan cannot be reached between the Service and Army during the development of the document, then this consultation will be reinitiated in order to determine if a jeopardy threshold has been surpassed.

9. Management of the Keamuku Parcel will be included in the PTA Implementation Plan and the Integrated Natural Resources Management Plan. Those items addressing federally endangered or threatened species protocols will be extended to Keamuku species populations with long-term lease or purchase of the parcel.

Fence Units and Buffers

The Army will develop and construct several fence exclosures and buffers in accordance with the following criteria:

1. The Army shall construct an exclosure on the western portion of PTA to minimize threats to federally listed plants and the Hawaiian hoary bat. This western fence unit will be in addition to the 2,900 hectares (7,166 acres) of existing fences at

PTA. The size of the western fence unit will be approximately 8,700 hectares (21,500 acres) but exact acreage will depend upon the final positioning of the fence boundary. The goal is to include as many listed plant occurrences within the fence boundary while at the same time not directly impacting any plant occurrences during construction. The final location of the western fence unit shall be finalized by the Implementation Team. The fence unit shall be completed by December 2008, and may be constructed in phases, but with demonstrable progress accomplished by the end of each year.

2. Ungulates shall be removed from all future fence exclosures (*i.e.* the western fence unit and all eastern fence exclosures). The existing fenced areas, Kipuka Kalawamauna, Kipuka Alala, and Puu Kapele shall be kept ungulate free. In addition, if the Keamuku Parcel is leased or purchased, then fence exclosures will be constructed around Puu Papapa and Puu Nohonaohae and these shall be maintained ungulate free. A 75-meter (246-foot) buffer shall be included in the Keamuku fence units to reduce indirect effects of Army training (off-road maneuver) and maintenance of fuel modification areas on plants near the base of the cinder cones. All ungulates shall be removed from the new fence exclosures by 2010. An annual aerial survey of each fenced area shall be conducted after 2010 to ensure that ungulates have not returned to the fence units. Ground surveys will ensure the fencelines are intact. If ungulates are observed, appropriate hunts or snaring shall immediately commence to remove these animals. Complete removal of ungulates may be difficult to maintain at all times due to the size, topography and/or density of vegetation within the various exclosures, however, the goal is to have all fence units as ungulate free as practicable. The Implementation Team shall address the frequency and logistics associated with fence maintenance and hunting programs to accomplish the ultimate objective.

3. All individuals of *Neraudia ovata*, *Solanum incompletum* and *Hedyotis coriacea* will be included in the western fence unit unless they are located on non-Army lands. In addition, a 75-meter (246-foot) buffer (or a reasonable buffer determined by the Implementation Team) shall be included in the fence design for these individuals due to their extremely low numbers.

4. On the eastern side of PTA, fence units along Redleg Trail will also be constructed to protect sensitive lava tubes and crevices that provide habitat for *Asplenium fragile* or *Silene hawaiiensis* (see Figure 3). The fence units shall consist of approximately 607 hectares (1,500 acres). A minimum of 20 lava tubes suitable for or containing *A. fragile* shall be enclosed by protective fences (or grates) to minimize impacts from training activities and browsing pressure from ungulates.

The exact location of these eastern fence units shall be determined by the Implementation Team in cooperation with the archeological staff located at PTA.

5. A 75-meter (246-foot) buffer shall be established along the northern section of the Stryker off-road maneuver area adjacent to the large occurrence of *Haplostachys haplostachya* (see Figure 3). This buffer will be established to reduce indirect impacts of dust as Stryker vehicles move off-road through this area enroute to the Keamuku Parcel.

Synopsis of Training Minimization Efforts

The Army will implement the following measures to avoid and minimize impacts from Legacy and Transformation training:

1. The PTA Natural Resources Office will review all current and future training scenarios to ensure that any training plans that have the potential to affect federally listed species comply with this biological opinion.

2. Artillery training will be restricted to established firing points and ranges.

3. Off-road maneuver activities will be allowed only in designated areas; all other areas are off-limits to off-road vehicular training.

4. Bivouac will be restricted from sensitive areas. Future bivouac sites, other than at ranges and firing points, will require surveys and approval by the Natural Resources Office to ensure that an adequate buffer is established and maintained to avoid impacts to listed plant species.

5. Hunting protocols will be reviewed and updated to ensure that all privately owned vehicles will be restricted to established roads and trails.

6. Aviation pilots and airfield personnel will be instructed to document all bird and Hawaiian hoary bat strikes with the PTA Natural Resources Office. Any physical remains will be preserved as best as possible and given to the PTA Natural Resoures Office for identification with the results forwarded to the Service.

7. Firing point site improvement methods will be developed by the Army to reduce dust and risk of fire and implemented in conjunction with the Implementation Plan.

8. Staff from the Natural Resources Office will inspect the perimeter of the Bradshaw Airfield quarterly for alien species and remove invasive plant or animal species identified within the airfield environs.

9. The Army will actively follow the "Environmental Restrictions" described in 25th ID (L) & U.S. Army Hawaii Regulation 210-6, *Training* (Draft) (U.S. Army 2001) and update them as applicable pursuant to this biological opinion and the final Implementation Plan.

10. All ongoing and future construction projects will utilize rock from onsite locations at PTA to minimize inadvertent transport of invasive plant seeds.

Biological Studies

The Army will implement the following measures to avoid and minimize impacts from Legacy and Transformation training by incorporating the following actions:

1. The Implementation Team shall develop a dust accumulation study to identify whether dust adversely affects on a variety of native plant species (*e.g.*, mamane). The study will evaluate different growth forms, habitat types, and families (*e.g.*, the effect of dust on photosynthetic rates and, therefore, plant vigor). This study shall include potential habitat degradation from dust due to the use of Stryker vehicles within and adjacent to palila critical habitat, and to assess the efficacy of the buffer in minimizing any such impacts. Woodland habitat containing Hawaiian hoary bat roost areas shall be included as a component of the dust study. If it is determined that other factors may be affecting the health and vigor of mamane-naio woodland (particularly in palila critical habitat) then studies shall be developed and implemented to determine the cause for lack of mamane recruitment. If it is determined that dust does have a detrimental impact to plant vigor or abundance, then the Implementation Team shall assist with designing measures to minimize impacts. The Army shall implement dust reduction measures (*e.g.*, graveling of roads, additional buffers, reduce vehicular use, etc.) as specified by the Implementation Team.

2. Avian surveys will be conducted to determine species presence, abundance, and habitat use by Hawaiian dark-rumped petrel or uau, Hawaiian goose or nene, and Hawaiian hawk or io. Radar surveys shall be conducted for the petrel by biologists with experience in the use of radar equipment. Service biologists will assist with these surveys. The radar equipment will be provided by the Service, but the Army will be responsible for equipment transport to and from the island of Hawaii, transport of Service personnel to the study sites, providing a suitable vehicle on which to mount the radar during surveys, and for expert technician costs. These surveys can be scheduled to occur concurrently with hawk surveys. These and other bird surveys will be scheduled to occur at or near the optimum period and conditions for encounter. Daytime surveys shall be completed for the io and nene. Details of survey methodology shall be finalized by the

Implementation Team. Surveys for these species shall be initiated by 2005 and completed within two years of initiation.

3. Hawaiian hoary bat surveys shall be conducted to determine species abundance and habitat use by expert biologists familiar with the use of bat detectors, mist netting, tagging and/or other appropriate techniques for bat detection. Details of the survey methodology shall be finalized by the Implementation Team. These surveys shall be initiated before the end of 2005.

4. The PTA Integrated Natural Resources Management Plan (INRMP) will be revised to reflect the additional requirements and conditions of this biological opinion. The Implementation Plan shall be included as an addendum to the PTA INRMP.

Keamuku Parcel

The Army will implement the following measures to avoid and minimize impacts from Legacy and Transformation training on Keamuku Parcel:

1. Surveys of Keamuku Parcel gulches and gullies will be completed to determine the need for additional studies prior to the initiation of Transformation training events. Surveys will focus on areas of interest including rough lands and stony lands, semi-intact *Dodonaea* shrublands, and areas identified in Arnett (2002b) as *Pennisetum setaceum* with scattered *Dodonaea viscosa*, *Pennisetum setaceum* - *Dodonaea viscosa* association, and rangelands. A copy of the survey results shall be sent to the Service. All new occurrences of plants shall either be fenced *in situ* or genetic material shall be collected for propagation and eventual outplanting within an appropriate exclosure.

2. If the Keamuku Parcel is leased or purchased for Transformation training, the cinder cones, Papapa and Nohonaohae, will be fenced and all training activities will not be allowed within these two fence units.

3. No smoking will be permitted along the military vehicle trail within the Keamuku Parcel (either in or outside of a vehicle). All military vehicles using the new vehicle trail west of the Keamuku Parcel will not deviate from the hardened road surface to minimize risk of fire from catalytic converters and the illegal cigarette toss.

4. Prior to the commencement of training activities in the Keamuku Parcel, seed will be collected and cuttings made from the *Vigna o-wahuensis* plants that are located along the western border of the parcel.

Wildland Fire Management Plan
The Army will implement the WFMP for PTA:

1. The WFMP will address the following actions including: establishment and maintenance of fuel breaks, fire breaks, and fuel management corridors; dip tanks; suppression measures; and implementation of a Fire Danger Rating System. 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 24 hours after a fire occurs outside the Impact Area for live-fire training. A copy of the report will be sent to the Service within three (3) working days.

3. Prescribed burns will require separate consultation with the Service.

4. The WFMP will be an adaptive document and will be revised when new information is available or if it is determined by the Service or Army fire specialists that additional measures are necessary to further reduce the risk of fire. Biologists and fire personnel from the Army and Service shall meet annually to review the efficacy of the plan, discuss documented fires on the installations, and determine any necessary modifications to the Standard Operating Procedures to ensure that the best measures are being implemented that would reduce and minimize the risk of fires at PTA. Modifications to the WFMP shall require the concurrence of both the Army and the Service.

5. To avoid the possibility that future fires are caused by lack of compliance with the Standard Operating Procedures, the Army will implement measures to ensure compliance.

6. Two trained personnel and a Humvee equipped to fight a fire will be present on the installation during any training exercise at PTA.

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 Implementation Team will develop and the Army will implement a non-native invasive plant monitoring program within, and adjacent to, landing zones, trails, and roadsides. Newly identified non-native plants shall be eradicated using the most

effective means for those species. Monitoring and eradication methods for invasive alien plants will be included as part of the PTA Implementation Plan.

2. All vehicles will be thoroughly cleaned in the wash rack facility prior to returning to Oahu to minimize the risk of spreading non-native plant species (particularly *Pennisetum setaceum*). Vehicle washing will remove seeds and large clumps of soil that may have accumulated on the vehicles and minimize the spread of weeds. Once vehicles are washed in preparation for returning to Oahu, they shall travel only on paved roads until they reach the harbor for transport. Specific training will be provided and soldiers will be required to clean their gear and vehicles prior to arriving on the island of Hawaii and prior to returning to Oahu.

3. The Army will continue to implement an educational program regarding cleaning vehicles and field gear to all troops using the PTA installation (education materials will be reviewed and approved by the Service). PTA soldier briefing cards will be reviewed and updated to include the importance of clean equipment and clothes for the prevention of alien species spread and introductions.

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 as they arrive at PTA on the impacts that alien reptilian species, particularly brown treesnakes (*Boiga irregularis*), can have on Hawaii's environment. The Army shall require that all snake and lizard sightings be reported to the Army Natural Resources Office immediately. All reports of such observations will be investigated and results reported to the Service and the Hawaii Department of Land and Natural Resources - Division of Forestry and Wildlife and Hawaii Department of Agriculture.

2. The Army will require that all vehicles be washed in the wash rack facility at PTA prior to returning to the island of Oahu. This measure will minimize animals (*e.g.*, invertebrates) transported to Oahu from the island of Hawaii.

3. All plants or plant products shall be carefully inspected by staff from the Natural Resources Office to ensure that all materials are free of infestation from alien frogs, lizards or snakes. Plant products should only be purchased from pest-free plant vendors.

4. The Army will follow State and Federal pesticide regulations when using toxicants for alien species control or eradication associated with military operations or

natural resources management. All application will be pursuant to manufacturers directions and Army Standard Operating Procedures.

5. 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 pesticide to eradicate 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.

6. The Army shall provide assistance, possibly financial, to complete the registration and National Environmental Policy Act (NEPA) compliance for aerial broadcast of rodenticide at PTA. The Army has been an active participant and supporter of the efforts to obtain approval from the Environmental Protection Agency for conservation uses of rodenticides, including the registration of aerial broadcast, since the inception of the inter-agency Toxicant Working Group in 1993. The Army's natural resource management has greatly benefitted from the use of rodenticide in bait stations as a result of registrations obtained by the Toxicant Working Group. Aerial broadcast will significantly improve the Army's ability to achieve their conservation goals in a cost-effective manner. However, before this management tool can be used, the registration process must be completed, NEPA compliance completed, and early uses of aerial broadcast will need to be monitored for impact to the environment and non-target species. The details of the Army's assistance and involvement in the registry and NEPA compliance for aerial broadcast of rodenticide shall be addressed by the Implementation Team.

7. Once aerial rodenticides are approved by the Environmental Protection Agency and the Hawaii Department of Agriculture, Pesticides Branch, the Army shall treat fenced areas to include Kipuka Alala, Kipuka Kalawamauna, and the western fence unit annually with aerial broadcast of the rodenticide as allowed by the labels and where logistically feasible. The details of this measure will be addressed by the Implementation Team after product registration is complete. The Army will continue using bait stations and/or other appropriate methods of rodent control in the interim.

Reduction and Avoidance of Endangered Species from Foot Traffic

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

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

2. The Army will educate each set of new soldiers regarding the need to avoid listed species in order to minimize trampling/crushing of native vegetation, especially in Ranges 19, 22 and 23. Any new bivouac location will be surveyed for listed plants and an adequate buffer established as determined by the Implementation Team prior to use.

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

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. All plant material purchased by Integrated Training Area Management staff for revegetation shall be certified free of invasive species prior to moving the plants to any natural areas for planting. The certification will be outlined in the Implementation Plan and follow procedures previously established in the Makua Military Reservation Implementation Plan (U.S. Army Garrison 2003).

2. When using grass seed to revegetate an area, Integrated Training Area Management will periodically monitor these areas and immediately remove invasive plant species when observed.

3. The Army will maintain a minimum of 12 percent ground cover in off-road maneuver areas at PTA. This will be reviewed by the Implementation Team.

Palila Critical Habitat Minimization Measures

The Army will develop and implement the following measures to avoid and minimize impacts from Legacy and Transformation training to palila critical habitat:

1. A 75-meter (246-foot) buffer will be established along the southern edge of the Palila Critical Habitat Area B to reduce the impacts from Stryker off-road maneuvers. If it is determined, and agreed to by the Implementation Team, that Stryker use in this area does not result in adverse impacts to adjacent vegetation (pursuant to soil type, minimal numbers of vehicles being driven in this area, etc.) then the buffer can be reduced. However, if monitoring indicates that the buffer is being impacted by Stryker activity (indicating that the GPS on-board navigation system is insufficient to curtail Stryker incursion into the buffer), then a more obvious method of boundary demarcation will be necessary, such as Seibert stakes (41-centimeter (16-inch) piece of PVC pipe wrapped with bands of white, yellow and/or red reflective tape).

2. Smoking in palila critical habitat will be permitted only in designated, non-vegetated areas within firing points or bivouac sites to reduce the risk of ignition of wildfire. All cigarette butts will be disposed of in metal containers that shall be provided at each designated smoking area.

3. An experimental study shall be developed by the Implementation Team to determine whether rodents are limiting germination and recruitment of mamane. Methodology may include comparing mamane seed abundance, germination rate, and recruitment in areas with rodent control to areas without rodent control. The Implementation Team shall determine the timing of this study.

Construction Activities

The following measures will be a part of the construction and maintenance of all Transformation construction projects to minimize and avoid impacts to native vegetation and listed species:

1. All construction vehicles and earth-moving equipment will be thoroughly cleaned and inspected (to remove all soil and seeds) before moving on to PTA construction sites.

2. All construction equipment will be confined to the PTA area or subject to subsequent cleaning and inspection if moved offsite during construction.

3. Construction employees will be educated on the need to wear clean clothes and maintain clean vehicles.

4. If a construction site is within 75 meters (246 feet) of a listed plant occurrence, then construction grading or earth moving operations shall be sprayed with water to reduce airborn dust.

5. Natural Resources personnel will be consulted and approve all auxiliary construction support sites. Natural Resources personnel will inspect construction and auxiliary sites quarterly for alien species. If alien species are found, then appropriate eradication measures shall be immediately implemented.

6. Night-time construction activities will be coordinated with the Service.

7. The construction crews will follow the established Army protocols for proper use and disposal of petroleum, oils and lubricants when refueling or working on any construction equipment or vehicles.

STATUS OF THE SPECIES AND ENVIRONMENTAL BASELINE

The following section combines Status and Baseline discussions for palila critical habitat and the species as outlined in Table 2.

Table 2. Federally listed species covered in the PTA biological opinion.

Status	Scientific Name	Hawaiian/Common Name
Plants:		
Endangered	*Asplenium fragile* var. *insulare*	Fragile fern
Endangered	*Haplostachys haplostachya*	Honohono/Hawaiian mint
Endangered	*Hedyotis coriacea*	Kioele/leather leaf sweet ear
Endangered	*Isodendrion hosakae*	Aupaka
Endangered	*Lipochaeta venosa*	Nehe
Endangered	*Neraudia ovata*	Malaloa/spotted nettle bush
Endangered	*Portulaca sclerocarpa*	Poe, ihi, ihi makole
Threatened	*Silene hawaiiensis*	Hawaiian catchfly
Endangered	*Silene lanceolata*	Lanceleaf catchfly
Endangered	*Solanum incompletum*	Popolo, popolo ku mai
Endangered	*Spermolepis hawaiiensis*	Hawaiian parsley
Endangered	*Stenogyne angustifolia*	Creeping mint
Endangered	*Tetramolopium arenarium* ssp. *arenarium*	None
Endangered	*Vigna o-wahuensis*	Cowpea, Oahu vigna
Endangered	*Zanthoxylum hawaiiensis*	Ae/Hawaiian yellow wood
Animals:		
Endangered	*Lasiurus cinereus semotus*	Opeapea/Hawaiian hoary bat

Status of the Species - *Asplenium fragile* var. *insulare* (fragile fern)

Species Description *Asplenium fragile* var. *insulare* is a fern in the Aspleniaceae, or spleenwort family. It is a perennial plant that is delicate, small to medium-sized and terrestrial. The rhizomes

are decumbent and 3 to 12 millimeters (0.1 to 0.5 inch) in diameter. The fronds are 15 to 46 centimeters (6 to 18 inches) long and 1 to 3 centimeters (0.4 to 1.2 inches) wide. The fronds are often proliferous with one to many proliferations on the upper stipes and lower rachises. It can be differentiated from other *Asplenium* in Hawaii by its habitat; its narrow, long-linear, pale green fronds; dull gray or brown stipes with two greenish ridges on the upper surface; and occasional one to many plantlets on the upper stipes and lower rachises (Palmer 2003).

Listing Status *Asplenium fragile* var. *insulare* was federally and State-listed as an endangered species on September 9, 1994 (59 FR 49025). A recovery plan was adopted for this species in April 1998 (Service 1998a). Critical habitat was designated for this species on Maui on May 14, 2003, and on the island of Hawaii on July 2, 2003 (68 FR 25934; 68 FR 39624).

Historic and Current Distribution *Asplenium fragile* var. *insulare* was known historically from East Maui and from the island of Hawaii. Historically, the species was present on east Maui, recorded from the north slope of Haleakala and on Kanahau Hill (U.S. Army 2003a). On the island of Hawaii, *A. f.* var. *insulare* was found at Kalaieha, Laumaia, Keanakolu and Umikoa on Mauna Kea, Puu Waawaa on Hualalai, west Keawewai, above Kipuka Ahiu on Mauna Loa, and near Hilo. Currently on Maui there are two occurrences with 18 individuals found in Kalialinui within the East Maui Watershed Partnership. On the island of Hawaii, *A. f.* var. *insulare* is currently found in 17 occurrences with more than 600 individuals. There are 13 occurrences in PTA, one in Hawaii Volcanoes National Park, two just south of the Upper Waiakea Forest Reserve and the Mauna Loa Forest Reserve, and one occurrence in the Keokea section of the South Kona District (68 FR 25934; 68 FR 39624).

Ecology On Maui, *Asplenium fragile* var. *insulare* is found within streamside hollows and grottoes that occur in mesic to dry subalpine shrubland dominated by *Leptecophylla tameiameiae* and *Sadleria cyatheoides*, with scattered *Metrosideros polymorpha*. *Asplenium fragile* var. *insulare* has also been observed in montane wet ohia forest in rocky gulches in association with other fern species. *Asplenium fragile* var. *insulare* has been observed at elevations between 1,682 and 2,407 meters (5,518 and 7,897 feet).

On the island of Hawaii *Asplenium fragile* var. *insulare* grows in moist and dark areas in large lava tubes, pits, and deep cracks on varying ages of lava that have moderate soil or ash accumulation, and is associated with mosses and liverworts. The species can occasionally be found growing in the interface between young aa and older pahoehoe lava flow deposits. At PTA, the species is found in sparse or open *Metrosideros* Treeland, with shrub understory, *Myoporum-Dodonaea* or *Myoporum-Sophora* Shrublands, *Sophora-Myoporum-Chamaesyce* Shrubland, and *Leptecophylla-Dodonaea* Shrubland. Associated native plant species include *Dryopteris wallichiana*, and *Grammitis hookeri* (U.S. Army 2003a). Plants are frequently found growing in white mineral deposits of caves without any soil or ash accumulation. Reproductive cycles, longevity, specific environmental requirements, and limiting factors are unknown. No gametophytes (gamete-producing life stage) have been found, and the age-class

structure of the sublocations sampled at PTA was determined to be 100 percent reproductive adults (U.S. Army 2003a; 68 FR 25934).

Threats *Asplenium fragile* var. *insulare* is threatened by browsing by feral sheep and goats; competition for light, space and nutrients with *Pennisetum setaceum*; and habitat degradation or destruction when lava tubes or caves fill with debris and subsequent invasion by non-native plants. Fire and military operations also threaten this species, and, due to the small remaining number of occurrences and individuals, a single natural or human-caused environmental disturbance could be catastrophic to the species (U.S. Army 2003a).

Conservation Needs of the Species The most important conservation need of *Asplenium fragile* var. *insulare* is to protect high elevation lava tubes which includes construction of fenced exclosures around all known occurrences and/or control or removal of feral ungulates. The areas that are most important for protection include PTA, Keahou and Kulani forests and portions of Kapapala and Kau Forest Reserves. In addition, the following conservation actions are needed: propagation and maintenance of genetic stock *ex situ*, augmentation of extant occurrences and establishment of new occurrences within the species' historical range; control or eradication of non-native plants, protection from fire and human disturbance; implementation of a comprehensive monitoring program; surveys to identify individuals and/or occurrences that may exist in former habitats, or that may be present in areas that have not been surveyed recently. The establishment of Waihaka Natural Area Reserve and protection of its native habitat are much-needed conservation actions for *A. f.* var. *insulare* (Service 1998a). In addition, a State-wide management plan that identifies areas and landscapes for the long-term conservation of all known occurrences of *A. fragile* var. *insulare* is needed. As part of this management plan, landowners and managers should delineate management units to conserve this species and other native species through threat control and habitat restoration.

Ongoing Conservation Actions Propagation of *Asplenium fragile* var. *insulare* from spores has been initiated at Army facilities, the Harold L. Lyon Arboretum on Oahu and the Cincinnati Zoo and Botanical Gardens in Ohio. The preliminary results indicate that some spores will germinate and some gametophytes have developed into sporophytes. All plants in collections are from PTA, none are from Maui or other occurrences on the island of Hawaii. Conservation actions within the Olaa Kilauea Partnership are anticipated to protect and potentially allow for natural recruitment of *A. F.* var. *insulare*. A portion of Kapapala and Kau Forest Reserves (Waihaka) that is important for the protection of *A. f.* var. *insulare* and other native plants has been proposed, but not yet officially recommended, for inclusion in the State-wide Natural Area Reserve system.

Environmental Baseline

Status of the Species in the Action Area Currently, 605 plants are known to be in the action area in Training Areas 2, 21, 22, and 23 (see Figure 37 in the Transformation Biological Assessment), representing 93 percent of the naturally occurring *Asplenium fragile* var. *insulare* State-wide

(Evans 2003a; U.S. Army 2003a). The fern is found at PTA in the Kipuka Alala, near Kipuka Kalawamauna and Puu Koli, on the 1843 lava flow, and in palila critical habitat.

Threats in the Action Area While *Asplenium fragile* var. *insulare* is typically found in lava tubes and caves that are off-limits to military personnel, other threats to this species in the PTA action area include browsing by feral sheep and goats; competition with *Pennisetum setaceum*; and habitat degradation or destruction when lava tubes cave in or fill with debris, with subsequent invasion by non-native plants. Military actions increase the risk of fire, facilitate the spread of non-native plants, and increase dust deposition from military activities such as off-road maneuvers. A single natural disturbance or human-caused environmental disturbance from military action could be catastrophic for the species, as the majority of the extant individuals are found within the action area.

Conservation Needs in the Action Area An Implementation Plan for PTA will be developed (incorporating conservation actions from the existing Ecosystem Management Program Plan) and implemented to address long-term conservation needs of *Asplenium fragile* var. *insulare*. These management actions will include: fencing and subsequent control of feral ungulates; reduction of non-native invasive plants; monitoring known occurrences of *A. f.* var. *insulare*; and reducing training impacts particularly fire. Specifically, the Army should protect individual plants and occurrences of *A. f.* var. *insulare* and their habitat in lava tube entrances from feral ungulates by construction of fenced exclosures or grates and by increased hunting on the eastern portion of PTA. In addition, control or eradication of non-native plants, particularly *Pennisetum setaceum*, from the vicinity of all known *A. f.* var. *insulare* occurrences will reduce competition for space, light and nutrients. It will be necessary to propagate and outplant *A. f.* var. *insulare* to increase the number of individuals and conduct surveys to locate new occurrences of this species thereby locating new sites for reintroduction. Many areas at PTA have not been surveyed for biological resources so the current level of survey coverage should be considered incomplete. Outplanting should consist of multiple occurrences that replicate the existing density and known distribution for *A. f.* var. *insulare* within the action area. Managed occurrences should be established within the preferred substrate and plant community types known for *A. f.* var. *insulare* and free from the impacts of ungulates and non-native plants. The WFMP addresses the methods and protocols necessary to control the frequency, intensity, and size of fires on Army installations. However, as it is implemented the success and efficacy of the plan should be carefully monitored and modified, as appropriate, to continue reducing the threat of fire at PTA. A management plan for the control and localized eradication of non-native invasive plants will be completed as part of the Implementation Plan process.

Ongoing Conservation Actions Within the Action Area The Army has implemented an Ecosystem Management Program Plan that outlines priorities, project goals, and annual funding for management and monitoring of natural resources at PTA. This plan includes conservation actions for several federally listed plant species within the installation including *Asplenium fragile* var. *insulare*. The Natural Resources staff at PTA are currently monitoring this species within IMUs

11, 13, 14, and 15 (Figure 8) (U.S. Army 2003c). Several occurrences of *A. f.* var. *insulare* are located with the Kipuka Alala fence unit and the Army is currently removing the remaining ungulates within this enclosure (S. Gleason, pers. comm. 2003).

Status of the Species - *Haplostachys haplostachya* (honohono)

Species Description *Haplostachys haplostachya* is in the Lamiaceae, or mint family. It is an erect short-lived subshrub and grows to 3 to 6 decimeters (12 to 24 inches) tall. The leaves are fleshy, narrowly cordate and the upper surface is green, rugose, and densely puberlent. Leaf lower surfaces are densely white tomentose. The inflorescence is a raceme with white and tubular flowers. Reproduction is by seed and basal sprouts. The taxon is distinguished by its densely white tomentose stems (U.S. Army 2003a).

Listing Status *Haplostachys haplostachya* was federally and State-listed as an endangered species on October 30, 1979 (44 FR 62468). A recovery plan was drafted for this species in 1993 (Service 1993).

Historic and Current Distribution. *Haplostachys haplostachya* was once present on the islands of Kauai (mountains), Maui (sands of the low isthmus and at Kaula), and Hawaii (slopes of Mauna Kea, Nohonaohae cinder cone, and the plains of Waimea). Currently, the species is only known from 458 occurrences totaling approximately 13,956 individuals on the island of Hawaii (U.S. Army 2003a). All these occurrences are located within the action area (see Figure 38 in the Transformation Biological Assessment).

Ecology *Haplostachys haplostachya* grows in dry exposed areas on ash-veneered lava, very stony, shallow soils, and lava outcrops. It often establishes in large cracks on rocky ridges and on cinder cones (puu). *Haplostachys* was noted in 1880 as a component of the upper forest zone along with stunted vegetation, and in 1942 the taxon was described as being in the open forest and scrub zone. In 1990, the species was described as part of the *Dodonaea* montane shrubland habitat. On Hawaii, *H. haplostachya* is found in *Chamaesyce* Treeland, Open *Metrosideros* Treeland with dense shrub understory, open *Dodonaea* Shrubland, *Dodonaea* Mixed Shrubland, *Myoporum* Shrubland, and *Myoporum-Dodonaea* Shrubland vegetation types. The taxon occurs almost exclusively on old Mauna Kea flows, with one population on Mauna Loa pahoehoe lava (U.S. Army 2003a).

Haplostachys haplostachya may be sensitive to drought. Plants can survive low and moderate intensity fires (*i.e.*, the plants appear to be fire resistant). The success of the species following fire is due to its ability to resprout and its frequent location on rocky slopes. Fire in rocky areas tends to occur at low intensities because of low fuel load. However, fire coupled with drought appears to affect the species' ability to maintain population numbers. Life history information is limited.

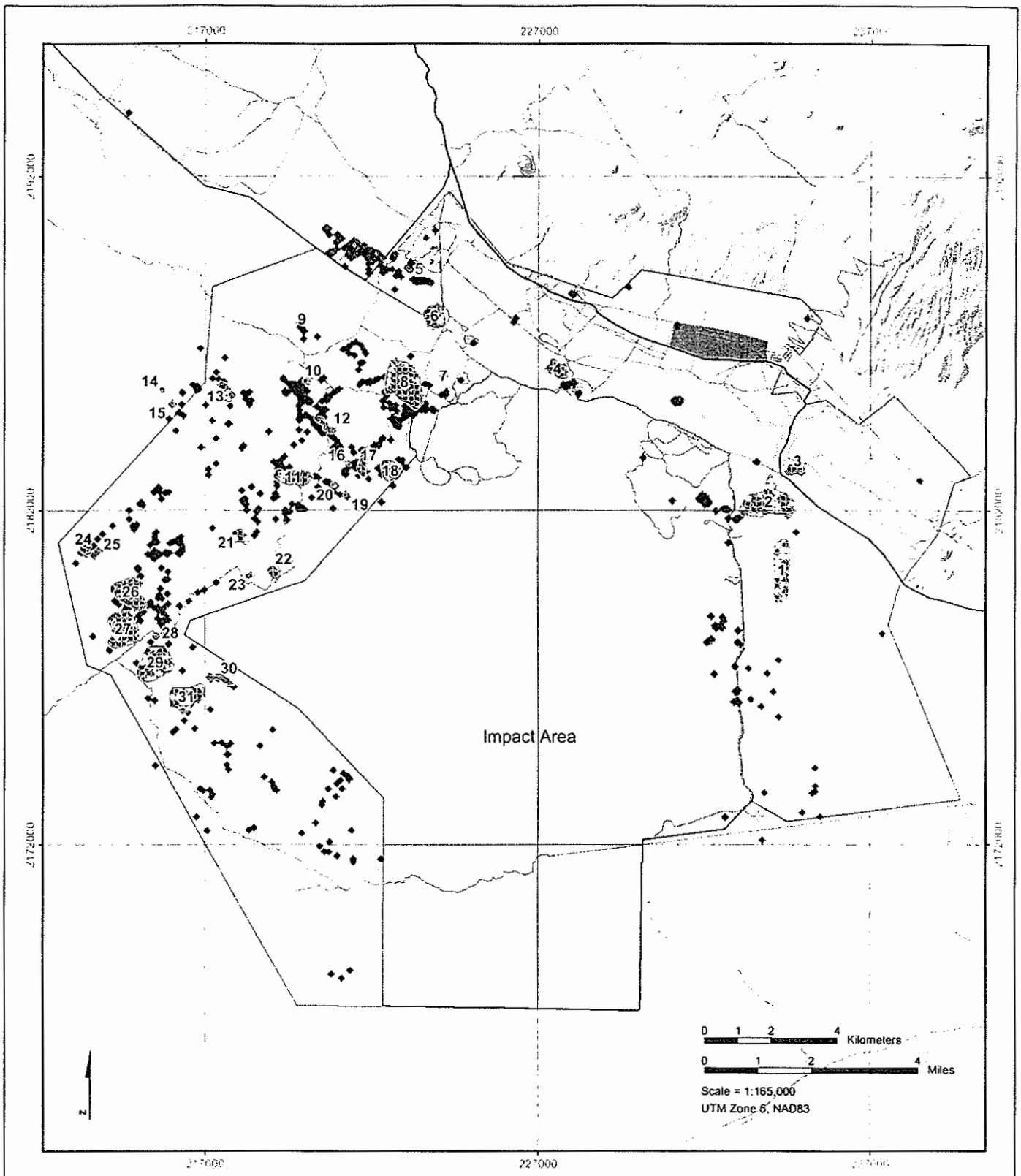
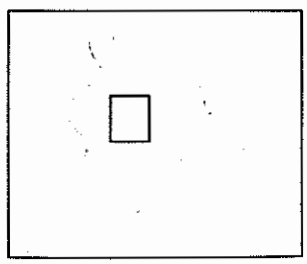


Figure 8 - Intensive Managed Units on PTA

- T & E Locations
- Other Roads
- Major Roads
- Intensive Management Unit
- Keamuku
- PTA Boundary
- Bradshaw Army Airfield
- Cantonment
- Impact Area



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

The species is present on the Keamuku parcel as vegetative plants, juveniles and mature plants, and in fruit and flower in July. Pollination vectors, longevity, seed viability, and dispersal mechanisms are unknown (U.S. Army 2003a).

Threats The primary threats to *Haplostachys haplostachya* are feral sheep and goats that browse on the flowers; rooting by feral pigs; competition for light, space, and nutrients by *Pennisetum setaceum* and other non-native plants; and invasion by and conversion of habitat to a fire-based vegetation community. Army training such as mounted and dismounted off-road maneuvers, bivouac, and live-fire training, increase the risk of fire, habitat fragmentation and alien plant seed spread. Off-road and on-road driving and training increases the level of dust (that can compromise plant health and vigor) due to the fine soils in northern PTA. Aphids and the introduction of mildew have been noted on the plants in the Keamuku parcel and on plants in greenhouse conditions. In addition, due to the very limited distribution of this species, a single natural or human-caused environmental disturbance could be catastrophic (U.S. Army 2003a).

Conservation Needs of the Species The following conservation actions are needed: fenced exclosures around all known occurrences of *Haplostachys haplostachya* to reduce impacts from feral ungulates; control and/or eradication of non-native plants, particularly *Pennisetum setaceum*; control of aphids and other non-native invertebrates and mildew in areas where these organisms threaten *H. haplostachya*; research on habitat requirements, population characteristics, viable population sizes and structure, and reproductive biology; and, establishment of additional viable occurrences within the historic range of the species (Service 1993). In addition, a State-wide management plan that identifies areas and landscapes for the long-term conservation of all known occurrences of *H. haplostachya* is needed. As part of this management plan, landowners and managers should delineate management units to conserve this species and other native species through threat control and habitat restoration. Propagation and maintenance of genetic stock *ex situ*, and surveys to identify individuals and/or occurrences that may exist in former habitats should be included in the management plan for this species.

Ongoing Conservation Actions The Volcano Rare Plant Facility has propagated 600 plants from wild-collected sources and 20 plants from cultivated sources (Service 2003a). Because the total population of *Haplostachys haplostachya* occurs within the action area additional ongoing conservation actions for this species are discussed below.

Environmental Baseline

Status of the Species in the Action Area Currently, there are approximately 13,950 plants in the action area occurring in Training Areas 7, 13, 17, 18, 19, 20, and 22, and in the Keamuku parcel on the Nohonaohae cinder cone (see Figure 38 in the Transformation Biological Assessment). These individuals are found in 458 occurrences and represent all known individuals of *Haplostachys haplostachya* in the State. The Service considers the existing individuals to compose one meta-population, with some outliers on the Keamuku Parcel and others to the east of the main population (Evans 2003a; U.S. Army 2003a).

Threats in the Action Area Because all remaining individuals of this species are located in the action area, the threats in the action area are the same as those listed above.

Conservation Needs in the Action Area An Implementation Plan shall be developed and implemented to include: 1) construction of fenced exclosures around all known occurrences to eliminate impacts from feral ungulates; 2) control and/or eradication of non-native plants, particularly *Pennisetum setaceum*, in the vicinity of all known occurrences of *H. haplostachya*; 3) reintroduction of propagated plants within the historic range of the species; 4) implementation of control measures for aphids and mildew on the plants on the Keamuku parcel, using the most current and effective methods available; and, 5) monitoring extant occurrences. The WFMP addresses the methods and protocols necessary to control the frequency, intensity, and size of fires on Army installations. However, as it is implemented the success and efficacy of the plan should be carefully monitored and modified, as appropriate, in order to continue reducing the threat of fire at PTA. A management plan for the control and localized eradication of non-native invasive plants will be completed as part of the Implementation Plan process.

In addition, the Implementation Team will outline the monitoring protocols for plants in the Keamuku Parcel, if that area is used for long-term training. Annual monitoring would assess population structure (plant height, number and type of reproductive structures, and age class), vigor, and damage. A large fence unit will be constructed to encircle most of the plants present in the western section of the installation and the southern corner of the Keamuku Parcel with the long-term acquisition of that area. In addition, the long-term affect of dust associated with off-road military vehicle maneuvers in the northern corridor needs to be evaluated on the plants located in the southwestern corner of the parcel.

Plants will be propagated by vegetative cutting and seed for outplanting. Germ plasm needs to be collected from plants in the Battle Action Course and used in propagation and outplanting. In addition, with long-term use of the Keamuku Parcel a fence will be constructed around the federally listed plant species on or near Puu Nohonaohae. Fencing, the removal of ungulates, and weeding will help minimize habitat degradation and reduce fire threat. Fire breaks and fuel breaks are planned and the clearing of non-native plants, including *Pennisetum setaceum* will be ongoing. All known plant locations will be visited and plant numbers documented by the end of 2005.

Ongoing Conservation Actions Within the Action Area The Army has 5,000 seeds from 20 plants from Puu Kapele in seed storage. They also have 10 plants in cultivation. The Army has developed and implemented an Ecosystem Management Program Plan that addresses management actions for the conservation of federally listed species on their property. *Haplostachys haplostachya* will be monitored during the 2003-2004 field season at IMUs 4, 5, 6, 10, 16, 17, and 18 (see Figure 8). The affect of *Pennistem setaceum* on *H. haplostachya* is evaluated at IMU 6 by removing non-native plants from three transect-plots and maintaining three control plots without any treatment. Plants will be partially or completely monitored depending on

density at the other sites. All non-native plants will be controlled in these IMUs. To date, all *P. setaceum* has been removed from Units 16, 17, and 18 (U.S. Army 2003a, 2003c).

Status of the Species - *Hedyotis coriacea* (kioele)

Species Description *Hedyotis coriacea* is in the Rubiaceae, or coffee family. It is a small, many-branched, erect shrub, with leathery leaves that are more or less oval-shaped. The leaves are hairless above, hairless or downy below, and 3 to 8 centimeters (1.2 to 3.2 inches) long with sheath-like petioles. Stipules are reduced and attached to the petiole base. Flowers are clustered, trumpet-shaped, cream colored, and fleshy. Fruits are cup or top-shaped, containing dark-brown, irregularly angled seeds. *Hedyotis coriacea* is distinguished from other species in the genus by its small flowers with triangular leaf-like appendages (calyx lobes) that do not enlarge when the fruit develops. The fruits are longer than wide and flower buds are square in cross-section (U.S. Army 2003a).

Listing Status *Hedyotis coriacea* was federally and State-listed as an endangered speceis on May 15, 1992 (57 FR 20772). A recovery plan was adopted for this species in July 1997 (Service 1997). Critical habitat for this species was designated on Maui and Oahu (68 FR 25934; 68 FR 35950).

Historic and Current Distribution Historically, *Hedyotis coriacea* was present on the islands of Oahu, Maui, and Hawaii. It is presently known from the islands of Maui and Hawaii. At least one plant is currently known on the island of Maui (West Maui Natural Area Reserve). On the island of Hawaii, plants are known from the Kipuka Kalawamauna Endangered Plants Habitat, along Charlie Circle, and near Kipuka Alala (U.S. Army 2003a).

Ecology *Hedyotis coriacea* is found on steep, rocky, slopes in dry *Dodonaea* Shrublands and forests on the island of Maui. On the island of Hawaii, the species occurs on pahoehoe lava flows in Sparse *Metrosideros* Treelands and Open *Metrosideros* Treelands with sparse to dense shrub understories. It is found at elevations from 1,500 to 1,700 meters (4,921 to 5,577 feet) at PTA. Associated species include *Metrosideros polymorpha*, *Leptecophylla tameiameiae*, *Alyxia oliviformis*, *Bidens menziesii*, *Gouania hillebrandii*, *Sida fallax*, *Melanthera lavarum*, *Myoporum sandwicense*, and *Schiedea menziesii*. Life history information is unknown, including flowering cycles, pollination vectors, seed dispersal agents, longevity, and environmental requirements. Immature and mature fruits have been observed in August, flowers in September, vegetative growth in December, and immature fruits and flowers in January 1999 (U.S. Army 2003a).

Threats The threats to *Hedyotis coriacea* includes browsing pressure from feral sheep and goats; habitat degradation by feral ungulates; introduction and expansion of invasive plant populations; military exercises that ignite fires which degrade habitat and subsequent invasion by non-native

plants; and due to the very limited distribution of this species, a single natural or human-caused environmental disturbance could be catastrophic (U.S. Army 2003a).

Conservation Needs of the Species The following important conservation actions are needed: 1) additional populations of *Hedyotis coriacea* should be established across the species' range to increase the number of individuals; 2) existing populations of *H. coriacea* should be protected by constructing ungulate exclosures; 3) control non-native plants species; and 4) monitor plants and habitat. Research should be conducted on pollinators, reproductive biology, and other possible limiting factors that affect this species including specific research to determine if this species is susceptible to direct or indirect damage by ants (Service 1997). In addition, a State-wide management plan that identifies areas and landscapes for the long-term conservation of all known occurrences of *H. coriacea* is needed. As part of this management plan, landowners and managers should delineate management units to conserve this species and other native species through threat control and habitat restoration.

Ongoing Conservation Actions There are 16 plants in cultivation at the Hawaii Department of Land and Natural Resources - Division of Forestry and Wildlife Maui baseyard. Ten of those plants are from seeds collected from the Lihau Natural Area Reserve on Maui and 6are cuttings from some of those 10 seedlings (U.S. Army 2003a).

Environmental Baseline

Status of the Species in the Action Area There are 90 individuals of *Hedyotis coriacea* located in Training Areas 22 and 23 and in the buffer area adjacent to the Impact Area (see Figure 39 in the Transformation Biological Assessment). These individuals represent 99 percent of the naturally occurring individuals remaining in the wild (Evans 2003a; U.S. Army 2003a).

Threats in the Action Area The threats outlined above in the Status section are the same for threats in the action area since nearly all of the remaining plants (99 percent) occur in PTA.

Conservation Needs in the Action Area An Implementation Plan shall be developed and implemented to include: 1) construction of fenced exclosures around all known occurrences to eliminate impacts from feral ungulates; 2) control non-native plants, particularly *Pennisetum setaceum*; 3) reintroduction of propagated plants within the historic range of the species; and 4) monitoring of extant occurrences. The WFMP addresses the methods and protocols necessary to control the frequency, intensity, and size of fires on Army installations. However, as it is implemented the success and efficacy of the plan should be carefully monitored and modified, as necessary, to continue reducing the threat of fire at PTA. A management plan for the control and localized eradication of non-native invasive plants will be completed as part of the Implementation Plan process. Outplanting should consist of multiple occurrences that replicate the existing density and known distribution for *Hedyotis coriacea* within the action area. Managed occurrences should be established within the preferred substrate and plant community types known for *H.*

coriacea within the action area. Occurrences should be established in areas free from the impacts of ungulates and non-native plant competition.

Ongoing Conservation Actions Within the Action Area The propagation facility at PTA has 150 plants in cultivation grown from seed collected from 20 individuals. They also have 500 seeds collected from 24 individuals in storage (Service 2003a). All but one of the known plants at PTA have been fenced with emergency exclosures unless they were already protected by a permanent fence to reduce the threat of browsing from feral ungulates. The Army has implemented an Ecosystem Management Program Plan that outlines priorities, project goals, and annual funding for management and monitoring of natural resources at PTA. This plan includes conservation actions for federally listed plant species within the installation. To date, *Pennisetum setaceum* had been removed from 25 meter buffers in IMUs 11 and 18. During the 2003-2004 field season, *Hedyotis coriacea* is to be monitored and all non-native invasive plant species will be controlled in IMUs 11, 12, 18, 19 - 23, 29, and 30 (see Figure 8). Surveys for additional plants is scheduled for the 2003-2004 field season in Unit 11 (L. Schnell, pers. comm.; U.S. Army 2003c).

Status of the Species - *Isodendrion hosakae* (aupaka)

Species Description *Isodendrion hosakae* is in the Violaceae, or violet family. It is a branched, upright, short-lived evergreen shrub. Plants range from 8 to 82 centimeters (3 to 32 inches) tall. Flowers and fruits occur on woody stems. Leaves are leathery and lance-shaped, measuring 3 to 7 centimeters (1.2 to 2.8 inches) long and 0.6 to 2.0 centimeters (0.2 to 0.8 in) wide. Stipules are persistent and conspicuously cover stem ends. Flowers are bilaterally symmetrical, yellowish-green to white, and up to 18 millimeters (0.7 inches) long. The fruit is a red-tinged, green elliptical capsule measuring 12 to 16 millimeters (4.7 to 6.3 inches) long, and contains obovoid seeds. *Isodendrion hosakae* is most similar to *I. pyrifolium* differing in leaf shape and size of lower flower petal (U.S. Army 2003a).

Listing Status *Isodendrion hosakae* was federally and State-listed as an endangered species on January 14, 1991 (56 FR 1454). A recovery plan was adopted for this species in June 1994 (Service 1994). Critical habitat was designated for this species on the island of Hawaii on July 2, 2003 (68 FR 39624).

Historic and Current Distribution. *Isodendrion hosakae* is limited in distribution to the South Kohala District on the island of Hawaii. The potential historical distribution of the taxon is not known, since it was only described some 50 years ago. The species is found on three cinder cones in the Waikoloa area to include Puu Papapa, Puu Nohonaohae, and an unnamed cone east-northeast of Nohonaohae (see Figure 40 in the Transformation Biological Assessment). The presence of this species was confirmed in 2002 on Nohonaohae cinder cone and Puu Papapa. (U.S. Army 2003a). The Service considers the existing individuals to be in one meta-population with several sub-populations.

Ecology *Isodendrion hosakae* occurs in areas that have been converted to pasture lands for many decades. The species is typically found on steep cinder cones, inaccessible to cattle and feral herbivore grazers but it was likely to have been more widely distributed before ungulates were introduced to Hawaii. The species occurs in dry montane shrublands dominated by *Dodonaea viscosa*, *Sophora chrysophylla*, *Wikstroemia* sp, and *Santalum* sp. Plants are often found within the crown of other native shrubs, suggesting a beneficial association. Currently, much of the habitat is now dominated by non-native grass species (*e.g.*, *Pennisetum setaceum*). *Isodendrion hosakae* has been observed at elevations from 900 to 1,030 meters (2,953 to 3,379 feet) (U.S. Army 2003a).

Threats The major threat to *Isodendrion hosakae* is browsing by cattle due to the species' presence on pasture land. Other threats include fire; browsing pressure from ungulates; competition with non-native plant species; and due to the very limited distribution of this species, a single natural or human-caused environmental disturbance could be catastrophic. At the occurrence with the largest number of individuals, severe damage from cattle was noted during a botanical survey conducted in 1988. Plants were broken, and only 25 to 50 plants out of more than 300 previously surveyed in 1980 and 1982, remained. The cinder cones and the species on them are particularly vulnerable to fire. For example, in 1999, fire consumed 95 percent of the Nohonaohae cinder cone vegetation and the occurrence of eight individuals of *I. hosakae* was reduced to a single plant. *Isodendrion hosakae* is also threatened by competition for light, space and nutrients from non-native plant species including *Pennisetum setaceum*, *Salsola kali*, and *Senecio madagascariensis* (U.S. Army 2003a).

Conservation Needs of the Species The following important conservation actions are needed: control threats from cattle and maintenance of ungulate-proof fences around each occurrence of *Isodendrion hosakae*; establishment of fire breaks and development of a fire response and suppression plan for Keamuku Parcel; establishment of a germ plasm reserve; control of *Pennisetum setaceum* and other non-native plants species; restoration of native habitat; and outplanting to enhance remaining wild occurrences and establishment of new occurrences within its historic range (Service 1994). In addition, a State-wide management plan that identifies areas and landscapes for the long-term conservation of all known occurrences of *I. hosakae* is needed. As part of this management plan, landowners and managers should delineate management units to conserve this species and other native species through threat control and habitat restoration.

Ongoing Conservation Actions Thirty-five plants are being grown in the micropropagation facility at the Harold L. Lyon Arboretum on Oahu, all from PTA plants. The Volcano Rare Plant Facility on the island of Hawaii has 22 plants in cultivation. In 2002, nine plants grown at that facility were planted on Puu Papapa (Service 2003a). Most of the 900 remaining plants in the State are within fence units to protect them from cattle grazing (U.S. Army 2003a).

Environmental Baseline

Status of the Species in the Action Area There are 871 individuals of *Isodendrion hosakae* in the

action area and all of these individuals are found in the Keamuku parcel on Nohonaohae and Papapa cinder cones. These individuals represent 97 percent of the naturally occurring individuals remaining in the wild (Evans 2003a; U.S. Army 2003a).

Threats in the Action Area In addition to the threats as outlined in the Status section above, effects of military actions are of additional concern because 97 percent of all remaining plants occur within the action area. If the Keamuku Parcel is utilized for more intensive Transformation training, particularly off-road maneuvers by Stryker vehicles, then additional threats for this species would include increased risk of fire, spread of non-native plant species, habitat fragmentation and dust. The majority of the soils in Keamuku are sandy and fine sandy loam which will crush easily and will create large dust plumes over large areas. Dismounted maneuvers and bivouac also increase the risk of fire, promote habitat fragmentation, disperse alien plant seeds, and potential trampling of seedlings and young plants. Other threats to *Isodendrion hosakae* include continued habitat degradation from cattle and feral ungulates, competition with non-native plant species, and wildfires (U.S. Army 2003a).

Conservation Needs in the Action Area If the Keamuku Parcel is utilized for Army training (leased or purchased) then the Implementation Plan shall include this species and address: 1) construction of fence exclosures around all known species occurrences to eliminate impacts from cattle and feral ungulates; 2) control of non-native plants, particularly *Pennisetum setaceum*; 3) reintroduction of propagated plants within the historic range of the species; and 4) monitoring extant occurrences. The WFMP has been finalized and addresses many proactive measures to reduce the risk of fire at PTA and the Keamuku Parcel. However, as it is implemented the success and efficacy of the plan should be carefully monitored and modified, as necessary, to continue reducing the threat of fire on the installation. A management plan for the control and localized eradication of non-native invasive plants will be completed as part of the Implementation Plan process. Outplanting should consist of multiple occurrences that replicate the existing density and known distribution for *Isodendrion hosakae* within the action area. These occurrences should be established within the preferred substrate and plant community types for *I. hosakae* in the action area. Occurrences should be established in areas free from ungulate impacts and non-native plant competition.

Ongoing Conservation Actions Within the Action Area The puu in the Keamuku Parcel are fenced to restrict cattle; however, sheep and goats are still able to access the sites. Locations in the Keamuku Parcel were surveyed (Arnett 2002b) and plants were categorized by life stage, phenology, indication of browse, and the presence of disease. No other ongoing conservation measures are known for this species.

Status of the Species - *Lipochaeta venosa* (nehe)

Species Description *Lipochaeta venosa* is in the Asteraceae, or aster family. It is a low-growing, perennial herb with curved, spreading stems that are 50 centimeters (20 inches) long. The species is partly deciduous and loses leaves during periods of drought. The leaves are triangular with two

basal lobes, pinnately dissected throughout, and 2.1 to 2.8 centimeters (0.8 to 1.1 inches) long and 1.5 to 2.2 centimeters (0.6 to 0.9 inch) wide. The upper surface of the leaves has minute, straight, appressed hairs. On the lower surface, the hairs are denser. Flower heads are solitary or in clusters of two. Ray floret achenes are 2 to 2.4 millimeters (0.08 to 0.09 inch) long and 1.5 to 1.8 millimeters (0.06 to 0.07 inch) wide with minute wings. The disk floret achenes are about the same size but wingless. *Lipochaeta venosa* is closely related to *L. subcordata*, a species that occurs on the islands of Hawaii and Kauai, and formally Lanai. The two species can be distinguished by leaf morphology (U.S. Army 2003a).

Listing Status *Lipochaeta venosa* was federally and State-listed as an endangered species on October 30, 1979 (44 FR 62468). A recovery plan was adopted for this species in June 1994 (Service 1994).

Historic and Current Distribution *Lipochaeta venosa* is a narrow endemic species found on the island of Hawaii. The taxon was first collected at the Nohonaohae cinder cone. The species was later found on Puu Holoholoku and an unnamed puu, the Heihei cinder cone, and the 1859 Mauna Kea lava flow. Currently, the species is known from five occurrences on the Keamuku Parcel and Parker Ranch including Puu Papapa, Puu Holoholoku, Puu Heihei, Puu Nohonaohae, and an unnamed puu east-northeast of Nohonaohae (see Figure 41 in the Transformation Biological Assessment). All occurrences are on the leeward side, northwest flank of Mauna Kea (U.S. Army 2003a).

Ecology *Lipochaeta venosa* is typically found on cinder cones in montane dry shrublands, dominated by non-native grasses (*e.g.*, *Pennisetum setaceum*) with some native shrubs (*e.g.*, *Dodonaea viscosa*, *Chenopodium oahuense*, and *Osteomeles anthyllidifolia*), typically at elevations from 725 to 1,136 meters (2,379 to 3,727 feet). In the absence of grazing pressures this species most likely would be more widespread. On the Keamuku Parcel, the species occurs on very stony soils of a cinder cone. The species is known to rootsprout and can recolonize areas following fire.

Lipochaeta venosa is known to flower between March and June, but flowering periods may extend beyond this period. In 2002, plants were noted flowering in July. Most plants found on the Nohonaohae cinder cone were mature during the 2002 survey. Flowers do not appear to be specialized. The species roots readily in greenhouse cultivation indicating that vegetative reproduction may occur in nature (U.S. Army Garrison 2002).

Threats The primary threat to *Lipochaeta venosa* today is grazing and trampling by cattle and ungulates, which is thought to have strongly influenced the species distribution. The species has also been impacted by habitat loss and modification due to land conversion, competition with non-native plant species (particularly *Pennisetum setaceum)*, and wildfires. Cinder cone mining, military activities, and ranching pressures are all continuing threats to *L. venosa*. Due to the very

limited distribution of this species, a single natural or human-caused environmental disturbance could be catastrophic and the species could be lost (U.S. Army 2003a).

Conservation Needs of the Species Important conservation actions needed for *Lipochaeta venosa* include the following: identified threats must be controlled by construction and maintenance of ungulate-proof fences around each occurrence; establishment of fire breaks and development of a fire response and suppression plan for all sites; establishment of a germ plasm reserve; control of *Pennisetum setaceum* and other non-native plants species; restoration of native habitat; outplanting to enhance remaining occurrences and establishment of new occurrences within its historic range (Service 1994). In addition, a State-wide management plan that identifies areas and landscapes for the long-term conservation of all known occurrences of *L. venosa* is needed. As part of this management plan, landowners and managers should delineate management units to conserve this species and other native species through threat control and habitat restoration.

Ongoing Conservation Actions The Volcano Rare Plant Facility has 102 plants in cultivation from the Nohonaohae occurrence. In 2002, 110 plants grown at that facility were planted to augment the existing occurrence (Service 2003a). The puu on the Parker Ranch in the Keamuku Parcel are fenced to restrict cattle. The Keamuku Parcel was surveyed (Arnett 2002b) and plants were categorized by life stage, phenology, indication of browse, and the presence of disease. No other conservation measures for this species are known.

Environmental Baseline

Status of the Species in the Action Area There are approximately 3,346 known individuals within the action area located in the Keamuku Parcel on Nohonaohae cinder cone. These occurrences represent 98 percent of the naturally occurring individuals remaining in the wild (Evans 2003a; U.S. Army 2003a).

Threats in the Action Area In addition to the threats as outlined in the Status section above, effects of military actions are of additional concern because 98 percent of all remaining plants occur within the action area. If the Keamuku Parcel is utilized for more intensive Transformation training, particularly off-road maneuvers by Stryker vehicles, then additional threats to this species would include increased risk of fire, spread of non-native plant species, habitat fragmentation and dust. The majority of the soils in Keamuku are sandy and fine sandy loam which crush easily and create large dust plumes over large areas. Other threats to *Lipochaeta venosa* include continued habitat degradation by feral ungulates, cattle and competition with non-native plant species.

Conservation Needs in the Action Area If the Keamuku Parcel is either leased or purchased, *Lipochaeta venosa* shall be included in the Implementation Plan to address the following management issues: 1) construction of fenced exclosures around all known occurrences to eliminate impacts from cattle and feral ungulates; 2) control and/or eradication of non-native plants, particularly *Pennisetum setaceum*, in the vicinity of all known occurrences of *L. venosa*; 3)

reintroduction of propagated plants within the historic range of the species; and 4) monitoring extant occurrences within the puu. The WFMP addresses the methods and protocols necessary to control the frequency, intensity, and size of fires on Army installations. The WFMP also includes measures to reduce the risk of fire on the Keamuku Parcel. However, as it is implemented the success and efficacy of the plan should be carefully monitored and modified, as necessary, to continue reducing the threat of fire at PTA. A management plan for the control and localized eradication of non-native invasive plants will be completed as part of the Implementation Plan process. Multiple plant occurrences should be outplanted that replicate the existing density and known distribution of *L. venosa*. These new occurrences should be located within the preferred substrate and plant community types known for *L. venosa*, free of ungulates and non-native plants.

Ongoing Conservation Actions Within the Action Area The Keamuku Parcel is privately owned; therefore, conservation measures cannot be conducted by the Army until the land is leased or purchased. There are fences around Puu Papapa and Nohonaohae; however, only cattle are excluded as goats and sheep can still access the site (S. Gleason, pers. comm., 2003). A few locations in the Keamuku Parcel were surveyed (Arnett 2002b) and plants were categorized by life stage, phenology, indication of browsing, and presence of disease.

Status of the Species - *Neraudia ovata* (spotted nettlebrush)

Species Description *Neraudia ovata* is in the Urticaceae, or nettle family. It is a sprawling, rarely erect, shrub with 1 to 3 meters (3.3 to 10 feet) long stems or it can develop into a small tree. The leaves are grayish to greenish on the lower surface, thin, ovate to elliptic-ovate or elliptic. They are 4 to 12 centimeters (1.6 to 4.7 inches) long and 2.0 to 6.4 centimeters (0.8 to 2.5 inches) wide. This species is mostly dioecious, male and female flowers occurring on separate plants. Male flowers are short with a densely haired calyx and female flowers are sessile, are also densely haired, and have a boat-shaped calyx. The fruit is an achene. The lack of a conspicuous tuft of hairs at the base of the leaves, the distribution of the hairs on the lower surface, and the shape of the female flower are diagnostic characteristics for the *N. ovata* (U.S. Army 2003a).

Listing Status *Neraudia ovata* was federally and State-listed as an endangered species on October 10, 1996 (61 FR 53137). A recovery plan was adopted for this species in May 1998 (Service 1998b). Critical habitat was designated for *N. ovata* in July 2003 (68 FR 39624).

Historic and Current Distribution *Neraudia ovata* is known currently and historically only from the island of Hawaii. The species is found on the Kona coast from North Kona to Kau. There are only 13 individuals persisting on the island of Hawaii. There is one individual in Kaloko, North Kona; one individual in the Manuka Natural Area Reserve; 10 individuals in three locations at PTA, and one individual on State land outside of PTA (U.S. Army 2003a).

Ecology *Neraudia ovata* occurs in dry forests, on open lava flows, and in subalpine forests on the leeward side of the island of Hawaii at elevations from 115 to 1,520 meters (377 to 4,987 feet). At PTA, the species grows in Open *Metrosideros* Treelands with a sparse shrub understory and in *Myoporum* Shrublands. Most plants are found on Mauna Loa aa flows that are approximately 4,000 years old (U.S. Army 2003a).

Plants have been observed in vegetative form during fall and winter, and in flower and fruit during spring and summer. Limited observations suggest plants are not truly dioecious, but facultatively monoecious, bearing male and female flowers at different times on the same plant (U.S. Army 2003a).

Threats The threats to *Neraudia ovata* are heavy browsing and the resulting habitat modification by feral sheep and goats; competition from non-native species such as *Pennisetum setaceum*, *Leucaena leucocephala*, and *Schinus terebinthifolius*; insect damage (*e.g.*, from *Aleurodicus dispersus*; spiraling whitefly); reduced reproductive vigor; residential development; fire; and due to the very limited distribution of this species, a single natural or human-caused environmental disturbance could be catastrophic (U.S. Army 2003a).

Conservation Needs of the Species Important conservation actions needed for *Neraudia ovata* include the following: protective fences to be constructed around the known occurrences of *N. ovata*, and removal of feral ungulates and non-native plants from habitat. A commitment from all landowners on whose land this species grows should be developed for long-term stewardship and conservation of these areas once they have been enclosed. Insect damage must be controlled, such as that caused by the spiraling whitefly. In addition, the following conservation actions are needed: propagation and maintenance of genetic stock *ex situ*; augmentation of extant occurrences and establishment of new occurrences within the species' historical range; control or eradication of non-native plants; protection from fire and human disturbance; implementation of a comprehensive monitoring program; surveys to identify individuals and/or occurrences that may exist in former habitats, or that may be present in areas that have not been surveyed recently (Service 1998b). A State-wide management plan that identifies areas and landscapes for the long-term conservation of all known occurrences of *N. ovata* is needed. As part of this management plan, landowners and managers should delineate management units to conserve this species and other native species through threat control and habitat restoration.

Ongoing Conservation Actions The Volcano Rare Plant Facility has three plants in cultivation from the Manuka population and eight plants from the Kona population. Fifteen plants grown at the facility were outplanted at Manuka in 2002. The Hawaii Department of Agriculture has conducted a very successful biocontrol program for the spiraling whitefly which has significantly reduced damage caused by this insect. The spiraling whitefly remains a problem on certain preferred host plants, particularly in the summer, or on windy coastal areas where biocontrol efforts are not effective (Service 1998b).

Environmental Baseline

Status of the Species in the Action Area There are 10 individuals in the action area in Training Area 22 and west of Training Area 22, representing 77 percent of the naturally occurring individuals State-wide (see Figure 42 in the Transformation Biological Assessment) (Evans 2003a; U.S. Army 2003a).

Threats in the Action Area The threats to *Neraudia ovata* include heavy browsing and the resulting habitat modification by feral sheep and goats; competition from non-native species such as *Pennisetum setaceum*, *Leucaena leucocephala*, *Kalanchoe tubiflora*, and *Schinus terebinthifolius*; insect damage (*e.g.*, spiraling whitefly); military training activities that increase the risk of wildfire; reduced reproductive vigor; and, due to the very limited distribution of this species, a single natural or human-caused environmental disturbance could be catastrophic.

Conservation Needs in the Action Area An Implementation Plan will be developed and implemented to address long-term conservation needs of *Neraudia ovata*. These management actions will include: fencing and subsequent control of feral ungulates; reducing of non-native invasive plant species; monitoring occurrences of *N. ovata*; and reducing training impacts; particularly fire. It will be necessary to propagate and outplant *N. ovata* to increase the number of individuals and conduct surveys to search for new occurrences of this species and new sites for reintroduction. Outplanting should consist of multiple occurrences that replicate the existing density and known distribution for this species within the action area. Managed occurrences should be established within the preferred substrate and plant community types known for *N. ovata*. The WFMP addresses the methods and protocols necessary to control the frequency, intensity, and size of fires on Army installations. However, as it is implemented, the success and efficacy of the plan should be carefully monitored and modified to continue reducing the threat of fire on the installation. A management plan for the control and localized eradication of non-native invasive plants will be completed as part of the Implementation Plan process.

Ongoing Conservation Actions Within the Action Area The PTA propagation facility has 45 plants (from seven local individuals) in cultivation. There are 300 seeds from four individuals in seed storage (Service 2003a). The Army is implementing the Ecosystem Species Management Plan for PTA that outlines their current management for natural resources within PTA proper. Ungulate threats to all *Neraudia ovata* plants at PTA have been minimized with "hasty" fences that prevent ungulate browsing. *Pennisetum setaceum* and *Kalanchoe tubiflora* as well as other non-native plants in the IMUs are being removed from around plants (Evans *et al* 2002). Large areas, of approximately one hectare (three acres), have been cleared of non-native invasives around each hasty fence exclosure to reduce the fire threat and improve the adjacent habitat. Twelve juvenile plants are watered on a monthly basis. These management actions have been ongoing for the last 18 months (U.S. Army Garrison 2002). During the 2003-2004 field season IMUs 14 and 24 are scheduled to be visited and all plants located will be monitored and non-native plants controlled in these units (see Figure 8). *Pennisetum setaceum* has been removed from the these IMUs. Approximately 200 individuals will be outplanted in IMUs 30, and 31. A

rodent control grid has been established around each plant since 2002 (L. Schnell, per. com., U.S. Army 2003c).

Status of the Species - *Portulaca sclerocarpa* (poe)

Species Description *Portulaca sclerocarpa* is in the Portulacaceae, or purslane family. It is a short, generally herbaceous perennial that has a fleshy tuberous taproot that becomes woody. Its stems are up to 20 centimeters (7.9 inches) long. The species has stalkless, succulent, grayish-green leaves that are almost circular in cross-section. Dense tufts of hairs are located in each leaf axial and underneath the tight clusters of three to six stalkless flowers. The flowers are grouped at the end of the stalk and petals are white, pink, or pink with a white base. The sepals are 5 millimeters (0.2 inch) long with membranous edges. The hardened capsules are 5 millimeter (0.2 inch) long, and have thick walls that open late or not at all. The species is closely related to *P. villosa*, differing in the thickness of the capsule wall, the length of the capsule, and the capsule of *P. sclerocarpa* is indehiscent or tardily indehiscent (U.S. Army 2003a).

Listing Status *Portulaca sclerocarpa* was federally and State-listed as an endangered species on March 4, 1994 (59 FR 10305). A recovery plan was finalized for this species in September 1996 (Service 1996a). Critical habitat was designated for this species on Lanai in January 2003 and the island of Hawaii in July 2003 (68 FR 1220; 68 FR 39624).

Historic and Current Distribution The historic and current locations of *Portulaca sclerocarpa* are limited to the islands of Lanai and Hawaii. On the island of Lanai, plants are found on the Poopoo Islet. On the island of Hawaii, the species occurs in the Nohonaohae area, at Puu Anahulu, near Puu Keani and Lehua, and at PTA (see Figure 43 in the Transformation Biological Assessment). At PTA, the species occurs in Kipuka Kalawamauna Endangered Plant Habitat, north and west of Kipuka Alala, and on the 1859 Mauna Kea lava flow (U.S. Army 2003a).

Ecology *Portulaca sclerocarpa* is found in montane dry shrublands, often on bare cinder, near steam vents, and in open *Metrosideros polymorpha* woodlands from 1,030 to 1,630 meters (3379 to 5,348 feet) in elevation. At PTA, the species is found on barren lava and in the Sparse *Metrosideros* Treeland, Open *Metrosideros* Treeland with sparse shrubs understory, Open *Metrosideros* Treeland with dense shrub understory, Intermediate *Metrosideros* Mixed Treeland, and the *Myoporum* Shrubland vegetation types. Little is known about the life history of the species. Flowers have been observed in March, June, and December. Juveniles are present in some locations, indicating reproduction is taking place (U.S. Army 2003a).

Threats The major threats to *Portulaca sclerocarpa* are competition from non-native grasses, such as *Pennisetum setaceum* and *Andropogon virginicus*; trampling and habitat disturbance from feral sheep, goats, and pigs; habitat disturbance associated with military exercises; and fire. Plant grazing has not been observed, but it has been suggested that trampling by feral animals may damage the understory, destroy plants, and open sites to non-native species (U.S. Army 2003a).

Conservation Needs of the Species The following important conservation actions are needed: continued propagation and maintenance of *ex situ* genetic stock of *Portulaca sclerocarpa*, protection of habitat from feral ungulates, and control of non-native grasses. Efforts should be made to ensure that both the Lanai and island of Hawaii populations remain viable. Outplanting of propagated plants may be necessary in order to augment populations (Service 1996a). In addition, a State-wide management plan that identifies areas and landscapes for the long-term conservation of all known occurrences of *P. sclerocarpa* is needed. As part of this management plan, landowners and managers should delineate management units to conserve this species and other native species through threat control and habitat restoration.

Ongoing Conservation Actions The Service is unaware of any conservation actions being carried out for this species other than those being done at PTA.

Environmental Baseline

Status of the Species in the Action Area *Portulaca sclerocarpa* was known to occur on Nohonaohae cinder cone and Puu Papapa in 1982, but is now absent from this area. There are 22 individuals located in Training Area 22, representing approximately two percent of the naturally occurring individuals State-wide (Evans 2003a; U.S. Army 2003a).

Threats in the Action Area The main threats to *Portulaca sclerocarpa* in the action area are the increased risk of fire from military training activities such as live-fire training, bivouac and mounted and dismounted maneuvers. These training actions can degrade native habitats and spread invasive plants which outcompete native species. Ungulates are also a threat to this species mostly due to trampling and subsequent habitat disturbance (U.S. Army 2003a).

Conservation Needs in the Action Area Propagation and maintenance of *ex situ* genetic stock of *Portulaca sclerocarpa* should continue. Habitat of this species should be protected from feral ungulates which would enable natural recruitment of seedlings. The WFMP addresses the methods and protocols necessary to control the frequency, intensity, and size of fires on Army installations. However, as it is implemented the success and efficacy of the plan should be carefully monitored and modified, as necessary, to continue reducing the threat of fire at PTA. A management plan for the control and localized eradication of non-native invasive plants will be completed as part of the Implementation Plan process.

Ongoing Conservation Actions Within the Action Area The PTA propagation facility has 65 cultivated plants propagated from 10 naturally occurring individuals. They also have 5,000 seeds collected from eight individuals in storage (Service 2003a). The Army developed and implements an Ecosystem Management Program Plan that addresses management actions for the conservation of federally listed species on their property. In the upcoming year *Portulaca sclerocarpa* will be monitored at IMUs 24, 25, and 28 (see Figure 8). Non-native plants will be removed from these IMUs (U.S. Army 2003c).

Status of the Species - *Silene hawaiiensis* (Hawaiian catchfly)

Species Description *Silene hawaiiensis* is in the Caryophyllaceae, or pink family. It is a sprawling, short-lived shrub with slanting or climbing stems approximately 15 to 40 centimeters (6 to 16 inches) long that arise from an enlarged root, and are generally covered with short, sticky hairs. Leaves are slender, often recurved, and stalkless. The stems are 6 to 15 millimeters (0.2 to 0.6 inch) long and 0.5 to 0.8 millimeters (0.02 to 0.03 inch) wide. Flowers are borne in loosely arranged, elongate, sticky clusters. The calyx is fused, five-toothed, purple-tinged, and 11 to 14 millimeters (0.02 to 0.03 inch) long. Petals are green-white above and sometimes maroon or maroon-streaked below. Each petal is divided into two parts, a two-lobed expanded blade and a long narrow, stalk-like base (U.S. Army 2003a).

Listing Status *Silene hawaiiensis* was federally and State-listed as a threatened species on March 4, 1994 (59 FR 10305). A recovery plan was adopted for this species in September 1996 (Service 1996a). Critical habitat was designated for *S. hawaiiensis* on the island of Hawaii on July 2, 2003 (68 FR 39624).

Historic and Current Distribution *Silene hawaiiensis* is endemic to the island of Hawaii. The species can be found on the western slopes of Mauna Kea; the Hualalai summit and Humuula saddle; the northern, western, and northwestern slopes of Mauna Loa; and near the Kilauea Crater. Currently more than 50 occurrences are known in a 200-square kilometer (77-square mile) area (U.S. Army 2003a).

Ecology *Silene hawaiiensis* typically grows in montane and subalpine dry shrublands on decomposed lava and ash, as well as on all ages of lava and cinder substrates at elevations from 900 to 1,300 meters (2,953 to 4,265 feet). The species is found on barren lava, on disturbed sites, and in Sparse *Metrosideros* Treelands, Open *Metrosideros* Treelands with sparse shrub understory, Open *Metrosideros* Treelands with dense shrub understory, *Chenopodium* Shrublands, Open *Dodonaea* Shrublands, *Dodonaea* Mixed Shrublands, *Sophora-Myoporum* Shrublands with forb understory, *Leptecophylla-Dodonaea* Shrublands, and *Eragrostis* Grasslands. Life history information is limited. Flowering has been observed in August and September. Most plants surveyed have been adults. The species is considered short-lived; however, the plant may be longer lived than originally thought because it can sprout from a large, woody taproot. The species has also been documented to resprout following fire (U.S. Army 2003a).

Threats Threats to *Silene hawaiiensis* include sheep, goats, and pigs browsing and trampling (browsing can be severe to the base of the plant, as mouflon sheep and feral pigs are known to root up and consume the fleshy taproot); competition by non-native plant species such as *Pennisetum setaceum*; disturbances associated with military exercises; fire; and property development (U.S. Army 2003a).

Conservation Needs of the Species Important conservation actions needed for *Silene hawaiiensis* include the following: construction of fenced exclosures around important occurrences to reduce impacts from feral ungulates and control and/or eradication of non-native plants, particularly *Pennisetum setaceum* to reduce threats from competition, habitat degradation, and fire (Service 1996a). In addition, a State-wide management plan that identifies areas and landscapes for the long-term conservation of all known occurrences of *S. hawaiiensis* is needed. As part of this management plan, landowners and managers should delineate management units to conserve this species and other native species through threat control and habitat restoration.

Ongoing Conservation Actions The Volcano Rare Plant Facility has 13 plants in cultivation that were propagated from a population at the Mauna Loa Radio Facility and about 100 seeds still germinating from that same location (Service 2003a). The Center of Environmental Management of Military Lands, Colorado State University is documenting all locations and condition (*e.g.*, vigor, browse, disease) of this species. Research has been proposed to establish population distribution and genetic diversity of this species on the island of Hawaii (C. Bern, pers. comm.).

Environmental Baseline

Status of the Species in the Action Area There are approximately 14,835 individuals of *Silene hawaiiensis* in Training Areas 3, 9, 10, 11, 12, 13, 16, 21, 23 and in the Bradshaw Army Airfield (see Figure 44 in the Transformation Biological Assessment). These occurrences represent approximately 71 percent of all naturally occurring individuals State-wide (Evans 2003a; U.S. Army 2003a).

Threats in the Action Area The major threats to this species in the action area include increased risk of fire from mounted and dismounted maneuvers and bivouac. Military actions can also result in habitat fragmentation, dispersal of alien plant seeds, and increased potential for trampling of plants. Other threats to *Silene hawaiiensis* include continued habitat degradation by feral ungulates, competition with non-native plant species, and browsing by sheep and goats which is particularly detrimental to this species because plant stems are fragile and easily broken.

Conservation Needs in the Action Area An Implementation Plan will be developed and implemented and will include: 1) construction of fenced exclosures for a majority of the known occurrences to eliminate impacts from feral ungulates; 2) control of non-native plants, particularly *Pennisetum setaceum*; 3) reintroduction of propagated plants within the historic range of the species; and, 4) monitoring extant occurrences. The WFMP addresses the methods and protocols necessary to control the frequency, intensity, and size of fires on Army installations. However, as it is implemented the success and efficacy of the plan should be carefully monitored and modified, as necessary, to continue reducing the threat of fire at PTA. A management plan for the control and localized eradication of non-native invasive plants will be completed as part of the Implementation Plan process.

Ongoing Conservation Actions in the Action Area The propagation facility at PTA has 6,000 seeds in storage that were collected from four plants growing on the installation (Service 2003a). The Army has implemented an Ecosystem Management Program Plan that outlines priorities, project goals, and annual funding for management and monitoring of natural resources at PTA. This plan includes conservation actions for federally listed plant species within the installation including *Silene hawaiiensis*. *Pennisetum setaceum* has been removed from IMU 3. A fence exclosure has been constructed and ungulates have been removed to protect approximately 5,000 *S. hawaiiensis* plants located by Saddle Road and Mackenzie Trail (near Lava Ridge). *Silene hawaiiensis* occurs at nine locations within the existing Kipuka Alala Fence Unit and ungulate control is currently ongoing. During the 2003-2004 field season *S. hawaiiensis* will be monitored or re-surveyed at IMUs 1-4, and 29 (see Figure 8). These IMUs contain the highest densities of *S. hawaiensis* at PTA. Non-native plants will be removed from the IMUs as they are found. Approximately 200 individuals will be outplanted in 2004 in an area yet to be determined (U.S. Army 2003c).

Status of the Species - *Silene lanceolata* (lance-leaf catchfly)

Species Description *Silene lanceolata* is a member of the Caryophyllaceae, or pink family. It is an upright, suffrutescent, perennial shrub with stems that range in length from 15 to 50 centimeters (6 to 20 inches). Leaves are 25 to 80 millimeters (1 to 3 inches) long and 2 to 11 millimeters (0.08 to 0.4 inch) wide and are fringed with hairs. Flowers are arranged in open clusters with stalks 8 to 23 millimeters (0.3 to 0.9 inch) long. The calyx is 5-toothed, 10-veined, and approximately 6 millimeters (0.2 inch) in length. Capsules are approximately 8 to 9 millimeters (0.3 inch) long and dehisce at the top. *Silene lanceolata* is distinguished from *S. alexandri* (a closely related species) by its smaller flowers and capsules, and stamens which are shorter than its sepals (U.S. Army 2003a).

Listing Status *Silene lanceolata* was federally and State-listed as an endangered species on October 8, 1992 (57 FR 46325). A recovery plan for this species and others on the island of Hawaii was finalized on September 26, 1996 (Service 1996b). Critical habitat was designated for *S. lanceolata* on the island of Hawaii on July 2, 2003 (68 FR 39624).

Historic and Current Distribution Historically, the species was known from Kauai, Oahu, Molokai, Lanai, and Hawaii. Currently, only 640 to 1,140 individuals of *Silene lanceolata* persist State-wide. Approximately 40 individuals can be found on Oahu, 100 individuals remain on Molokai, and 500 to 1,000 individuals occur on the island of Hawaii (U.S. Army 2003a).

Ecology On the island of Molokai, the species occurs on cliff faces and ledges of gullies in the dry to mesic shrublands. On the island of Oahu the species is found on a steep cliff at the Makua Military Reservation. On the island of Hawaii, this species grows on rocky tumuli or outcrops, on aa lava, in deep ash deposits over pahoehoe lava, and in Mauna Kea substrate in dry montane shrubland at elevations between 1,253 and 1,320 meters (4,111 and 4,331 feet). At PTA, *Silene*

lanceolata may be found in the following plant communities: Chamaesyce Treelands, Open Metrosideros Treelands with sparse shrub understory, Open Metrosideros Treelands with dense shrub understory, Intermediate *Metrosideros* Mixed Treelands, Open *Dodonaea* Shrublands, Dense *Dodonaea* Shrublands, *Dodonaea* Mixed Shrublands, *Myoporum* Shrublands, *Myoporum-Dodonaea* Shrublands, *Myoporum-Sophora* Shrublands, and Mixed Shrublands. Associated species include *Eragrostis* sp., *Metrosideros polymorpha*, *Chamaesyce* sp., *Myoporum sandwicense, Sophora chrysophylla, Chenopodium oahuense, Dodonaea viscosa, Leptecophylla tameiameiae,* and *Dubautia linearis* (U.S. Army 2003a).

Threats *Silene lanceolata* is extremely susceptible to ungulate browsing and trampling. Additional threats include rooting by feral pigs; competition for light, space, and nutrients by *Pennisetum setaceum* and other non-native plants; and conversion of habitat to a fire-based vegetation community. Army training such as mounted and dismounted off-road maneuvers, bivouac, and live-fire training, increase the risk of fire, habitat fragmentation and dispersal of alien plant seeds. Off-road and on-road driving and training increases the level of dust (which can compromise plant health and vigor) due to the fine soils in northern PTA. In addition, due to the very limited distribution of this species, a single natural or human-caused environmental disturbance could be catastrophic (U.S. Army 2003a).

Conservation Needs of the Species The following important conservation actions are needed for *Silene lanceolata*: control of ungulates and non-native plants; protection from fire; control of rodents; protection from human disturbance; collection, storage, and maintenance of genetic material; and a comprehensive monitoring program. If deemed necessary, protection from insects and disease should also be provided. Augmentation of small populations and re-establishment of new populations within the historical range of the species are also expected to benefit the species. Research on basic life history characteristics such as seed ecology, growth, reproduction, phenology, and pollination biology is also needed (Service 1996b). In addition, a State-wide management plan that identifies areas and landscapes for the long-term conservation of all known occurrences of *S. lanceolata* is needed. As part of this management plan, landowners and managers should delineate management units to conserve this species and other native species through threat control and habitat restoration.

Ongoing Conservation Actions Currently there are two *Silene lanceolata* plants in cultivation at the Pahole Mid-Elevation rare Plant Nursery that have been propagated from cultivated sources. There are 100 plants in cultivation at Volcano Rare Plant Facility propagated from seeds produced from plants in the wild. The Makua Military Reservation population on Oahu was monitored in 2001. The population is located on a steep cliff and rappelling is necessary for management of this occurrence (U.S. Army Garrison 2002).

Environmental Baseline

Status of the Species in the Action Area Between 500 and 1,000 individual *Silene lanceolata* have been observed in the action area. Sixty-one occurrences of this species have been identified

within Training Areas 7, 19, 20, 22, and 23 and represent between 78 and 88 percent of the naturally occurring individuals known in the State (see Figure 45 in the Transformation Biological Assessment). Two major concentrations of plants at PTA are found in the Kipuka Kalawamauna Endangered Plants Habitat and at Kipuka Alala (Evans 2003a; U.S. Army 2003a).

Threats in the Action Area The threats to *Silene lanceolata* in the action area are predominantly those previously discussed in the Status section. At PTA, military training activities increase the risk of fires due to live-fire training, bivouac and mounted and dismounted off-road activities. Other training threats include trampling, dust, spread of invasive non-native plants, and fragmentation of remaining habitat (U.S. Army 2003a).

Conservation Needs in the Action Area Surveys should be conducted to identify current distribution and density of *S. lanceolata.* An Implementation Plan shall be developed and implemented to include: 1) construction of fenced exclosures around occurrences with high densities to eliminate impacts from feral ungulates; 2) control and/or eradication of non-native plants, particularly *Pennisetum setaceum*, in the vicinity of all high density occurrences of *S. lanceolata*; 3) reintroduction of propagated plants within the historic range of the species; and 4) monitoring of extant occurrences. Outplanting should consist of multiple occurrences that replicate the existing density and known distribution for this species within the action area. Managed occurrences should be established within the preferred substrate and plant community types known for *S. lanceolata*. The WFMP addresses the methods and protocols necessary to control the frequency, intensity, and size of fires on Army installations. However, as it is implemented the success and efficacy of the plan should be carefully monitored and modified, as necessary, to continue reducing the threat of fire at PTA. A management plan for the control and localized eradication of non-native invasive plants will be completed as part of the Implementation Plan process. *S. lanceolata* should be outplanted in numbers that replicate the existing densities and distribution. These occurrences should be established on the preferred substrate and plant community types and in areas free from the feral ungulates and non-native invasive plants.

Ongoing Conservation Actions Within the Action Area As previously stated, there are 100 individuals of *Silene lanceolata* in cultivation at Volcano Rare Plant Facility propagated from seeds produced from naturally occurring plants. In addition, the propagation facility at PTA has 198 plants in cultivation that were propagated from seven individuals located within PTA. This facility also has 8,000 seeds in storage collected from 12 wild individuals growing on the installation (Service 2003a). The Army has implemented an Ecosystem Management Program Plan that outlines priorities, project goals, and annual funding for management and monitoring of natural resources at PTA. This plan includes conservation actions for federally listed plants within the installation. The majority of the *S. lanceolata* individuals are located within the Kipuka Kalawamauna Fence Unit and Kipuka Alala Fence Unit 1. Individuals near an earlier burn site in the Kipukua Kalawamauna Endangered Plants Habitat were monitored and four of five individuals were relocated (Evans *et al* 2002). *Pennisetum setaceum* removal is ongoing at all occurrences within the IMUs. During the 2003-2004 field season *S. lanceolata* will be monitored at IMUs 5,

9, 12, 13, 27, and 31 (see Figure 8). Special care will be taken in Unit 27 to relocate plants because previous relocation attempts have not been successful. Approximately 400 individuals of *S. lanceolata* will be outplanted in IMUs 12, 30, and 31 (U.S. Army 2003c).

Status of the Species - *Solanum incompletum* (popolo ku mai)

Species Description *Solanum incompletum* is a member of the Solanaceae, or nightshade family. In 1888, two varieties, *S. incompletum* var. *glabrum* and *S. incompletum* var. *mauiense,* were described. In 1969 a collection from Maui was described and named as *S. haleakalaense. Solanum haleakalaense* and *S. incompletum* were synonymized by David Symon in the *Manual of Flowering Plants of Hawaii* (1999) into *S. incompletum.* No varieties of this species are now recognized.

Solanum incompletum is a woody shrub which reaches heights of up to 3 meters (10 feet). Its stems and lower leaf surfaces are covered with prominent reddish prickles and, sometimes, on younger plants yellow fuzzy hairs. Leaf margins are one to four-lobed on each side. Leaves are oval to elliptic, 10 to 15 centimeters (4 to 6 inches) long and 7 centimeters (2.8 inches) wide and found on petioles of up to 7 centimeters (2.8 inches) in length. There are prominent veins on the lower leaf surface. Inflorescences are loose clusters of single-stalked flowers. The white petals form a star that is approximately 2 centimeters (0.8 inch) in diameter. Fruits are round berries, yellow-orange to black in color and approximately 1.5 centimeters (0.6 inch) in diameter (U.S. Army 2003a). *Solanum incompletum* differs from others in the genus by the presence of prickles, loose flower clusters, curved anthers, and berry size (U.S. Army 2003a)

Listing Status *Solanum incompletum* was federally and State-listed as an endangered species on November 10, 1994 (59 FR 56333). A recovery plan for this species was adopted in July 1999 (Service 1999). Critical habitat was designated for this species on the island of Hawaii on July 2, 2003 (68 FR 39624).

Historic and Current Distribution Historically, *Solanum incompletum* was known from the islands of Lanai, Maui, and Hawaii. It is believed that the distribution of *S. incompletum* may also have included the islands of Kauai and Molokai. Currently, it is only known from the island of Hawaii at PTA (U.S. Army 2003a).

Ecology Historically, *Solanum incompletum* occurred in dry to mesic forests, diverse mesic forests, and subalpine forests. On Army lands at PTA, the species is found on lava flows of various ages in Sparse *Metrosideros* Treelands and *Myoporum* Shrublands at an elevation of 1,425 meters (4,675 feet). Associated species include *Sophora chrysophylla* and *Myoporum sandwicense* (U.S. Army 2003a).

Threats *Solanum incompletum* is threatened primarily by browsing and habitat degradation by feral ungulates, competition from non-native plant species, wildfire, reduced reproductive vigor

(*e.g.*, limited gene pool), and extinction as a result of a single environmental disturbance (U.S. Army 2003a).

Conservation Needs of the Species Important conservation actions needed for *Solanum incompletum* include the following: control of ungulates and non-native plants; protection from fire; protection from human disturbance and effects of military training actions; collection, storage, and maintenance of genetic material; and a comprehensive monitoring program. Augmentation of small populations and re-establishment of new occurrences within the historical range of the species will benefit the species. Research on basic life history characteristics such as seed ecology, growth, reproduction, phenology, and pollination biology is also needed (Service 1999). In addition, a State-wide management plan that identifies areas and landscapes for the long-term conservation of all known occurrences of *S. incompletum* is needed. As part of this management plan, landowners and managers should delineate management units to conserve this species and other native species through threat control and habitat restoration.

Ongoing Conservation Actions The Seed Storage Facility at Lyon Arboretum and the University of Kentucky, School of Biological Sciences are conducting research on the seed storage requirements of an unspecified number of seeds of *Solanum incompletum* collected from PTA. Additionally, the Lyon Micropropagation Facility has, *in vitro*, tissue collected from plants at PTA. This material, to date, has not produced any plants. At PTA, the propagation facility has 160 plants that were propagated from two individuals collected at this installation. In addition, there are also 5,000 seeds in storage that were collected from eight individuals at PTA. Two hundred *S. incompletum* were outplanted in Kipuka Alala; however, only six have survived. Twenty-one plants outplanted by the State of Hawaii are surviving on Puu Huluhulu (Service 2003a; S. Gleason pers. comm., 2003).

Environmental Baseline

Status of the Species in the Action Area Forty individuals are found as part of six occurrences within the PTA action area (see Figure 46 in the Transformation Biological Assessment). These individuals occur in Training Area 22 and represent 100 percent of all known individuals occurring in the wild (Evans 2003a; U.S. Army 2003a).

Threats in the Action Area The primary threat from military activities is the increased risk of fire. Other threats to *Solanum incompletum* include continued habitat degradation and browsing by feral ungulates; competition with non-native plant species (*e.g.*, *Senecio mikanioides*); reduced reproductive vigor (*e.g.*, limited gene pool); and the potential for a single environmental event to result in the loss of all individuals as they are relegated to a small area in western PTA (13 hectares; 32 acres) (U.S. Army 2003a).

Conservation Needs Within the Action Area An Implementation Plan shall be developed and implemented to include: 1) construction of fenced exclosures around all known occurrences to eliminate impacts from feral ungulates; 2) control and/or eradication of non-native plants,

particularly *Pennisetum setaceum*, in the vicinity of all known occurrences of *Solanum incompletum*; 3) reintroduction of propagated plants within the historic range of the species; 4) monitoring of extant occurrences. The WFMP addresses the methods and protocols necessary to control the frequency, intensity, and size of fires on Army installations. However, as it is implemented the success and efficacy of the plan should be carefully monitored and modified, as necessary, to continue reducing the threat of fire at PTA. (U.S. Army 2003a).

Conservation Actions Within the Action Area All known individuals are in emergency exclosures and hand weeding is being done to control non-native plant competition. Outplantings (approximately 200 individuals) are scheduled to be attempted in similar habitat on-site to increase occurrences and individual numbers (U.S. Army 2003a). The Army has implemented an Ecosystem Management Program Plan that outlines priorities, project goals, and annual funding for management and monitoring of natural resources at PTA. This plan includes conservation actions for *Solanum incompletum* (U.S. Army 2003c). Habitat requirements have been evaluated and are met as needed (*e.g.*, provided shade cloth during drought). Manual and mechanical weeding is ongoing. Additional plants are being established near existing *S. incompletum* occurrences and other locations. During the 2003-2004 field season all *S. incompletum* plants are scheduled to be monitored and weeded, and a rodent control grid is scheduled to be established around each plant. These activities are planned to be executed at IMUs 24 and 13 (U.S. Army 2003c) (see Figure 8).

Status of the Species - *Spermolepis hawaiiensis* (Hawaiian parsley)

Species Description *Spermolepis hawaiiensis* is a member of the Apiaceae, or parsley family. It is a slender, annual herb which reaches heights between 5 and 20 centimeters (2 and 8 inches). The leaves are dissected into narrow, lance-shaped divisions and grow on stalks approximately 2.5 centimeters (1 inch) in length. The inflorescence is a loosely compound umbrella-shaped inflorescence arising from the stem opposite the leaves and contains two to six flowers. The petals are white, elliptic to ovate. Fruits are oval, laterally compressed, and constricted at the line where the two halves meet. The fruits are 4 millimeters (0.2 inch) long and 3 millimeters (0.1 inch) wide, and are covered with curved bristles (U.S. Army 2003a).

Listing Status *Spermolepis hawaiiensis* was federally and State-listed as an endangered species on November 10, 1994 (59 FR 56333). A recovery plan for this species was adopted in July 1999 (Service 1999). Critical habitat was designated for *S. hawaiiensis* on the island of Hawaii on July 2, 2003 (68 FR 39624).

Historic and Current Distribution Historically, *Spermolepis hawaiiensis* was known from Kauai, Oahu, Molokai, Lanai, Maui, and Hawaii and is still extant on all of these islands. State-wide, there are at least 500 to 1,800 individuals of *S. hawaiiensis* found as part of 17 occurrences (Evans 2003a; U.S. Army 2003a).

Ecology *Spermolepis hawaiiensis* is known from a variety of plant communities throughout its range, including *Metrosideros* Forests, *Dodonea* Lowland Dry Shrubland, cultivated fields, and pastures. It occurs at an elevation range of 300 to 600 meters (984 to 1,969 feet). Associated plant species include *Sida fallax*, *Doryopteris* sp., *Gouania hillebrandii*, and *Leucaena leucocephala* (a non-native species) (U.S. Army 2003a). On Hawaii, *S. hawaiiensis* is known from shady spots in *Dodonaea viscosa* dry shrubland which occurs on pahoehoe lava at elevations between 1,134 and 2,140 meters (3,721 and 7,021 feet). Associated native plant species include *Myoporum sandwicense*, *Osteomeles anthyllidifolia*, and *Sophora chrysophylla* (U.S. Army 2003a). At PTA, *Spermolepis hawaiiensis* occurs on lava, in ash, and in soil pockets where moisture accumulates, typically in open Metrosideros Treelands with sparse shrub understory, *Myoporum-Sophora* Mixed Shrublands, and *Myoporum-Sophora* Shrublands with forb understory (U.S. Army 2003a).

Threats *Spermolepis hawaiiensis* is threatened by browsing from feral sheep and goats; habitat degradation and competition from various non-native plants such as *Melinis minutiflora* and *Pennisetum setaceum*. Threats from military activities include degredation and loss of habitat resulting from mounted and dismounted maneuvers, fire, trampling by ground troops, maintenance activities, and construction of landing zones in occupied areas occupied (U.S. Army 2003a).

Conservation Needs of the Species The following important conservation actions are needed for *Spermolepis hawaiiensis*: control of ungulates and non-native plants; protection from fire; habitat stabilization; protection from human disturbance; collection, storage, and maintenance of genetic material; and a comprehensive monitoring program. Augmentation of small populations and re-establishment of new populations within the historical range of the species would also benefit *S. hawaiiensis*. Research on basic life history characteristics such as seed ecology, growth, reproduction, phenology, and pollination biology is also needed (Service 1999). In addition, a State-wide management plan that identifies areas and landscapes for the long-term conservation of all known occurrences of *S. hawaiiensis* is needed. As part of this management plan, landowners and managers should delineate management units to conserve this species and other native species through threat control and habitat restoration.

Ongoing Conservation Actions Aside from specific actions occurring at PTA (and discussed below), the Service is unaware of species-specific conservation actions being conducted for *Spermolepis hawaiiensis*.

Environmental Baseline

Status of the Species in the Action Area There are 27 individuals in the action area as part of 13 occurrences located in Training Areas 22 and 23. These individuals represent between two and five percent of the naturally occurring individuals known State-wide (Evans 2003a; U.S. Army 2003a). The species is found within both fenced units in Kipuka Alala and along the westernmost boundary of the installation near the Mauna Loa 1859 Lava Flow (see Figure 47 in the Transformation Biological Assessment).

Threats in the Action Area The threats to *Spermolepis hawaiiensis* within the action area are the same as those previously discussed in the Status section. In addition, military activities such as mounted and dismounted maneuvers and bivouac increase the potential of fire frequency, spread of non-native plant species, trampling of individuals, and dust. Threats not directly related to military activities include continued habitat degradation and browsing by feral ungulates.

Conservation Needs in the Action Area The conservation needs of this species are similar to those previously discussed for the species in the Status section. Non-native plants need to be controlled or removed to reduce habitat competition and allow for recruitment of new individuals. Fence exclosures will benefit this species by removing browsing pressure from ungulates. The WFMP addresses the methods and protocols necessary to control the frequency, intensity, and size of fires on Army installations. However, as it is implemented the success and efficacy of the plan should be carefully monitored and modified, as necessary, to continue reducing the threat of fire at PTA. A management plan for the control and localized eradication of non-native invasive plants will be completed as part of the Implementation Plan process (U.S. Army 2003a).

Ongoing Conservation Actions Within the Action Area The propagation facility at PTA has 20 individuals of *Spermolepis hawaiiensis* that were propagated from one plant from PTA (Service 2003a). To date, there have not been any species-specific management actions at PTA for *S. hawaiiensis*. Because this taxon is in close proximity to other species receiving more intensive management due to their more precarious status, *S. hawaiiensis* will benefit from enhanced habitat monitoring, fencing, and weed eradication (U.S. Army 2003a).

Status of the Species - *Stenogyne angustifolia* (no common name)

Species Description *Stenogyne angustifolia* is a member of the Lamiaceae, or mint family. Although six varieties have been described, none are currently accepted by Weller and Sakai in the *Manual of Flowering Plants of Hawaii* (Wagner *et al.* 1999). It is a prostrate, trailing plant with four-sided, smooth stems which are occasionally pubescent at the nodes. Leaves are undivided, contracted at the base into a petiole approximately one centimeter (0.4 inch) in length, and smooth. The leaf blade is oblong to linear, wavy to serrate, and between 2 and 6 centimeters (0.8 and 2.4 inches) long and 6 and 12 millimeters (0.2 and 0.5 inch) wide. Flowers are tubular, distinctly veined, and 8 to 13 millimeters (0.3 to 0.5 inch) long. The upper lip of the flower is twice as long as the lower and petals are yellow to dull brownish-pink and finely pubescent (U.S. Army 2003a).

Listing Status *Stenogyne angustifolia* was federally and State-listed as an endangered species on October 30, 1979 (44 FR 62468) A recovery plan was drafted for this species in 1993.

Historic and Current Distribution Historically, *Stenogyne angustifolia* was known from the islands of Molokai, Maui, and Hawaii. Currently, an estimated 5,000 to 7,500 individuals occur only on the island of Hawaii (U.S. Army 2003a).

Ecology *Stenogyne angustifolia* grows on relatively flat, ash-veneered lava and shallow soils in semi-arid shrublands and *Metrosideros* Woodlands at an elevation of 1,555 meters (5,102 feet). The species also occurs at an elevation of 1,035 meters (3,396 feet) in the transition zone between pastureland and the Keamuku lava flow. The species has been described as abundant on various-aged lava or rock outcrops that support the following diversity of plant communities: *Eragrostis* Grassland, *Chenopodium* Shrubland, Chamaesyce Treelands, Open *Metrosideros* Treelands with sparse and dense shrub understory, Intermediate *Metrosideros* Mixed Treelands, Open and Mixed *Dodonaea* Shrublands, *Myoporum-Dodonaea* Shrublands, *Myoporum-Sophora* Mixed Shrublands, *Myoporum* Shrublands, and *Leptecophylla* Mixed Shrublands (U.S. Army 2003a).

Threats The threats to *Stenogyne angustifolia* include habitat competition from non-native plants, particularly *Pennisetum setaceum*; and conversion of habitat to a fire-based vegetation community. Army training such as mounted and dismounted off-road maneuvers, bivouac, and live-fire training increase the risk of fire, habitat fragmentation and alien plant seed spread. Off-road and on-road driving and training increases the level of dust (which can compromise plant health and vigor) due to the fine soils in northern PTA. In addition, due to the very limited distribution of this species, a single natural or human-caused environmental disturbance could be catastrophic. The taxon does not appear palatable to feral sheep and goats, and appears to be consumed only during dry periods or after a fire (U.S. Army 2003a).

Conservation Needs of the Species Important conservation actions needed for *Stenogyne angustifolia* include the following: control of non-native plant species and feral ungulates; reduction of fire; and research on habitat requirements, population structure, reproductive biology, and seed biology. Multiple occurrences that replicate the existing density and distribution for *S. angustifolia* should be established to increase species abundance and density (U.S. Army 2003a). In addition, a State-wide management plan that identifies areas and landscapes for the long-term conservation of all known occurrences of *S. angustifolia* is needed. As part of this management plan, landowners and managers should delineate management units to conserve this species and other native species through threat control and habitat restoration.

Ongoing Conservation Actions Aside from specific actions occurring at PTA (and discussed in a subsequent section), the Service is unaware of species-specific conservation actions being conducted for *Stenogyne angustifolia*.

Environmental Baseline

Status of the Species in the Action Area Between 5,000 and 7,500 individuals of *Stenogyne angustifolia* occur in the PTA action area in Training Areas 18, 19, 20, 22, and 23, as well as the buffer area adjacent to the Impact Area. These individuals are found as part of 291 occurrences and represent 100 percent of the naturally occurring individuals known State-wide (see Figure 48 in the Transformation Biological Assessment) (Evans 2003a; U.S. Army 2003a).

Threats in the Action Area Because all remaining individuals of *Stenogyne angustifolia* are located at PTA, the threats in the action area are the same as previously discussed in the Status section.

Conservation Needs in the Action Area An Implementation Plan shall be developed and implemented to include: 1) construction of fenced exclosures around high density occurrences to eliminate impacts from feral ungulates; 2) control and/or eradication of non-native plants, particularly *Pennisetum setaceum*, in the vicinity of high density occurrences of *Stenogyne angustifolia*; 3) reintroduction of propagated plants within the historic range of the species; and 4) monitoring of extant occurrences. The WFMP addresses the methods and protocols necessary to control the frequency, intensity, and size of fires on Army installations. However, as it is implemented the success and efficacy of the plan should be carefully monitored and modified, as necessary, to continue reducing the threat of fire at PTA. In addition, research on habitat requirements, population structure, reproductive and seed biology would benefit this species. Another suggested conservation action is to maintain fire breaks along Keekee Road in order to protect upper Kipuka Kalawamauna which is very important habitat for this taxon as well as *Haplostachys haplostachya*, *Silene lanceolata*, and *Tetramolopium arenarium* ssp. *arenarium*. Multiple occurrences should be established that replicate the existing density and distribution for *S. angustifolia* within the preferred substrate and plant community types for this species. Outplanting sites should be established in areas free from the impacts of ungulates and invasive plant competition. The Implementation Team will address other management issues for this species including developing an invasive plant management plan to reduce the threats from non-native plant species (U.S. Army 2003a).

Ongoing Conservation Actions Within the Action Area The propagation facility at PTA has four plants growing from cuttings of one individual of *Stenogyne angustifolia* (Service 2003a). The Army has implemented an Ecosystem Management Program Plan that outlines priorities, project goals, and annual funding for management and monitoring of natural resources at PTA. This plan includes conservation actions for federally listed plant species within the installation (U.S. Army 2003c). Three fence units protect occurrences of *S. angustifolia* including Kipuka Alala, and Kipuka Kalawamauna. Ungulates are currently being removed from both of these fenced exclosures. During the course of other survey work, new plant locations have been found and documented. During the 2003-2004 field monitoring of *S. angustifolia* will occur at IMUs 16-20, and 11 (see Figure 8). Plant densities will be evaluated to determine an appropriate method for monitoring within other established IMUs (U.S. Army 2003c).

Status of the Species - *Tetramolopium arenarium* ssp. *arenarium* (no common name)

Species Description *Tetramolopium arenarium* is a member of the Asteraceae, or sunflower family. Current classification recognizes three intraspecific taxa: *T. arenarium* ssp. *arenarium* var. *arenarium*, *T. arenarium* spp. *arenarium* var. *confertum*, and *T. arenarium* ssp. *laxum*. These are distinguished from other members of the genus by its erect habit; presence and types of

glands and hairs on the plant; few-flowered head clusters; large male ray florets; few, bisexual, maroon-petalled disk florets; and wide achenes (U.S. Army 2003a).

Tetramolopium arenarium ssp. *arenarium* is an erect tufted shrub 0.8 to 1.3 meters (2.6 to 4.3 feet) tall. Plants are covered with tiny glands and straight hairs. Leaves are alternate, shallowly toothed (or toothless), and lance-shaped. They range in length from 15 to 35 millimeters (0.6 to 1.5 inches) and in width from 3 to 9 millimeters (0.1 to 0.4 inch). Inflorescences are terminal with 5 to 10 heads. Each head has 20 to 34 bracts beneath a single series of white florets (male ray florets) on the outside and fewer than 15 inner bisexual maroon-petalled disk florets. The fruits are compressed achenes (U.S. Army 2003a).

Listing Status *Tetramolopium arenarium* ssp. *arenarium* was federally and State listed as an endangered species on March 4, 1994 (59 FR 10305). A recovery plan was adopted for this species on September 26, 1996 (Service 1996a). Critical habitat was designated for *Tetramolopium arenarium* ssp. *arenarium* on the island of Hawaii on July 2, 2003 (68 FR 39624).

Historic and Current Distribution Historically, *Tetramolopium arenarium* ssp. *arenarium* was known from the islands of Maui and Hawaii. Currently, between 292 and 296 individuals occur only on the island of Hawaii (see Figure 49 in the Transformation Biological Assessment) (U.S. Army 2003a).

Ecology *Tetramolopium arenarium* ssp. *arenarium* occurs in *Dodonaea viscosa* dominated lowland and montane dry shrublands at elevations from 800 and 1,500 meters (2,625 and 4,921 feet). At PTA the species is found in the *Dodonaea* Mixed Shrubland at elevations between 1,300 and 1,700 meters (4,265 and 5,577 feet). *Tetramolopium arenarium* ssp. *arenarium* is extremely rare on very old Mauna Kea flows (greater than 10,000 years old) (U.S. Army 2003a).

Threats The primary threats to *Tetramolopium arenarium* ssp. *arenarium* are feral ungulates that browse on the plant; rooting by feral pigs; competition from non-native plant species such as *Pennisetum setaceum*; and conversion of habitat to a fire-based vegetation community. Army training such as mounted and dismounted off-road maneuvers, bivouac, and live-fire training, increase the risk of fire, habitat fragmentation and alien plant seed spread. Off-road and on-road driving and training increases the level of dust (which can compromise plant health and vigor) due to the fine soils in northern PTA. In addition, due to the very limited distribution of this species, a single natural or human-caused environmental disturbance could be catastrophic (U.S. Army 2003a).

Conservation Needs of the Species The following important conservation actions are needed for *Tetramolopium arenarium* ssp. *arenarium*: control of non-native plant species and feral ungulates; reduction of fire risk; and research on habitat requirements, population structure, reproductive biology, and seed biology. Augmentation of small populations and re-establishment

of new populations within the historical range of the species are also expected to benefit the species (U.S. Army 2003a). In addition, a State-wide management plan that identifies areas and landscapes for the long-term conservation of all known occurrences of *T. arenarium* ssp. *arenarium* is needed. As part of this management plan, landowners and managers should delineate management units to conserve this species and other native species through threat control and habitat restoration.

Ongoing Conservation Actions Aside from specific actions occurring at PTA (and discussed below), the Service is unaware of species-specific conservation actions being conducted for *Tetramolopium arenarium* ssp. *arenarium.*

Environmental Baseline

Status of the Species in the Action Area Within the action area at PTA, there are an estimated 292 to 296 individuals (22 occurrences) of *Tetramolopium arenarium* ssp. *arenarium* within Training Areas 19 and 22. These individuals represent 100 percent of all naturally occurring *T. arenarium* ssp. *arenarium* remaining in the State (Evans 2003a; U.S. Army 2003a).

Threats in the Action Area Because all remaining individuals of *Tetramolopium arenarium* ssp. *arenarium* occur within the action area, the threats are as previously discussed for the species rangewide. The species is impacted by military activities such as mounted and dismounted maneuvers and bivouac which can result in increased fire frequency, spread of non-native plant species, and dust. Other threats to *T. arenarium* ssp. *arenarium* include continued habitat degradation by feral ungulates and competition with non-native plant species.

Conservation Needs in the Action Area An Implementation Plan shall be developed and implemented to include: 1) construction of fenced exclosures around occurrences to eliminate impacts from feral ungulates; 2) control and/or eradication of non-native plants, particularly *Pennisetum setaceum*; 3) reintroduction of propagated plants within the historic range of the species; and, 4) monitoring of extant occurrences. The WFMP has been finalized and the document addresses many proactive measures to reduce the risk of fire at PTA. However, as it is implemented the success and efficacy of the plan should be carefully monitored and modified, as necessary to continue reducing the threat of fire at PTA. Multiple occurrences that replicate the existing density and known distribution for *T. arenarium* ssp. *arenarium* should be established in the action area to offset potential impacts from military activities. A management plan for the control and localized eradication of non-native invasive plants will be completed as part of the Implementation Plan process (U.S. Army 2003a).

Ongoing Conservation Action Within the Action Area The propagation facility at PTA has 165 plants of *Tetramolopium arenarium* ssp. *arenarium* in cultivation that were propagated from six individuals. The Army has implemented an Ecosystem Management Program Plan that outlines priorities, project goals, and annual funding for management and monitoring of natural resources at PTA. This plan includes conservation actions for federally listed plant species within the

installation including *T. arenarium* ssp. *arenarium* (U.S. Army 2003c). All known plants at PTA are located in the Kipuka Kalawamauna Endangered Plant Habitat. A recent survey identified 13 new locations with 91 adult plants and 112 juveniles observed (Evans *et al* 2002). During the 2003-2004 field season management activities are scheduled at IMUs 8 and 12 to include monitoring and invasive plant removal. In addition, approximately 400 individuals of *T. arenarium* ssp. *arenarium* are scheduled to be outplanted in IMUs 12 and 18 (see Figure 8).

Status of the Species - *Vigna o-wahuensis* (Oahu vigna)

Species Description *Vigna o-wahuensis* is a member of the Fabaceae, or pea family. It is a slender, short-lived, twining perennial herb with fuzzy stems that grow to 0.4 meter (1.3 feet). Leaves are compound, with three leaflets that are 1.2 to 8 centimeters (0.5 to 3.0 inches) long and 0.1 to 2.5 centimeter (0.04 to 1.0 inch) wide. Leaflets are sparsely to moderately covered with coarse hairs. Flowers occur in clusters of one to four, and have thin, translucent, pale yellow or greenish-yellow petals approximately 2.0 to 2.5 centimeters (0.8 to 1.0 inch) long. The calyx is sparsely hairy and 4.0 to 8.0 millimeters (0.2 to 0.3 inch) long with asymmetrical lobes. Fruits are slender pods of 4 to 9 centimeters (1.6 to 3.5 inches) in length and 5 millimeters (0.2 inch) in width. Pods may be slightly inflated and contain between 7 and 15 gray to black seeds that are less than 6.0 millimeters (0.2 inch) long (U.S. Army 2003a).

Listing Status *Vigna o-wahuensis* was federally and State-listed as an endangered species on November 10, 1994 (59 FR 56333). A recovery plan for this species was adopted in July 1999 (Service 1999). Critical habitat was designated for *V. o-wahuensis* on the island of Hawaii on July 2, 2003 (68 FR 39624).

Historic and Current Distribution Historically, *Vigna o-wahuensis* was known from the islands of Hawaii, Maui, Molokai, Lanai, Kahoolawe, Nihoa, and Niihau (U.S. Army 2003a). Currently, it is known from Maui, Molokai, Lanai, Kahoolawe, and Hawaii (68 FR 25934; 68 FR 1220; 68 FR 39624). At least 86 individuals are believed to occur in 10 locations (U.S. Army 2003a). Thirty plants were located on the lower south and southwestern slope of Puu Nohonaohae during botanical surveys in the early 1980s, but only a single plant was observed in 2002 (Arnett 2002b).

Ecology *Vigna o-wahuensis* occurs in lowland dry to mesic grassland and shrubland at elevations from 10 to 1,370 meters (33 to 4,495 feet). Associated plant species include *Sida fallax*, *Chenopodium* sp., *Dubautia menziesii,* and *Osteomeles anthyllidifolia* (U.S. Army 2003a). Life history information is unknown. The taxon has been observed flowering in March, April and July. Fruits were present in July. All individuals were classified as mature (U.S. Army 2003a).

Threats Threats to *Vigna o-wahuensis* include habitat degradation by feral ungulates, competition from non-native plant species, fire, effects of military activities, reduced reproductive vigor due to the small number of existing populations and individuals, and extirpation or extinction as the result of naturally-occurring events (U.S. Army 2003a).

Conservation Needs of the Species Important conservation actions needed for *Vigna o-wahuensis* include the following: control of non-native plant species and feral ungulates; elimination of fire; and research on habitat requirements, population structure, reproductive biology, and seed biology. Management actions to protect existing *V. o-wahuensis* populations and habitat from fire should be developed. *Ex situ* propagation should be initiated and research on seed storage methodology continued to maintain adequate genetic stock and buffer against extinction of this species. Outplanting to enhance the remaining wild populations should begin when adequate propagated material is available, and fencing and weed control are underway. New populations should be established within the historic range of *V. o-wahuensis* in areas free from the impacts of feral ungulates and non-native plants (Service 1999). In addition, a State-wide management plan that identifies areas and landscapes for the long-term conservation of all known occurrences of *V. o-wahuensis* is needed. As part of this management plan, landowners and managers should delineate management units to conserve this species and other native species through threat control and habitat restoration.

Ongoing Conservation Actions Aside from specific actions occurring at PTA (and discussed in a subsequent section), the Service is unaware of species-specific conservation actions being conducted for *Vigna o-wahuensis*.

Environmental Baseline

Status of the Species in the Action Area There are 74 individuals of *Vigna o-wahuensis* located in six occurrences in the Keamuku Parcel. These plants occur on Nohonaohae cinder cone (66 individuals), Puu Papapa (three individuals), and one occurrence along the southern border (five individuals) (see Figure 50 in the Transformation Biological Assessment). These individuals represent 83 percent of all naturally occurring individuals of *V. o-wahuensis* State-wide (Evans 2003a; U.S. Army 2003a).

Threats in the Action Area Because the majority of the remaining individuals of *Vigna o-wahuensis* occur in the action area, the threats previously discussed for the species State-wide is similar to the threats in the action area. Additional threats include increased military activity if Keamuku Parcel is utilized for more intensive training maneuvers, particularly off-road maneuvers by Stryker vehicles. The majority of the soils in Keamuku are sandy and fine sandy loam which will crush easily and create large dust plumes over large areas. Additionally, the use of Keamuku for mounted and dismounted maneuvers and bivouac will result in an increased risk of fire, spread of non-native plant species, and habitat fragmentation. Other threats to *V. o-wahuensis* include continued habitat degradation by feral ungulates, cattle and competition with non-native plant species.

Conservation Needs in the Action Area If the Keamuku Parcel is utilized for Army training (leased or purchased) then the Implementation Plan shall include this species and address: 1) construction of fence exclosures around all known species occurrences to eliminate impacts from cattle and feral ungulates; 2) control of non-native plants, particularly *Pennisetum setaceum*; 3)

reintroduction of propagated plants within the historic range of the species; and 4) monitoring of extant occurrences. The WFMP addresses the methods and protocols necessary to control the frequency, intensity, and size of fires on Army installations. The WFMP also includes measures to reduce the risk of fire on the Keamuku Parcel. However, as it is implemented the success and efficacy of the plan should be carefully monitored and modified, as necessary, to continue reducing the threat of fire at PTA. A management plan for the control and localized eradication of non-native invasive plants will be completed as part of the Implementation Plan process. Outplanting should consist of multiple occurrences that replicate the existing density and known distribution for *Vigna o-wahuensis* within the action area. These occurrences should be established within the preferred substrate and plant community types for *V. o-wahuensis* in the action area. New occurrences should be established in areas free from impacts of ungulates and non-native plant competition.

Ongoing Conservation Actions Within the Action Area The puu on Parker Ranch in the Keamuku Parcel are fenced to restrict cattle; however, sheep and goats are still able to access the sites. Locations in the Keamuku Parcel were surveyed (Arnett 2002b) and plants were categorized by life stage, phenology, indication of browse, and the presence of disease. No other ongoing conservation measures are known for this species.

Status of the Species - *Zanthoxylum hawaiiense* (ae)

Species Description *Zanthoxylum hawaiiense* is a member of the Rutaceae, or citrus family. It is a tree which can range in height from 3 to 8 meters (10 to 26 feet) tall, with trunks that can be 25 centimeters (10 inches) in diameter. Leaves are alternate and are comprised of three, leathery triangular-oval or lance-shaped, gland-dotted, lemon-scented, toothed leaflets. These leaflets are 3.4 to 10 centimeters (1.3 to 3.9 inches) long and 1.5 to 5 centimeters (0.6 to 2.0 inches) wide. The stalk of the opposite leaflets has one joint and the central, terminal leaflet has two. Trees are dioecious, having either male or female flowers. Inflorescences contain 15 to 20 flowers, each with four triangular sepals. Fruits are sickle-shaped follicles which range in length from 8 to 10 millimeters (0.3 to 0.4 inch). The fruits contains a single black seed of approximately 7 to 8 millimeters (0.3 inch) in diameter. The species is distinguished from other Hawaiian species by its leaves, presence of only one joint on some the leaflet stalks, and length and shape of the follicle (U.S. Army 2003a).

Listing Status *Zanthoxylum hawaiiense* was federally and State-listed as an endangered species on March 4, 1994 (59 FR 10305). A recovery plan was adopted for this species in September 1996 (Service 1996a). Critical habitat was designated for *Z. hawaiiense* on the island of Hawaii on July 2, 2003 (68 FR 39624).

Historic and Current Distribution Historically, *Zanthoxylum hawaiiense* occurred on Kauai (central portion), Molokai (east side), Lanai (central), Maui (eastern portion, on the southern slopes of Haleakala), and Hawaii (Kohala Mountains). This species has been extirpated from

Lanai but still persists on Hawaii, Molokai, Maui and Kauai. On these islands, approximately 262 to 312 individuals are found in 10 to 13 occurrences (U.S. Army 2003a).

Ecology *Zanthoxylum hawaiiense* typically grows in Metrosideros-dominated lowland dry or mesic forests, in montane dry forests, and on lava at elevations that range from 550 to 1,740 meters (1,804 to 5,709 feet). The species is associated with *Antidesma platyphyllum* and *Streblus pendulinus* on the island of Maui and with *Myrsine lanaiensis, Sophora chrysophylla*, and *Myoporum sandwicense* on the island of Hawaii. Individuals of this species are widely scattered and rarely will more than a few plants be found in close proximity to one another (U.S. Army 2003a). At PTA, *Z. hawaiiense* is found on lava and in a variety of plant community types including sparse *Metrosideros* Treelands, Open *Metrosideros* Treelands with dense shrub understory, Intermediate *Metrosideros* Mixed Treelands, *Myoporum* Shrublands, and *Myoporum-Dodonaea* Shrublands.

Threats Threats to *Zanthoxylum hawaiiense* include habitat degradation and browsing by feral and domestic animals, competition from non-native plant species, seed predation by rodents, fire; trampling, and effects of military activities (U.S. Army 2003a).

Conservation Needs of the Species The following important conservation actions are needed for *Zanthoxylum hawaiiense*: control of non-native plant species, feral ungulates, and rodents; elimination of fire; and research on habitat requirements, population structure, reproductive biology, and seed biology. Steps should be taken to ensure that populations remain viable on each of the four islands on which *Z. hawaiiense* presently occurs. Additional populations should be established across the species' range to increase the number of individuals. The widely scattered distribution and dioecious behavior of this species may suggest that larger areas are required to maintain viable populations for the survival and recovery of *Z. hawaiiense*. Rodent control in existing and reintroduced populations is necessary to allow for successful recruitment (Service 1996a). In addition, a State-wide management plan that identifies areas and landscapes for the long-term conservation of all known occurrences of *Z. hawaiiense* is needed. As part of this management plan, landowners and managers should delineate management units to conserve this species and other native species through threat control and habitat restoration.

Ongoing Conservation Actions Aside from any actions occurring at PTA (and discussed the section below), the Service is unaware of species-specific conservation actions being conducted for *Zanthoxylum hawaiiense*.

Environmental Baseline

Status of the Species in the Action Area There are approximately 225 individuals of *Zanthoxylum hawaiiense* at PTA in Training Areas 18, 19, 22, and 23; to the Impact Area and adjacent buffer area (see Figure 51 in the Transformation Biological Assessment). These individuals represent between 72 and 86 percent of the State-wide population in the wild (Evans 2003a; U.S. Army 2003a).

Threats in the Action Area Because such a large percentage of all remaining individuals of *Zanthoxylum hawaiiense* occur within in the action area at PTA, threats are similar to those previously discussed. Dismounted maneuvers and bivouac also increase the risk of fire, promote habitat fragmentation, disperse alien plant seeds, and increase potential trampling of seedlings and young plants. Other threats to *Z. hawaiiense* include continued habitat degradation by feral ungulates, competition with non-native plant species, and seed loss from rodent predation (U.S. Army 2003a).

Conservation Needs in the Action Area *Zanthoxylum hawaiiense* shall be included in the Implementation Plan for PTA and the following management measures shall be addressed for this species: 1) construction of fenced exclosures around all known occurrences to eliminate impacts from feral ungulates; 2) control and/or eradication of non-native plants, particularly *Pennisetum setaceum*, in the vicinity of high density occurrences; 3) reintroduction of propagated plants within the historic range of the species; and, 4) monitoring of extant occurrences. The WFMP addresses the methods and protocols necessary to control the frequency, intensity, and size of fires on Army installations. However, as it is implemented the success and efficacy of the plan should be carefully monitored and modified, as necessary, to continue reducing the threat of fire at PTA. As this species occurs in a variety of plant community types, potential locations for management of population units within the action area include Puu Leilani mixed tree area, Kipuka Kalawamauna, and Charlie Circle (U.S. Army 2003a).

Ongoing Conservation Actions Within the Action Area The Army has implemented an Ecosystem Management Program Plan that outlines priorities, project goals, and annual funding for management and monitoring of natural resources at PTA. This plan includes conservation actions for federally listed plant species within the installation including *Zanthoxylum hawaiiense*. One benefit is that new occurrences of *Z. hawaiiense* have recently been discovered while performing botanical surveys (Evans 2002; Evans *et al* 2002). During the 2003-2004 field season monitoring for *Z. hawaiiense* will occur at IMUs 7, 13, 14, 15, 21, 23, 25 and 27 (see Figure 8). All non-native plants are scheduled to be removed from the units. Rodent bait-station grids will be established in Unit 26 (62 hectares; 153 acres). Individual trees in other Units will be protected with small bait grids (12 diphacinone stations per tree, 25 meters (82 feet) apart) (U.S. Army 2003c).

Status of Palila Critical Habitat

Palila Critical Habitat Critical habitat for the palila (*Loxioides bailleui*) was designated on September 22, 1977 (42 FR 40685) and consists of: 1) the State of Hawaii Mauna Kea Forest Reserve, except (a) the portion above the 10,000-foot contour line, (b) the portion south of Saddle Road (State Highway 20), (c) lands owned by the United States Army in the Pohakuloa Training Areas north of Saddle Road (State Highway 20) established by Executive Order 1719 (Parcel 6, State of Hawaii Tax Map Key 4-4-16, Third Division), (d) the portion (Parcel 10, Kaohe IV, State of Hawaii Tax Map Key 4-4-16, Third Division) lying north of Saddle Road

(State Highway 20) and south of Power Line Road; 2) the portion of the State of Hawaii Kaohe Game Management Areas (Parcel 4, State of Hawaii Tax Map Key 4-4-15, Third Division to the north and east of Saddle Road (State Highway 20); 3) the portion of the Upper Waikii Paddock (Parcel 2, State of Hawaii Tax Map Key 4-4-15, Third Division) northeast of Saddle Road (State Highway 20); and 4) the portion of the lands of Humuula between Puu Kahinahina and Kole lying southeast of the Mauna Kea Forest Reserve fence (portions of Parcels 2, 3, and 7, State of Hawaii Tax Map Key 3-8-1 Third Division) that is included in State conservation district (50 CFR 17.95(b); see Figure 58 in the Transformation Biological Assessment). A total of 24,356 hectares (60,185 acres) of critical habitat were designated for palila on the island of Hawaii.

The primary constituent elements of palila critical habitat are large and intermediate-sized mamane (*Sophora chrysophylla*) and naio (*Myoporum sandwicense*) trees, enough space for the palila population to expand, and the full range of altitudinal and geographical sites needed by the palila for normal life cycle movements in response to shifting seasonal and annual patterns of flowering, seed set, and ensuing pod development of mamane (42 FR 40685).

The palila is dependent entirely on mamane and mamane-naio ecosystems for food, nesting, and shelter. The palila feeds primarily on mamane seeds, flowers, leaf buds, insects, and insect larvae that are found inside mamane seeds. Naio berries may also be eaten, particularly if mamane seeds are in short supply. Munro (1960) reported that palila also feed on poha (*Physalis peruviana*) fruit and caterpillars, and recent studies by the U.S. Geological Survey, Biological Resources Discipline (BRD) suggest that caterpillars and other insects may be an important diet component for palila nestlings (Service 2003b). Larger mamane trees produce more pods and therefore can support larger numbers of palila in a smaller area (Service 2003b). Mamane trees bear seeds at different times of year across an elevational gradient, thereby providing palila with food and shelter throughout the year.

Palila critical habitat is currently browsed by feral ungulates including goats, sheep, mouflon, and pigs. In some areas young cohorts of mamane trees have been damaged by ungulate browsing (P. Banko, pers. comm., 2003). Many areas of palila critical habitat contain harmful invasive species that are capable of causing declines in populations of native plant species (Banko *et al.* 2003). Palila critical habitat is in fairly good condition in some areas, notably the southwestern slope of Mauna Kea, the only area where palila are known currently to breed in the wild. In other areas, for example the eastern slope of Mauna Kea, primary constituent elements are not adequate to sustain palila populations. A large portion of palila critical habitat is in need of restoration so that all primary constituent elements are available for palila to live and breed, including the eastern slope and portions of the northern and western slopes of Mauna Kea.

Threats to Palila Critical Habitat The major threats to primary constituent elements include wildfire and browsing by feral ungulates. Palila critical habitat is seriously affected by fire that kills mamane trees and by the spread of fire-adapted invasive plants that encourage shifts in community composition toward non-native plant species. Non-native plants compete with mamane and naio

for water, nutrients, and space and can slow the rate of, or prevent, native plant recovery after a fire event. Mamane are also seriously affected by feral ungulate browsing and habitat damage caused by feral pigs. Browsing reduces the number of pods and flowers near the ground on larger mamane trees and can girdle and kill younger trees. Pigs also damage palila critical habitat through rooting and digging. Another potential threat is predation of mamane seed pods by rodents, possibly reducing recruitment of trees.

Conservation Needs of Palila Critical Habitat Conservation needs of palila critical habitat are restoration and maintenance of large, well-connected blocks of native mamane and mamane-naio forest that provide a full range of altitudinal and geographical sites needed by the palila for normal life cycle movements in response to shifting seasonal and annual patterns of flowering, seed set, and ensuing pod development of mamane. This can be accomplished through: 1) fencing and ungulate removal to reduce browsing pressure and pig damage, 2) protection of habitat from fire, 3) invasive plant species control, and 4) rodent control to eliminate possible seedling and seed consumption by rodents. The primary conservation need is the removal of sheep and other ungulates from all areas within palila critical habitat. Removal of feral ungulates requires construction of ungulate exclusion fences around unfenced areas of palila critical habitat, repair of existing fences around the Mauna Kea Forest Reserve, and implementation of aggressive eradication programs and other measures to remove all feral ungulates from fenced exclosures. Restoration of some areas through invasive species control, and outplanting mamane and naio trees and other native species, may be needed in some areas where natural forest regeneration is slow.

Ongoing Conservation Actions for Palila Critical Habitat.
In 1978, a ruling by the Hawaii District Court under section 9 of the Endangered Species Act required that all feral sheep and goats be removed from Palila critical habitat (Palila *et al.* v. Hawaii Department of Land and Natural Resources *et al.*, CIV no. 78-0030; Nelson 1982). A similar ruling by the Federal Court of Appeals for the Ninth Circuit in 1987, ordered the eradication of mouflon sheep (Palila *et al.* v. Hawaii Department of Land and Natural Resources, No. 87-2188; Pratt *et al.* 1997). Efforts to remove sheep and mouflon from palila critical habitat are still underway by the Hawaii Department of Land and Natural Resources - Division of Forestry and Wildlife.

The ungulate exclusion fence along the lower elevational boundary that protects most palila critical habitat on Mauna Kea currently needs repair and/or replacement at several locations including the northern perimeter boundary to PTA. This fence is needed to prevent the ingress of sheep, goats, and mouflon to palila critical habitat. At this time small herds of goats and sheep are causing damage to mamane saplings and preventing mamane recruitment in some areas of palila critical habitat (P. Banko, pers. comm., 2003). Removal of feral pigs was not required by the court order; however, they are also causing damage to mamane by rooting and digging, especially at lower elevations.

Plans for realignment of Saddle Road include several design features to protect palila critical habitat on the southern slope of Mauna Kea, including construction of a fence parallel to the road that will prevent vehicles from leaving the roadway, a fire/fuel break to the north of the roadway, and shoulder curbs to prevent cigarettes and other flammables tossed from vehicles from rolling off the roadway as source of fire ignition.

Environmental Baseline

Status of Critical Habitat in the Action Area There currently are no documented populations of palila within the action area at the PTA and the Keamuku parcel. The most recent sighting of palila on the PTA was in 1950 (Gon *et al.* 1993).

The palila critical habitat lands at PTA are leased (Tract 1-105; expires in August 2029) from the State of Hawaii (U.S. Army 2003a). Palila Critical Habitat Area A was omitted from this consultation because no Transformation actions will occur in this area and the effects of Legacy training actions on palila critical habitat are addressed in a separate biological opinion (Service 1978, 1981, 1983). Palila critical habitat on the southwestern slopes of Mauna Kea was not included in the action area because the flight corridor to Bradshaw Army Airfield will be along the planned realigned Saddle Road and will not pass over or near palila breeding areas on the western and southern slopes of Mauna Kea. Only the portion of Palila Critical Habitat Area B and Mauna Kea State Park lands south of the planned realigned Saddle Road are included in the action area for Tansformation (see Figure 2).

Palila critical habitat within the action area for Transformation consists of 758 hectares (1,873 acres) of open mamane and naio woodland with a grass understory. There are 11 firing points in this area. This area is used for maneuver (on-road and dismounted), bivouac (up to battalion-sized units), and digging of firing positions (individual and crew) at previously disturbed sites. Landing Zone Rob and Brad are just south of the southern border of Area B (see Figure 4). Approximately 24 helicopter maneuvers occur in the landing zones for each battalion-sized maneuver. Existing training restrictions within palila critical habitat are outlined in the project description and provided in Appendix B and shall remain in place during SBCT Transformation.

Threats in the Action Area Threats to palila critical habitat primary constituent elements within the action area include: 1) habitat destruction by fire; 2) browsing pressure from feral ungulates and habitat degradation by feral pigs; 3) habitat damage caused by Legacy training activities (direct crushing) (analyzed in separate biological opinions); 4) dust deposition from off-road and on-road maneuvers; and 5) invasive plant introductions and dispersal. Mamane tree recruitment in Palila Critical Habitat Area B appears to be low (S. Gleason, pers. comm. 2003). This may be a result of recent low rainfall conditions and forest ecology. However, other factors that may be responsible include effects of bivouac and foot maneuvers as part of Legacy training, feral ungulate browsing, possible mamane seed predation by rodents, or a combination of these or other factors. Of these threats, direct damage to mamane trees from ungulate browsing has been observed on Palila Critical Habitat Area B (S. Gleason, pers. comm. 2003). Settling of dust on vegetation

could affect plants by reducing photosynthetic rates and by inhibiting pollinators from using the area, both of which could threaten the long-term integrity of the habitat.

Conservation Needs in the Action Area Reduction or removal of feral ungulates is an important conservation need of palila critical habitat in the action area. Feral ungulate control began in the early 1900s to protect mamane woodland and the watershed of Mauna Kea Forest Reserve (Service 2003b). Over time, removal of over 46,000 feral sheep and smaller numbers of feral cattle, goats, and pigs retarded the severe deterioration of mamane forest on Mauna Kea and allowed the recruitment of a cohort of mamane seedlings that has support palila to the present. Removal of feral ungulates from portions of the action area would reduce browsing and degradation of mamane trees, saplings, and seed pods thereby allowing regeneration of the mamane forest woodland.

The Army must adhere to Standing Operating Procedures (see Appendix B)and the WFMP in order to prevent ignition of wildfires and to minimize training impacts to mamane forest woodland in designated palila critical habitat. Training actions, especially those in the Stryker off-road maneuver areas adjacent to palila critical habitat, may have indirect effects from dust deposition and weed seed dispersal which would facilitate recruitment and establishment of non-native plant species. Implementation of the WFMP, effective invasive seed dispersal control, monitoring and weed removal programs, and measures to reduce dust deposition would benefit conservation of palila critical habitat.

Palila Critical Habitat Area B does not have an ungulate exclusion fence along the western, southern, and eastern boundaries. Without a fence to exclude feral sheep, goats, and mouflon from the area, it is unlikely that public hunting will result in the removal of all the feral ungulates that are causing habitat damage. In addition, the fence along the northern perimeter of palila critical habitat needs to be repaired to preclude ungulates from accessing the critical habitat.

A systematic study is needed to evaluate potential reasons for lack of mamane recruitment in Palila Critical Habitat Area B, including a determination of factors that contribute to the lack of seedling production of mamane. It is likely, given observed damage to mamane trees caused by browsing, that feral ungulates are the primary factor contributing to the lack of mamane regrowth; however, other factors such as mamane seed predation by rodents, damage caused to mamane seedlings by bivouac, and growth suppression resulting from dust deposition on mamane plants may also be involved. Because evidence of browsing has been observed in Critical Habitat Area B and is known to contribute to significant degradation of principal constituent elements in palila critical habitat (Service 2003b), initial emphasis of studies should be to monitor the amount of feral ungulate browsing on mamane and its impacts.

Ongoing Conservation Actions in the Action Area As described in U.S. Army Support Command Hawaii Reg. 210-11 (November 23, 1981) and Biological Opinion 1-2-83-F-39 (September 20, 1983), training restrictions have been identified for palila critical habitat. These include: 1) limiting

the number of troops using the area to approximately 500; 2) prohibiting the use of pyrotechnics or simulators; 3) prohibiting cargo helicopters from flying over palila critical habitat; 4) limiting vehicle use only to roads and well-defined trails; 5) prohibiting the cutting of vegetation; 6) prohibiting open fires; 7) prohibiting all refueling, food preparation, and vehicle maintenance activities; 8) limiting the number of helicopters authorized in the critical habitat to seven at any given time; and 9) restricting battery firing.

Conservation actions in the Palila Critical Habitat Area B as part of the planned Saddle Road realignment include fence construction along the realigned Saddle Road that will prevent vehicles from leaving the roadway, the construction of a fire/fuel break to the north of the roadway, and the construction of shoulder curbs to prevent cigarettes or other flammables tossed from vehicles from rolling off the roadway and acting as a source of fire ignition. To offset loss of habitat in Palila Critical Habitat Area B resulting from the planned Saddle Road realignment, Kipuka Alala was fenced and most feral ungulates have been removed from the area. The Army has committed to complete the removal of feral ungulates from Kipuka Alala (S. Gleason, pers. comm. 2003).

As described in the PTA Integrated Natural Resources Management Plan (INRMP), 2002-2006, 25th Infantry Division (Light) U.S. Army, Hawaii, the Army is committed to: 1) conducting periodic surveys for palila within PTA; 2) developing and implementing environmental awareness training for soldiers using PTA; 3) incorporating training restrictions into training scenarios to protect sensitive natural and cultural resources; 4) evaluating the need for restoration of training lands; and 5) coordinating with Natural Resources staff to evaluate the use of Seibert stakes to demarcate sensitive natural and cultural resources.

Lastly, the Army allows public bow hunting in the action area that reduces numbers of sheep, goats, and mouflon; however, the intensity of the hunting has been insufficient to remove all feral ungulates.

Status of the Species - Hawaiian Hoary Bat, opeapea (*Lasiurus cinereus semotus*)

Species Description. The Hawaiian hoary bat is a medium-sized (14 to 22 grams; 0.5 to 0.8 ounces), wingspan 26.9 to 34.6 centimeters (10.5 to 13.5 inches), nocturnal, insectivorous bat with short, thick, rounded ears and a furry tail. "Hoary" refers to the white-tinged, frosty appearance of the bat's grayish brown or reddish brown fur. Although females are slightly larger than males, forearm lengths are similar in both genders. These bats are not colonial, and roost solitarily in tree foliage.

The Hawaiian hoary bat is classified under the Family Vespertilionidae of the Suborder Microchiroptera, and is one of three recognized hoary bat subspecies. The other two subspecies are *Lasiurus cinereus cinereus*, one of the most common and widespread bats in North America, and *Lasiurus cinereus vilosissimus*, which occurs in South America and the Galapagos. Morphologically, the Hawaiian hoary bat may have diverged significantly from the North American

form, as Hawaiian hoary bats are about 45 percent smaller. Nonetheless, preliminary genetic analysis indicates the Hawaiian hoary bat may be derived from the North American hoary bat. The low degree of genetic divergence, however, suggests subspecies classification may be appropriate (Service 1998c).

Listing Status The Hawaiian hoary bat was listed as endangered on October 13, 1970, under the Endangered Species Conservation Act of 1969, and a recovery plan was prepared in 1998 (Service 1998c). Species listed under the Endangered Species Act of 1973 are automatically listed under the State of Hawaii's endangered species law (Hawaii Revised Statutes 195D-4a). Critical habitat has not been designated for the Hawaiian hoary bat.

Historic and Current Distribution The Hawaiian hoary bat is endemic to the State of Hawaii where it is the only existing, native terrestrial mammal. It has been documented historically on the islands of Hawaii, Maui, Molokai, Oahu, Kauai, and possibly Kahoolawe. This bat is now resident only on Hawaii, Maui, and Kauai, with the largest populations probably on Hawaii and Kauai; no evidence of a breeding population (*e.g.*, pregnant or lactating females) has been documented on Maui (Service 1998c). Occasional observations of bats on Oahu and Molokai are considered to be migrant or vagrant individuals from other islands. There are no population estimates for the Hawaiian hoary bat and few historical or current records. Unsubstantiated population estimates across the State have ranged from hundreds to a few thousand (Service 1998c). Data are limited because no feasible method currently exists for surveying the abundance and distribution of solitary, tree-roosting bats. The Hawaiian hoary bat's distribution may be broader than indicated by the current limited information resulting from localized search efforts (Service 1998c).

Hawaiian hoary bats are thought to be most numerous on the island of Hawaii, where they are uncommon but fairly widespread (Jacobs 1994). Bats have been observed year-round in a wide variety of habitats and elevations below 2,286 meters (7,500 feet), and a few sightings from limited surveys have been reported as high as 4,023 meters (13,199 feet). Bats have been detected in both wet and dry areas of Hawaii but seem to be more abundant on the drier leeward side (Jacobs 1994) and generally less abundant in wet areas (Kepler and Scott 1990). Only three researchers have examined spatial/temporal variation in occurrence patterns of bats on Hawaii, with conflicting conclusions about possible altitudinal or regional migration (Tomich 1986a; Jacobs 1994; Menard 2001).

Ecology (Life History) The Hawaiian hoary bat has been little studied and information for a comprehensive life history is lacking. Furthermore, the existing information on population status and habitat ecology is often conflicting. The extent of the bat's dependence on native vegetation is also unclear. Hawaiian hoary bats roost in a variety of tree species during the day and forage in a wide range of habitat types during the night. There is no information on the Hawaiian hoary bat's average life span, age at first reproduction, and survivorship, nor on how age and reproductive condition affect its food habits, habitat selection, home range size, and movement patterns.

A few studies have documented Hawaiian hoary bats in a wide range of locations and habitat types on the island of Hawaii. Bats observed along 983 kilometers (611 miles) of forest bird survey transects and incidentally elsewhere on Hawaii during 1976-1983, at elevations from sea level to 3,050 meters (10,007 feet), were more frequently associated with non-native vegetation (64 percent), such as tall eucalyptus and other exotic plants, than with native vegetation (19 percent) (Kepler and Scott 1990). Visual observations and echolocation detections at 22 sites in southeast Hawaii, however, found no significant differences in bat activity among native or non-native vegetation types (Reynolds *et al* 1998). In addition, 57 percent of all bat activity was noted at open sites, forest edges, lava flows, volcanic pit craters, residential and agricultural clearings, and roads. In contrast, foraging bats at 14 survey sites over a range of altitudes were more frequently associated with native vegetation (44 percent) than non-native (16 percent) or mixed (nine percent) vegetation (Jacobs 1993a; 1994). Bats were detected most often in native mesic koa-ohia forest vegetation at 13 sites in and adjacent to Hakalau Forest National Wildlife Refuge (Cabrera 1995, 1996). All reports of bat occurrences may be biased to varying degrees by sampling efforts concentrated along roads and forest edges.

Roosting habitat for the Hawaiian hoary bat is sparsely documented. Like North American bats, Hawaiian hoary bats are generally believed to roost solitarily in tree foliage (Barclay 1985; Tomich 1986a). North American hoary bats roost three to five meters (10 to 16 feet) above the ground, mostly in hardwood trees (Shump and Shump 1982). Hawaiian hoary bats have been observed in a wide variety of trees, including native species (*Metrosideros polymorpha*; *Pandanus tectorius*; *Styphelia tameiameiae*), Polynesian-introduced species (*Aleurites moluccana*), and post-contact introduced species (*Syzygium cumini*) (Jacobs 1993a; Service 1998c). Bats also have been occasionally observed in fern clumps, low scrub, rock crevices, macadamia nut orchards, and buildings (Tomich 1986a).

The factors influencing roost-tree selection by Hawaiian hoary bats are unknown, although bats may select roost trees based in part on thermoregulation requirements. As foliage offers incomplete protection from inclement weather, factors other than tree species may be important (*e.g.*, tree diameter and height, tree architecture, overstory canopy, forest composition, roost-tree density within the forest stand, etc.). The energy demands of thermoregulation for foliage-roosting bats may be especially critical for pregnant and lactating females, and for non-volant young (Barclay 1989). Hawaiian hoary bats and North American hoary bats are not colonial and do not roost in caves. However, Fujioka and Gon (1988) reported a possible cave-roost site in the Kau-South Kona area of Hawaii where 16 Hawaiian hoary bats were seen entering and emerging from a collapsed lava tube in late July-early August 1977. No other studies have documented caves as possible Hawaiian hoary bat roost sites.

The extent of roost-tree fidelity in North American and Hawaiian hoary bats is unknown, but North American hoary bats occasionally move to alternate roosts (Barclay 1989). Roost-site fidelity among foliage-roosting bats in general may be to a home area rather than to a specific tree, and may vary seasonally and with reproductive condition (Pierson 1998; Barclay 1989). Two

radio-tagged male Hawaiian hoary bats returned to the same roosting area (possibly to the same tree) each night over several days during August-October, and one radio-tagged female returned to the same area (also possibly to the same tree) over a two-week period (Jacobs 1993b). Based on observations of these three radio-tagged bats, Jacobs (1993b) concluded they were roosting in native ohia trees and believed a high degree of roost fidelity is likely (while acknowledging the small sample size). Because tree-roosting bats in general may be adapted to an abundant supply of roost sites in forested areas, roost-tree fidelity may be unimportant; other factors such as distribution of suitable roost sites throughout the landscape may be more critical than micro habitat features of particular roost trees (Pierson 1998). Bats that do not return to specific roost trees, however, may require a larger supply of potential roost sites (Chung-MacCoubrey 2003). No one has studied Hawaiian hoary bat home range characteristics, how often bats switch roost sites, or how roosting sites differ by age, gender, reproductive condition, and season.

Selection of foraging habitat by Hawaiian hoary bats has been little more studied than roosting habitat. Like the North American hoary bat, the Hawaiian hoary bat is an opportunistic aerial hawker of flying insects (Whitaker and Tomich 1983). Aerial insectivorous bats in general detect and track individual insects, and consume most of them in flight (Kalko and Schnitzler 1998). Hawaiian hoary bats feed on native insects, such as noctuid moths and sphinx moths, as well as on non-native moths, beetles, and termites (Whitaker and Tomich 1983; Belwood and Fullard 1984; Jacobs 1993a). Conflicting information on the food habits of the Hawaiian hoary bat indicates its diet may be either more generalized than that of the North American hoary bat (Jacobs 1993b) or just as selective (Belwood and Fullard 1984). Moreover, the North American hoary bat may not necessarily be a "moth strategist," as previously thought, owing to evidence of opportunistic feeding on other large insects such as odonates and beetles (Barclay 1985). On the Hamakua Coast of Hawaii, Whitaker and Tomich (1983) found no evidence that Hawaiian hoary bats specialized in taking moths or other specific arthropod taxa. In contrast, Belwood and Fullard (1984) found that bats on Kauai did specialize on large moths, although beetles and dipterans also were taken. Jacobs (1993a) found that diet was influenced by habitat type and prey size: in open habitats at PTA, bats took larger insects, predominantly large moths; in relatively closed forest habitats elsewhere on the island of Hawaii, bats took smaller insects, predominantly beetles. Bats on both Hawaii and Kauai will opportunistically forage on insects attracted to lights (Jacobs 1993a; Belwood and Fullard 1984). The habitat associations of the Hawaiian hoary bat's insect prey have not been investigated.

Hawaiian hoary bats forage in a variety of open and vegetated habitats, including open fields, lava flows, open ocean in bays near shore, and streams and ponds. Bats on Hawaii forage in both relatively closed habitats near vegetation (such as clearings in lowland mesic ohia forest or town parks) as well as in open habitats and forest edges (Jacobs 1993a; Tomich 1974). Hawaiian hoary bats generally forage 1 to150 meters (3 to 492 feet) above the ground or open water, 1 to15 meters (3 to 49 feet) above the ground in closed forest habitats, and up to 30 meters (98 feet) and more above tree canopy (Jacobs 1993a; Kepler and Scott 1990). Around exterior lights, bats have been observed foraging as low as 15 centimeters (six inches) above the ground in pursuit of moths (Belwood and Fullard 1984). Although Hawaiian hoary bats are thought to

forage near their roost sites, they also sometimes commute long distances between roost sites and foraging areas, and have been tracked flying up to 15 kilometers (nine miles) in one night (Jacobs 1993a). Bats also seem to use several different foraging sites over a single night or a few consecutive nights, and may not return to reuse a particular site for up to two weeks (Jacobs 1993a, 1993b).

Little is known about the fidelity of any bat species to foraging sites (Pierson 1998). Territoriality in the Hawaiian hoary bat has not been investigated for either roosting or foraging habitat. Hawaiian hoary bats often forage in groups of up to 8 bats, and gatherings of up to 22 bats have been seen foraging near shore over open ocean (Tomich 1986a). Individual North American hoary bats and Hawaiian hoary bats occasionally establish feeding territories around exterior lights that attract insect swarms (Barclay 1985; Belwood and Fullard 1984). Audible agonistic vocalizations are associated with this territorial foraging behavior in Hawaiian hoary bats, and pursuits of other bats to defend foraging areas are common (Belwood and Fullard 1984; Fullard 1984; Tomich 1974).

Hawaiian hoary bats forage under most weather conditions, including fog, moderate rain, strong winds, and temperatures as low as 13° Celsius (55.4° Fahrenheit), but are inactive during heavy rains or temperatures below 10° Celsius (50° Fahrenheit) (Belwood and Fullard 1984; Fullard 1989). Researchers disagree whether Hawaiian hoary bats forage preferentially at certain peak times of the night, but most bat detection studies have been conducted only at dusk and shortly afterwards. At two military sites with exterior lighting (including PTA's Bradshaw Army Airfield), bats have often been seen foraging around security lights late into the night (Belwood and Fullard 1984; Fullard 1989; Jacobs 1993a).

Little is known about the breeding biology of Hawaiian hoary bats. Females of most temperate, autumn-breeding insectivorous bat species become pregnant in the spring by delayed ovulation and fertilization, and young are cared for exclusively by the female. The breeding cycle of the Hawaiian hoary bat on the island of Hawaii consists of pregnancy (April to June), with pups born in May or June; lactation (June through early August and possibly to September); post-lactation, after pups have fledged (September to December); and pre-pregnancy (January to March) (Menard 2001). Like North American hoary bats, Hawaiian hoary bat females are believed to give birth to two young at a time. North American hoary bat pups cling to the mother at the roost tree during the day, where she leaves them hanging on a twig while she forages at night (Shump and Shump 1982), and Hawaiian hoary bats are presumed to behave similarly. Female North American hoary bats adjust their foraging behavior to meet the increasing energy demands of pregnancy and lactation (Barclay 1989). Because newborn bats cannot thermoregulate very well in tree-foliage roosts, the mother's foraging activity may be constrained by the need to roost periodically with her young to keep them warm. Thus, foraging behavior changes with reproductive condition, and females with non-volant young may forage at different times of night and perhaps in different habitats than other bats. Preliminary evidence indicates that pregnant and lactating female Hawaiian hoary bats on Hawaii may prefer roosting in lowland areas rather than in

the cooler highlands, perhaps because the warmer lowland environment promotes faster juvenile growth (or, alternatively, because insect food sources may be more readily available) (Menard 2001).

Hawaiian hoary bat activity patterns seem to vary seasonally and/or geographically on Hawaii, with most observations occurring during August-September (Jacobs 1993a; Reynolds *et al* 1998) or August-December (Kepler and Scott 1990). Peak observations during August, September, and October may be due to recent recruitment of fledged juveniles (Kepler and Scott 1990; Jacobs 1994; Reynolds *et al* 1998). Declines in bat activity generally occur during November-December in the Puna area (Reynolds *et al* 1998) and during January-March in Kona (Jacobs 1994). Seasonal altitudinal differences in bat activity levels have been documented on the island of Hawaii (Menard 2001). Among other findings, Menard (2001) collected evidence that suggests Hawaiian hoary bats may be capable of torpor, and may migrate seasonally in search of suitable roost sites.

To investigate possible seasonal or altitudinal movements of Hawaiian hoary bats, Menard (2001) reviewed existing published and unpublished information on the Hawaiian hoary bat. Included in her review was an entire year of monthly records collected by the Hawaii Heritage Program at 12 PTA monitoring sites during 1992-1993; and unpublished sightings and biological measurements recorded by Dr. P.Q. Tomich of bats collected from the Hamakua and Hilo vicinity of the island of Hawaii during 1960-1979. In addition, Menard (2001) monitored activity patterns of Hawaiian hoary bats at 23 sites over a broad geographical and altitudinal range on the island of Hawaii.

Torpor is a dormant state characterized by reduced body temperature, by which many species of bats respond to adverse climatic conditions. Hibernation is an extended torpid state by which bats reduce their metabolic rate to conserve energy over weeks or months, usually during the winter when insect food sources are unavailable. Bats in temperate climates must gain additional fat reserves over the summer to support metabolic processes during hibernation. Whether the Hawaiian hoary bat hibernates over the winter or enters a more temporary torpid state during daily roosting is unknown.

Hawaiian hoary bats roost in tree foliage during the day throughout the year, presumably because entering a daily torpid state conserves energy for a small animal unable to forage constantly for food (Tomich 1986a). On Hawaii, tree roosts are exposed to weather conditions that change seasonally and with altitude. Tomich (1974, 1986a) found that Hawaiian hoary bats respond to cooler weather by acquiring 20 to 25 percent of their body weight in fat deposits during the late summer, indicating a potential for torpor. Lethargic or torpid bats that are occasionally found grounded or dislodged from their roosts are usually unable to fly, probably because of depleted energy reserves (Tomich 1974). The North American hoary bat is capable of entering torpor because its body temperature falls when ambient temperature is colder than the bat's normal homeothermic body temperature (*i.e.*, about 34.8° Celsius; 94.6° Fahrenheit), which is assumed

to be the same for Hawaiian hoary bats). The Hawaiian hoary bat's body temperature falls below that homoeothermic body temperature over a range of ambient temperatures (*i.e.*, 3° to 23° Celsius; 38° to 74° Fahrenheit), which suggests the Hawaiian subspecies has retained the capacity to enter torpor (Menard 2001, based on unpublished Tomich data).

Hawaiian hoary bats are strong fliers (Jacobs 1993a; Fullard 1989), but whether they migrate between islands or locally within each island is unknown. North American hoary bats seasonally migrate between north and south latitudes of that continent, and seem to avoid warm latitudes during the spring/summer breeding season and cool latitudes during the winter. According to a few studies based on limited data (see review in Menard 2001), South American hoary bats may migrate altitudinally to cooler mountain habitats during the winter. Hawaiian hoary bats seem to avoid the cool uplands of Hawaii during the summer breeding season and to avoid the warm lowlands during the winter (Menard 2001). However, no study has conclusively demonstrated altitudinal migration in Hawaiian hoary bats (see Tomich 1986; Jacobs 1994; Menard 2001). Tomich (1986a) found seasonal shifts of bat activity levels between coastal and upland areas at 300 to 790 meters (984 to 2,592 feet). Jacobs (1993a, 1994), however, found no indication of seasonal migration over a range of elevations below 1,890 meters (6,201 feet).

Menard (2001) concluded that patterns of temporal occurrence on Hawaii (*i.e.*, the proportion of nights with observed bat activity) varied among the lowlands, the eastern highlands (Hakalau Forest National Wildlife Refuge), and the central highlands (PTA) in a manner consistent with a pattern of altitudinal and possibly regional migration. Her observations suggested that bats migrate three times a year: 1) during the breeding period (April to August), when both males and females seem to move out of the eastern highlands and into the lowlands; 2) during the post-lactation period (September to December), when male bats seem to move into the eastern highlands and perhaps into the central highlands; and 3) during the pre-pregnancy period (January to March), when bats seem to move out of the lowlands and possibly the central highlands and into the eastern highlands. Bats did not completely vacate the lowlands during the winter or the eastern highlands during the breeding season, as some bats continued to roost in those areas. The apparent seasonal differences in bat occurrences by altitude on Hawaii have not been confirmed as migratory patterns by banding studies or radio-telemetry.

Population Trend Current and historical population numbers are unknown for the Hawaiian hoary bat, but the species is believed to have declined over the past 100 years. Little is known about the population trends of lasiurine bats in general, which typically are inferred from historical changes in the most limiting habitat factor, such as suitable roosting sites (Carter *et al* 2000). For example, the North American hoary bat population apparently has increased as a result of reforestation in the eastern United States since the 1930s (Carter *et al* 2000). Similarly, the decline of the Hawaiian hoary bat has been largely inferred from the lack of recent sightings in its former range and a concurrent range-wide loss of forest habitat. A possibly large population historically occurred on Oahu, based on a single observation in the early 1800s of an unknown number of bats at an unidentified location (Tomich 1986b). Observations on Hawaii and Kauai were

apparently widespread as recently as 1939-1986 (Tomich 1986a). Observations and specimen records suggest Hawaiian hoary bats are now absent from much of their historically-occupied range, but the magnitude and cause of any population decline is unknown (Service 1998c).

Threats The major threats to Hawaiian hoary bats are assumed to be the same as those that threaten many bat species in general (Harvey *et al* 1999; Service 1998c). Bats have the slowest reproductive rate and the longest life-span of all mammals of their size (Tuttle 2000). Thus, any mortality of breeding-age adults, particularly females, would constrain the recovery of the subspecies. The primary factor limiting recovery is thought to be habitat loss, primarily the availability of roosting sites; suitable roosting habitat is particularly important to pregnant and lactating females and non-volant young. Other possible threats identified in the recovery plan that have not been investigated may include pesticides (directly or by impacts to prey), predation (by native hawks and non-native feral cats), alteration of prey availability due to introduction of non-native insects, and roost disturbance. Occasional instances are documented of Hawaiian hoary bats killed by collisions with vehicles and structures (Belwood and Fullard 1984; Tomich 1986a; Kepler and Scott 1990; Menard 2001), and North American hoary bats seem quite susceptible to such collisions (Erickson *et al* 2002).

Conservation Needs of the Species The overall recovery strategy for the Hawaiian hoary bat is based on the need for research to provide information on the subspecies' abundance and distribution, life history, and habitat associations. The currently available information is so limited that even the most basic management actions cannot be undertaken with any certainty of benefit (Service 1998c). Therefore, the primary recovery goal is to conduct research essential to the conservation of the Hawaiian hoary bat. Research should focus on developing standardized survey and monitoring protocols for determining abundance and distribution, roosting habitat associations, basic life history biology, and food habits. Other recovery goals are to protect and manage current populations by identifying and managing threats, including protection of key roosting and foraging areas; conduct a public education program; and evaluate progress towards recovery and revise recovery criteria as necessary (Service 1998c).

Ongoing Conservation Actions The Service, the Hawaii Department of Land and Natural Resources - Division of Forestry and Wildlife, and Bat Conservation International (BCI, a non-profit conservation and education organization) jointly sponsor a public-private Hawaiian Hoary Bat Research Cooperative to collaboratively prioritize and fund management-oriented research on the Hawaiian hoary bat's abundance, distribution, and habitat requirements. Major stakeholders include private landowners, agricultural and commercial forestry interests, environmental groups, local governments, and Federal and State agencies. Most of the cooperative's current funding is provided by two Service Cooperative Endangered Species Conservation Fund Section 6 (of the Endangered Species Act) grants to the State. These cost-shared section 6 grants are for State development (including baseline surveys) of a programmatic Safe Harbor Agreement and a programmatic Habitat Conservation Plan under Endangered Species Act sections 10(a)(1)(a) and 10(a)(1)(b), respectively. The cooperative recently awarded funding to the U.S. Geological

Survey's Biological Resources Discipline for telemetry research in years 2004 to 2006 on Hawaiian hoary bat movements within State-owned timber management areas on the island of Hawaii. The Service is also working with several private landowners on the island of Hawaii to develop Safe Harbor Agreements and Habitat Conservation Plans for the Hawaiian hoary bat.

Environmental Baseline

Status of the Species in the Action Area The action area comprises about seven percent of the Hawaiian hoary bat's current range and about 13 percent of its range on Hawaii (*i.e.*, of the island's total area). The bat population at PTA is an unknown proportion of the subspecies' range-wide distribution, for which there are no abundance estimates. However, Hawaii is thought to have the largest existing population of Hawaiian hoary bats and for that reason is important to the survival and recovery of the subspecies.

Existing records of Hawaiian hoary bats at PTA include monthly monitoring data for an entire year (February 1992 to January 1993) from the Hawaii Heritage Program, which detected a few bats each month (Jacobs 1993a; Menard 2001). Those surveys recorded one to three bats along the Bobcat Trail at the Multi-Purpose Range Complex over each four-night monthly sampling period during February, May, June, and August; and 11 bats over one four-night period in August/September. In addition, Jacobs (1993a, 1994) documented 7 to 10 bats at PTA's Bradshaw Army Airfield for each of seven sampling periods during May through October 1992. Bat activity at PTA apparently was greatest during the post-lactation period (September to December), least during the pre-pregnancy period (January to March), and showed a minor peak during the breeding season (May and June) (Menard 2001). During June and early July 1995, a radar study conducted at PTA by Cooper *et al* (1996) detected a total of 45 flying bats at 12 of 19 sampling sites located in a wide variety of habitat types. Activity levels were higher at sites in eastern PTA, and adjacent to PTA on the northern and eastern slopes of Mauna Loa. Cooper *et al* (1996) concluded that bats likely were present in low numbers throughout the installation. The Transformation Biological Assessment documents these and other bat sightings in the following areas: immediately south of Bradshaw Army Airfield (where at times up to 10 foraging bats have been observed nightly); inside the Impact Area about one kilometer (0.6 mile) south of the proposed Anti-Armor Live-Fire Tracking Range; in Training Areas 4, 11, 22, and 23; in the cantonment area; and south of PTA near Mauna Loa Observatory. A few museum specimen records note bats found at the Ammunition Storage Position and at Bradshaw Army Airfield Fire Station (Menard 2001).

Based on the limited information available, Hawaiian hoary bats are present in low numbers throughout PTA year-round. The southwestern part of PTA is the only area on the island of Hawaii where bats have been seen at all months of the year, presumably owing to the presence of suitable summer and winter habitat (Menard 1997). The existing information is inadequate to determine the abundance and distribution of bats at PTA, or to confirm the presence of roosting or breeding bats. According to the Transformation Biological Assessment, bats are more frequently

seen at PTA than native birds, but the bat's habitat requirements and response to military activities are poorly understood.

According to the Legacy and Transformation Biological Assessments, no breeding or roosting bats have been reported at PTA or the Keamuku Parcel, and no bat sightings reported from the Keamuku Parcel, in the last 20 years. The Biological Assessments are unclear whether bat surveys ever have been conducted on the Keamuku Parcel, do not describe how frequently bats are monitored at PTA, and do not state whether surveys are designed to detect roosting bats or ascertain reproductive status (*e.g.*, through radio-telemetry or mist-net studies). Although the presence of bats at PTA is documented, the types of surveys conducted have not been able to determine the numbers of bats present. The Transformation Biological Assessment concludes that the Hawaiian hoary bat is "rarely observed" at PTA and "does not appear to be a resident species." Without accurate surveys of abundance and distribution, however, the relative rarity of bats at PTA cannot be evaluated; bats are probably no more rare there than elsewhere on the island of Hawaii. Nevertheless, pregnant and lactating female bats were captured at PTA in the early 1990s (see Menard 2001), indicating the likelihood of a resident breeding population. The year-round presence of bats and the availability of suitable roosting habitat indicate that bats likely are breeding, roosting, and foraging at PTA.

Hawaiian hoary bats have been detected at PTA in a wide variety of habitat types, from barren lava to open ohia forests (Cooper *et al* 1996), probably because of an abundant food supply of noctuid moths and sphinx moths, as stated in the both Biological Assessments. Treeland, shrubland, and grassland communities at PTA provide ample available roosting and foraging habitat for bats. Roosting (treeland) and foraging (shrubland) habitat categories are not mutually exclusive, as Hawaiian hoary bats occasionally have been observed roosting in shrub vegetation and often forage in relatively closed forest. Hoary bats in general are tree-roosting species and suitable roost trees are thought to be a major limiting factor in the survival of hoary bat populations. However, anecdotal observations from field biologists indicate Hawaiian hoary bats probably roost in any tree or shrub with adequate foliage, especially in open areas with dense shrub cover but few trees. There is currently no information on the habitat features bats use to select roost sites at PTA or elsewhere.

Tables 2 and 3 list PTA and Keamuku Parcel vegetation types that provide potential available roosting and foraging habitat for Hawaiian hoary bats (GIS analysis by the U.S. Fish and Wildlife Service's Pacific Islands Fish and Wildlife Office, from databases provided by the Army). PTA proper (excluding the Keamuku Parcel) currently provides about 19,966 hectares (49,317 acres) of available roosting habitat in treeland vegetation communities or in shrubland vegetation communities with either *Sophora chrysophylla* or *Myoporum sandwicense* as a dominant or co-dominant component; these vegetation types are defined as "treeland" roosting habitat for the purposes of this biological opinion. PTA proper (excluding the Keamuku Parcel) currently provides about 11,829 hectares (29,230 acres) of available foraging habitat (including about 10,001 hectares (24,713 acres) of shrubland communities and about 1,827 hectares (4,515 acres)

of grassland communities). Treeland roosting habitat as defined above is present on about 45 percent of PTA and shrubland/grassland foraging habitat is present on about 27 percent of PTA (about 22 percent of the PTA area is shrubland vegetation). These treeland and shrubland habitat types are present throughout most of PTA, except in the cantonment area and Bradshaw Army Airfield. The Keamuku Parcel contains mostly pasture due to historic cattle grazing with remnant open shrublands; no data are available on the amounts of existing vegetation types on the Keamuku Parcel.

Table 3. Vegetation communities providing available habitat for Hawaiian hoary bats at PTA.

Vegetation Type	Area in Hectares	Area in Acres
Treeland Communities (Available Roosting Habitat)		
Chamaesyce Treeland	16	39
Myoporum-Chamaesyce Treeland	259	641
Open *Metrosideros* Treeland with sparse shrub understory	6,448	15,928
Open *Metrosideros* Treeland with dense shrub understory	1,097	2,710
Intermediate *Metrosideros* Treeland	511	1262
Sparse *Metrosideros* Treeland	5,192	12,823
Sophora-Myoporum-Chamaesyce Shrubland	182	448
Sophora-Myoporum Shrubland with forb understory	571	1,412
Sophora-Myoporum Shrubland with grass understory	1,635	4,038
Myoporum-Dodonaea Shrubland	1,022	2,525
Myoporum-Sophora Mixed Shrubland	370	913
Myoporum-Sophora Shrubland with mixed understory	938	2,317
Myoporum Shrubland	1,726	4,263
Total	19,967	49,319
Shrubland Communities (Available Foraging Habitat)		
Open *Dodonaea* Shrubland	1,161	2,868
Dense *Dodonaea* Shrubland	34	85
Dodonaea Mixed Shrubland	1,854	4,581
Chenopodium Shrubland	364	899
Styphelia Mixed Shrubland	59	146
Styphelia-Dodonaea Shrubland	6,529	16,126
Total	10,001	24,705
Grassland Communities (Available Foraging Habitat)		
Eragrostis Grassland	1,172	2,895
Pennisetum Grasslands	1,620	656
Total	2,792	3,551

Bats apparently forage throughout PTA year-round, but the limited survey data available cannot confirm whether bats also roost there. Evidence of reproducing bats is documented at Bradshaw Army Airfield, where pregnant and lactating females have been captured during the breeding season (April through August) (see Menard 2001). Mean low ambient temperatures are warm enough during the summer to support roosting females and pups (*i.e.*, 11° to 14.4° Celsius (52° to 58° Fahrenheit) measured at Bradshaw Army Airfield), and a minor peak in bat activity occurs at PTA during May and June (Menard 2001). Although the pregnant and lactating bats captured at PTA were thought to have come from roosting areas outside PTA, no data were collected to confirm that supposition (see Menard 2001). Bat activity appears highest at PTA during the post-lactation period (September to December), when bats may migrate there from lowland areas (Menard 2001).

Jacobs (1993a, 1994) monitored foraging Hawaiian hoary bats in open mamane-naio woodland at Bradshaw Army Airfield during May-October 1992, and concluded his PTA survey sites were regularly used by bats at least some times of the year. All observations indicated foraging behavior, demonstrating the characteristic erratic flight and sonar pulses of foraging insectivorous bats (in contrast, bats commuting long distances fly in one direction at high altitudes of 150 meters (492 feet) or more). Although both moths and dipteran insects were available at the PTA survey sites, bats foraged mostly on moths (Jacobs 1993a). During June and early July 1995, Cooper *et al* (1996) observed long-distance directional flights just after sunset, indicating bats likely were commuting between widely separated roosting and foraging areas at PTA or from surrounding lands.

Most of the lands adjacent to PTA are conservation lands, of which 77 percent are owned by the Hawaii Department of Land and Natural Resources (including Mauna Kea State Park) and 23 percent are privately owned. An undetermined amount of treeland, shrubland, and grassland vegetation types are present on these surrounding lands. Limited surveys have documented bats on some adjacent lands within the last 20 years (HINHP 2002). Based on observation of long-distance flights, Jacobs (1993a, 1994) concluded bats likely commuted to forage at PTA from roosting areas outside the installation. These observations have not been confirmed by radio-telemetry or banding studies. Due to lack of sampling effort, no roosting habitat has been conclusively identified anywhere within the bat's range, including PTA, the Keamuku Parcel, or adjacent lands.

There are ongoing conservation actions being implemented by the Army at PTA to minimize the impacts of military activities on listed species. According to the Transformation Biological Assessment, several Biological Sensitive Areas were originally proposed to contain a total of approximately 2,914 hectares (7,201 acres) of fence units. These fence units protect native vegetation from feral ungulates in part of the Kipuka Kalawamauna Endangered Plants Habitat, two parts of Kipuka Alala, the Puu Kapele, and the *Silene hawaiiensis* Unit at PTA; and the Nohonahae Cinder Cone summit and Puu Papapa in the Keamuku Parcel. The existing fence units at PTA contain approximately 2,019 hectares (4,989 acres) of treeland communities (the

Service has no information on the vegetation types in the Keamuku Parcel fence units). In addition, approximately 2,124 hectares (5,249 acres) of designated palila critical habitat inside PTA are unfenced and receive varying degrees of protection through training restrictions (*e.g.*, prohibition of live fire, fires, and pyrotechnics; prohibition of vegetation cutting; restrictions on aircraft flight elevations). These palila critical habitat areas contain approximately 1,369 hectares (3,383 acres) of treeland communities. Standard Operating Procedures already minimize many training impacts in various locations throughout PTA, for example by restricting pyrotechnics and open fires during bivouac in certain areas. In the Kipuka Kalawamauna, for example, fires, pyrotechnics, and off-road vehicle travel are prohibited.

Threats in the Action Area The Biological Assessments do not address threats of the proposed action on the Hawaiian hoary bat in any specific detail. The major threats to Hawaiian hoary bats in the action area are habitat loss and degradation, primarily the destruction and disturbance of available roosting sites. Roosting habitat is considered a major limiting factor for hoary bats in general. Suitable roosting habitat is particularly important to pregnant and lactating females and non-volant young during the breeding season, and to the survival of all bats throughout the year. Likewise, the loss of foraging habitat would adversely affect existing populations of bats at PTA and perhaps bats roosting in surrounding lands. The primary threat to roosting and foraging habitat for the Hawaiian hoary bat is the risk of wildfire resulting from military training. Direct injury or death of Hawaiian hoary bats in conjunction with live-fire exercises is less likely, although still a threat, in the action area. In addition, indirect impacts such as dust from training activities may have a detrimental affect to young animals if subjected to continuous bouts of dusting.

Conservation Needs in the Action Area Conservation measures needed include development and implementation of monitoring protocols to identify the presence of bats in the action area, guidelines to protect bats from direct harm or harassment due to human activity, and minimization measures specifically designed to offset adverse impacts to bats by maintaining, enhancing, or replacing lost roosting and foraging habitat. To clarify these conservation needs, the following information would greatly improve understanding of the roosting and foraging habitat now present in the action area.

- Area of existing treeland, shrubland, and grassland vegetation types at PTA proper and the Keamuku Parcel.

- Area of existing treeland, shrubland, and grassland vegetation types in the Impact Area (*e.g.*, from recent aerial photography) and area of those vegetation types present before live-fire training commenced at PTA (from historical aerial photography).

- Annual area (and vegetation types, if known) destroyed by past fires at PTA, and frequency probabilities for occurrence of large fires.

- Spatial and temporal trends in abundance and distribution of Hawaiian hoary bats in the action area.

- Density of Hawaiian hoary bats in various roosting and foraging habitats in the action area.

Ongoing Conservation Actions Within the Action Area The Service is not aware of any species-specific conservation measures being implemented for the Hawaiian hoary bat in the action area.

EFFECTS OF THE ACTION ON LISTED SPECIES AND CRITICAL HABITAT

General Effects

This section outlines impacts from Legacy and Transformation that will affect many, if not all, species in this biological opinion, and is meant as an overview to facilitate analysis of training effects on 15 plant species, palila critical habitat and the Hawaiian hoary bat. Three types of effects may occur to listed species and their habitat due to Army training activities: 1) direct - a project or training action that will permanently impact a given species occurrence and/or its habitat; 2) indirect - those effects that are caused by, or will result from, the proposed action and may be later in time but are still reasonably certain to occur; and 3) beneficial effects - projects that may have a short-term negative effect but will result in a beneficial result in the long term. Many of the Legacy and SBCT Transformation actions will result in a combination of direct and indirect effects on species and their habitats. The following issues or activities will impact species and habitats and shall be discussed here as a general overview. Minimization and avoidance measures for these actions are summarized jointly. A more detailed effects discussion shall follow for each species and critical habitat.

The Transformation Biological Assessment categorized Transformation training actions as either having a very low, low, moderate, high, or very high probability of adversely affecting or impacting listed species or palila critical habitat. The following categories give a general probability for each predicted level of impact:

- Very low
- Low
- Moderate
- High
- Very High

Live-fire Training (Impact Area)

Three Army training actions will result in the complete loss of one or more occurrences of listed plants species. One of these actions, training with live-fire ammunition, results in the dedication of a large area as the repository for weaponry charges. At PTA, this Impact Area (see Figure 4) is approximately 20,628 hectares (50,973 acres) and is the danger area where all rounds and mortars from the firing points land. The Impact Area has been used for decades and is off-limits to

unauthorized personnel due to fired munitions hazards. Fires are not controlled in the Impact Area (due to the presence of unexploded ordinance) and uncontrolled fires may potentially spread from the Impact Area to other areas of the installation. Because the Impact Area is unsafe for human activity, surveys for listed species cannot be conducted, nor can it be accurately determined which species will be lost, or the magnitude of the loss. This area may be a source of pests for other parts of the installation due to the inability to carry out natural resource measures such as invasive plant control, ungulate removal, or small mammal trapping. The Impact Area effectively subdivides PTA into an eastern and western section (see Figure 3). The loss of this large, central area fragments natural habitats for bats and listed plants thereby diminishing ranges of species and genetic transfer among populations, subpopulations, and individuals. The Service has determined that there is a high probability that any listed plant species or roosting habitat for the Hawaiian hoary bat within the Impact Area will be lost through time due to fire or direct impact of live-fire munitions. The historic and future loss of this habitat and occurrences of listed species is considered important.

The Transformation Biological Assessment attempted to address the issue of listed plants and habitat that may be within the Impact Area by compiling a community plant map with 24 plant vegetation types delineated from aerial photos (see Figure 20 in the Transformation Biological Assessment). However, this methodology gives only a prediction of species presence and relative abundance based on vegetation type. According to this hypothesis, there is a high probability that *Silene hawaiiensis*, *Hedyotis coriacea*, and *Asplenium fragile* var. *fragile* would be found within the Impact Area. In addition, two listed species, *Stenogyne angustifolia* and *Zanthoxylum hawaiiense*, were observed while conducting botanical surveys for the construction of the Battle Action Course and Anti-armor Live-fire Tracking Range. Therefore, we know some plant occurrences that will be permanently impacted, and we can predict that at a minimum, occurrences of at least three other plant species will be lost from fire or munition rounds.

Off-Road Maneuver Areas

We have also determined that native habitat for listed plants and bats will likely be destroyed in designated Stryker off-road maneuver areas (see Figure 6). Vehicular off-road maneuver activity can either directly crush the plant or indirectly affect the species by habitat degradation from soil compaction, dust and habitat fragmentation. We do not know the frequency, or number of Stryker vehicles, that will utilize the off-road maneuver areas either within the northern portion of PTA, or the Keamuku Parcel, each year. It is our understanding that multiple Stryker vehicles will be driven in formations across any and all accessible land within these designated areas. Therefore, we determined that it there is a very high probability that off-road maneuver areas will be completely impacted over time. This loss of habitat also creates population and habitat fragmentation, essentially diminishing ranges of species and genetic transfer among individuals of a species. The Stryker maneuver areas are not off-limits to Natural Resources staff conducting management actions, however it would not be prudent to invest time and resources into these high-use training areas because it is likely that remaining native vegetation and listed species will be lost in the long term. The two plant species that will be permanently impacted by this activity are

Haplostachys haplostachya and *Silene hawaiiensis*. The loss of this habitat and occurrences of listed species is considered important. A more detailed analysis of these impacts shall follow in the species-specific effects section.

Indirect effects of off-road maneuvers is the creation of large plumes of dust (particularly in the Keamuku Parcel) and dust accumulation on adjacent habitats and species over time. See the discussion on dust below.

Construction Impacts

Nine construction projects are included as part of the action at PTA. Two of these projects, the Battle Action Course and the Anti-armor Live-fire Tracking Range, will result in the complete loss of several occurrences of listed plants and roosting habitat for the Hawaiian hoary bat. The project footprint for the Anti-armor Live-fire Tracking Range will impact several occurrences of *Silene hawaiiensis*. The Battle Action Course will impact one *Zanthoxylum hawaiiense*, and several occurrences of *Haplostachys haplostachya* and *Silene hawaiiensis*. Each of these species-specific impacts will be discussed in greater detail in the effects section. Overall, approximately 1,100 hectares (2,718 acres) of land will be impacted for the construction of these two training facilities (this includes conversion of existing training areas). The Service has determined these two construction projects have a very high probability of impacting all occurrences of listed plants within the project footprints and shrubland habitat for the Hawaiian hoary bat. The construction and training use of these two facilities is considered to be a permanent loss of species and habitat through time. The indirect effects associated with the construction of these nine projects include habitat fragmentation, edge effects, and dust production.

Fire

When assessing fire risk for PTA, the following elements were considered: fuel types, training activities, fire history, significant topographic barriers, buffers, defensible boundaries, and fire minimization and prevention. The threat of fire resulting from training exercises can range from low to very high, depending upon the location of the species or habitat in relation to the training action. Fires can also be started from non-training activities or accidental ignition such as catalytic converters, cigarettes, maintenance or construction equipment, or hunters. Fire is a considerable 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 vegetation it allows for the intrusion of non-native, fire-adapted, invasive plants and prohibits regeneration of native plants. Each successive fire that reaches native shrubland or woodland forest reduces habitat for listed species, affects the moisture and canopy of the native habitat boundary, and increases the number of alien plants in areas of native vegetation. Invasive plant encroachment increases after a major disturbance event such as a fire and this secondary threat can have a significant effect to any threatened or endangered plant species not destroyed by the fire.

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) went out of prescription and ended up burning over 850 hectares (2,100 acres) including 61 hectares (151 acres) of native habitat and several listed plant species. In addition, there have been two recent fires at Schofield Barracks Military Reservation (July and August 2003) and Kahuku Training Area (June 2003) that impacted critical habitat and consumed additional native habitat. Therefore, the fire risk, as stated in the Transformation Biological Assessment, is underestimated and the Service believes the risk to all species and habitats is higher than the Army has indicated.

To reduce the threat of wildfire at PTA a WFMP has been finalized and signed by the Army. Some measures of the plan have already been put into effect. See WFMP discussion in the Project Description.

Ungulates

Four species of ungulates have been observed at PTA including feral goats, sheep, mouflon sheep, pigs and sheep/mouflon sheep hybrids. The goat is the most common ungulate at PTA, as it is better adapted for survival in the dry, rugged terrain found on this installation. Mouflon sheep and sheep hybrids are more frequently observed in the higher altitude areas of PTA primarily in the northeast. Pigs are found mostly in the northwest. Feral ungulates have degraded extensive tracts of native vegetation through grazing and trampling, thereby affecting habitats of listed species as well as having direct impacts to the species themselves from foraging. Feral ungulates may also increase the spread of alien plant species by carrying seeds in their feces and fur. Ungulates have an extremely detrimental effect (on native vegetation and listed species) and we have determined ungulates to be the second most severe impact to species and habitats after military live-fire training.

Construction of fence units will preclude feral ungulates from high density listed plant areas thereby reducing the threat level from the detrimental effect of ungulates browsing on listed plants and their habitats. See fence discussion below.

Non-native Species

The threat of increased non-native species introductions and their subsequent spread is always prevalent within, and adjacent to, high disturbance areas such as military training facilities. Non-native species include plants, feral ungulates (sheep, goats, mouflon, and pigs), small mammals (rats, mice, mongooses, and feral cats), birds, invertebrates, and bacterial, viral, and fungal plant diseases. The combination of fire, grazers, browsers and alien introductions has collectively altered the Hawaiian environment. Invasive plants tend to be successful colonizers. They are often drought tolerant, quick to utilize and capture resources (*e.g.*, nutrients, light, water, and space), fast growing, and reproductively successful. Currently 33 out of 159 known invasive plant species at PTA are targeted species for management (U.S. Army 2003a). 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 remaining native forest, and/or can establish rapidly in newly burned areas. There are several potential sources of non-native species introductions or spread into the action area including: construction of buildings and roads; mounted and dismounted training maneuvers; movement of equipment, vehicles, and troops; routine maintenance activities on the installation; environmental activities such as outplanting, propagule collection, and monitoring; and access for public uses such as hunting.

Minimization measures outlined in the Project Description include current or proposed environmental regulations designed to reduce the potential threat of non-native species introductions or spread to a very low threat level for most actions. Proposed activities that degrade or destroy habitat, thereby enhancing establishment of non-native species, include dismounted maneuvers, live fire-training, and Stryker vehicle maneuver training. A program for invasive plant reduction and control will be developed by the PTA Implementation Team.

Dust

Dust is an indirect effect of many of the Legacy and Transformation training actions and can have an adverse effect on vegetation near helicopter pads, roads and trails. Wheeled and tracked vehicle operation on dry, unsurfaced roadways creates tremendous amounts of dust as soil particles are dislodged and carried into the atmosphere through wind action (Gebhart 1996). Military and civilian vehicles disturb soils, crush vegetation, and exacerbate wind erosion particularly in arid environments. In a study on the effects of wind erosion at PTA firing points, Gleason estimated 600 kilograms/hectare (536 pounds/acre) of soil was lost in a single day (U.S. Army 2003a). Dust has the potential to smother plants, and degrade their habitat, thus reducing the ability of plants to survive. Settling of dust on vegetation could affect plants by reducing photosynthetic rates and by inhibiting pollinators from using the area. A study using inert dust on cucumber and kidney bean plants indicated that dust decreased stomatal conductance in the light and decreased the photosynthetic rate by shading the leaf surface (Hirano, Kiyota, and Aiga 1995). Another study (Eller 1977) demonstrated that a covering of dust on leaf surfaces increases leaf temperatures thus becoming the major factor causing overheating. These physiological changes suggest that vegetation in dust-ridden conditions are susceptible to chronic decreases in photosynthesis and growth rates. There are several potential activities that may generate dust in the action area: on- and off-road vehicles including Stryker maneuvers; helicopter take-off/landings and low fly-bys; and artillery training. A discussion is included in each species-specific effect section for those plant species within 75 meters (246 feet) of a man-made feature (*e.g.*, road, firing point, helicopter landing zones, and construction site) that may be a source of dust. The effect of dust varies from very low to moderate depending upon the training action and proximity of the listed species or habitat to the source of dust.

Minimization measures to reduce impacts of dust include: establishment of buffers along palila critical habitat and *Haplostachys haplostachya*; vegetation improvement at firing points; and maintenance of a 12 percent ground cover in off-road maneuver areas (S. Gleason, pers. comm. 2003). In addition, a dust study will be developed by the Implementation Team and initiated by

the Army to determine the long-term effect of dust deposition on listed plants and native vegetation at PTA. Depending upon the results of this study, the Implementation Team will determine what measures are necessary to reduce dust in certain areas and could include measures such as revegetation of exposed areas or placement of palliatives on dirt roads.

Trampling and Bivouac

Trampling and bivouac can directly and indirectly impact listed plants and their habitats including roosting and foraging habitat for the Hawaiian hoary bat. Soldiers can directly crush a plant in the course of setting up camp or during dismounted training activities. In addition, repetitive walking or hiking can break plant stems, compact soil, and degrade the micro-habitat for listed plants. Trails made inadvertently by troop activity may increase ungulate use and open an otherwise closed canopy habitat.

There is no restriction of troop movement in vegetated areas at PTA. Reconnaissance or dismounted maneuvers are usually done in small groups, typically squads. Currently, troop training within the western portion of PTA (Training Area 22 and 23) is very low and the level of use is anticipated to remain low even post-Transformation. There is the potential that soldiers will trample a listed plant during dismounted maneuvers. However, movement of small groups of soldiers will likely have a minimal effect overall as the activity will occur randomly over an area of approximately 13,029 hectares (32,195 acres). Therefore, the risk of repetitive trampling to the extent of soil compaction or crushing a plant is considered very low. In addition, training leaders will be encouraged to use routes less populated with listed species and installation Standard Operating Procedures do not allow the cutting of vegetation.

Bivouac will be restricted from sensitive areas to avoid the inadvertent crushing of listed plants while setting up camps. Bivouac occurs at pre-approved firing points and ranges with oversight by the Natural Resources Office. Soldiers will be briefed on the unique environment at PTA and instructed to minimize disturbance.

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. There is the potential to introduce invasive plant and animal species while performing their work. Minimization measures for these activities are outlined in the Project Description of this biological opinion and include such measures as coordinating these decisions with the Army's Natural Resources staff; using native and non-invasive plants in revegetation projects; monitoring for and removing alien invasive species that become established in revegetation projects; and inspecting gear and clothing for invasive plant seeds. The overall effect from this activity is considered to be very low due to the minimization and avoidance measures discussed.

Natural Resource Program

The Army Natural Resources staff manages rare plants and animals and their habitats so that the Army is in compliance with the Act, other environmental laws and regulations and the PTA Integrated Natural Resources Management Plan. They work to improve conditions for listed species and native habitats by reducing or removing threats at PTA. Their work includes listed plant propagation and outplanting, monitoring extant listed plant occurrences, control of invasive plants and vertebrates, assisting the Army on combining training and natural resources stewardship, and reporting. There is the very low threat that Natural Resources staff could inadvertently introduce non-native or invasive species via field vehicles or gear; however, they are knowledgeable and trained in how to avoid this possibility. The Natural Resources staff provide a beneficial service to listed species and habitats at PTA and any negative effect from their activities is very low and offset by the tasks they perform.

Army Regulated Hunting

Hunting has the potential to impact threatened and endangered plants due to increased risk of fire (due to cigarette smoking, and /or catalytic converter ignition from cars driving off-road), trampling by troops or dogs, and introduction of non-native or invasive species. There is a maintained hunting program which allows hunting of wild pigs, game birds, sheep and goats. Hunting parties must coordinate with the Provost Marshal at PTA. Overall, the removal of feral ungulates benefits listed plants and habitat for the Hawaiian hoary bat and palila critical habitat by removing destructive animals from PTA. Hunters will only be allowed to drive established roads to minimize the risk of fire from off-road driving.

Beneficial Actions

Fence Units

A western fence unit will be constructed to encircle Training Areas 19 and 22, and parts of Training Areas 17 and 20 (see Figures 2 and 3). The western fence unit will be approximately 8,700 hectares (21,500 acres) and will connect with the northern section of the existing Kipuka Alala fence unit. It will be a solid hogwire fence, two meters (six feet) tall. If the Keamuku Parcel is acquired for long-term Army use, the western fence unit would extend north to include the *Haplostachys haplostachya* plants located in the southeast corner of the parcel. The western fence unit will incorporate the remaining areas that contain the highest densities of listed plants. This will also benefit the Hawaiian hoary bat by minimizing habitat degradation to *Sorphora* Woodland. The removal of ungulates from these fenced areas will allow listed plant species and their habitats to regenerate naturally.

In addition to the large western fence unit, five fence units encompassing approximately 607 hectares (1,500 acres) will be constructed on the eastern portion of PTA for the protection of *Silene hawaiiensis* and *Asplenium fragile* var. *insulare* from training actions and ungulates (see Figure 2). A sixth fence, in the eastern area of PTA that encloses several *S. hawaiiensis* plants, will be maintained. Additional fencing/protection grates will be constructed to protect *A. fragile* var. *insulare* and sensitive lava tubes. Also, a permanent fence will be constructed around a

grouping of *Haplostachys haplostachya* near Puu Ahi where currently only a single-strand "people" fence exists. In addition, dust studies will be conducted to determine the potential effect of dust on listed plant species and native habitats near high traffic and/or off-road areas within fence units. Two fence units are proposed for the Keamuku Parcel to include Puu Nohonaohae and Papapa. A 75-meter (246-foot) buffer will be included in the fenced exclosure unit to reduce/eliminate indirect effects from near-by training activities and fuel breaks encircling each puu.

The specific fence locations will be surveyed for federally listed endangered or threatened plant species. Best Management Practices will be undertaken to avoid any listed plant species during construction and maintenance. The Natural Resources staff will assist the construction crew to minimize impacts during the building of the fences. These large contiguous expanses of habitat without ungulates will be very beneficial to the listed plant species and the habitat in general.

Positive Genetic Consequences

The proposed action has several activities planned with the goal of increasing numbers of threatened and endangered plants. Many of the 15 threatened and endangered plant species at PTA are reduced to extremely low numbers of individuals or in extremely fragmented populations that they are not genetically healthy. The PTA Natural Resources staff have been collecting seeds, propagating, outplanting, and managing native habitat for many years. It is believed these activities will allow natural recruitment that will reverse the negative impacts of reduced numbers of individuals and habitat fragmentation. These activities will increase with the implementation of the PTA Implementation Plan which again will have long-term beneficial consequences for these species. Genetic stock of listed plants will be maintained *ex situ* and reproduction will be achieved *in situ* for most of these species.

Threat Abatement

All of the listed plant species at PTA have associated threats that are preventing them from recovering naturally. By reducing the threats to these species, natural recovery is possible. Ungulate and rodent damage will be reduced by fencing, ungulate removal, and rodent control. Dust will be reduced by graveling roads and other Integrated Training Area Management activities (such as revegetation). Introductions of new non-native pests to Hawaii will be reduced by inspections by U.S. Department of Agriculture and customs agents. The spread of existing pests, including ungulates, weeds and insects will be curtailed by fencing, weed and insect control, and the tactical vehicle wash rack. The threat of fire will be reduced by the WFMP, fuel/fire breaks and fuel corridors, and non-native invasive plant control. Briefing soldiers on the threat of non-native plant species should help reduce the spread of those pests.

Assumptions used in the Effects Analysis

It is difficult to quantify the affect of some of the Legacy and Transformation actions on listed species and their habitats. We have analyzed many of the effects in a more qualitative and categorical manner using the best available scientific and commercial information. There are several assumptions that we have made throughout this biological opinion that are the foundation

for our jeopardy analysis for listed plants, Hawaiian hoary bat and palila critical habitat. These assumptions are as follows:

- there will be an increase in density and abundance of listed plants species.
- the WFMP will be fully implemented and will reduce the frequency and size of fires on PTA.
- new fence units will enclose approximately 9,307 hectares (23,000 acres) of habitat on PTA and Keamuku and be maintained ungulate-free.
- dust caused by Army training actions will not adversely affect plants beyond 75 meters (246 feet).
- most effects from fire will be temporary in fenced areas where habitat is managed (*e.g.*, invasive species and ungulate control) [These areas are expected to revegetate with native species over time.]
- the Implementation Team will develop and the Army will implement the actions as outlined in the Conservation Measures section.

EFFECTS OF THE ACTION ON PLANT SPECIES

Refer to Figure 4 for the individually numbered Training Areas at PTA. An "occurrence" is defined as a data point from the Evans data set provided by the Army (Evans 2003a).

Asplenium fragile var. *insulare*

There are an estimated 605 *Asplenium fragile* var. *insulare* individuals found in 34 occurrences within the action area. These occurrences represent approximately 93 percent of the naturally occurring *A. fragile* var. *insulare* ferns remaining in the State of Hawaii (Evans 2003a). *Asplenium fragile var. insulare* has been observed in Training Areas 2, 21, 22, and 23 and the Impact Area (see Figure 37 in the Transformation Biological Assessment). Legacy and Transformation training actions that may affect this species include bivouac, reconnaissance, dismounted maneuvers, and live-fire training. There are no occurrences of *A. fragile* var. *insulare* within designated off-road maneuver areas nor within 75 meters (246 feet) of any roads, landing zones or other training sites.

Bivouac, reconnaissance, and dismounted training actions will occur within Training Areas 2, 21, 22, and 23 (see Figure 4). Each of these training activities may directly affect *Asplenium fragile* var. *insulare* due to crushing or trampling from foot traffic. This may occur during cross-country training (reconnaissance) or if a bivouac is established in close proximity to an occupied lava tube or crevice. *Asplenium fragile* var. *insulare* grows in lava tubes, and the edge integrity of the tube or crevice may be impacted from foot traffic, possibly leading to its eventual collapse over time. Dismounted maneuvers and reconnaissance training will occur in Training Areas 22 and 23 that include over 13,000 hectares (32,123 acres) of land. Soldiers are, and will continue to be, briefed regarding sensitive resources at PTA and Standard Operating Procedures state all lava tubes, caves and sinkholes are off-limits. Reconnaissance and dismounted training activities are usually

conducted by small groups of soldiers (squads) and are infrequent in the western portion of PTA (U.S. Army 2003a). Therefore, we determine that the risk from direct trampling is very low particularly because the activity is conducted in such a large expanse of land (13,000 hectares; 32,123 acres). To minimize impacts from training maneuvers on the eastern side (Training Area 21), the majority of the lava tubes (20) on the eastern side of PTA will be protected with fencing or covered with a grate which will prevent foot traffic and browsing ungulates. The one *A. fragile* var. *insulare* occurrence located within palila critical habitat will benefit from the additional limitations placed on training activities in this area (see Project Description).

Bivouac is currently conducted at ranges and firing points that are suitable for camp establishment with open, (non-vegetated) flat terrain. Bivouac may occur in all *Asplenium fragile* var. *insulare* occupied Training Areas (2, 21, 22, and 23). There are no occurrences of *A. fragile* var. *insulare* within any bivouac site, and soldiers generally stay within the designated encampment area although someone venturing outside of the bivouac site cannot be completely disregarded. On the western side of PTA only one *A. fragile* var. *insulare* location is within 100 meters of an unimproved road and two occurrences are within 70 meters of Bobcat Trail. There is a very low possibility that these three occurrences may be affected from bivouac activities, as previously discussed, and when soldiers arrive at PTA they are instructed to avoid all caves, lava tubes and crevices during all training actions and to minimize impacts to natural and cultural resources (*e.g.*, Hawaiian burial sites also found within lava tubes and caves). They are also instructed to use latrines at bivouac sites in order to curtail habitat disturbance outside the direct camp area. All future bivouac sites will be surveyed and approved by the Natural Resources Office prior to use.

There is the continued risk of wildfire from Legacy and Transformation activities due to extensive live-fire training at PTA. There is a high likelihood that *Asplenium fragile* var. *insulare* occurs within the Impact Area due to the presence of *Myoporum-Sophora* Shrubland (see General Effects-Impact Area). It is anticipated that all occurrences of *Asplenium fragile* var. *insulare* located in the Impact Area will be lost through time due to munitions explosions and subsequent fires in that area. This is a permanent impact and an unknown number of individuals will be lost from this action.

There is always a risk that a fire once ignited in the Impact Area could spread to areas outside the Impact Area. Or that a fire could ignite outside of the Impact Area due to training error (an errant round or pyrotechnic), cigarettes, catalytic converter, cookstoves at bivouac; or an other unforeseen event. PTA is a mosaic of dry habitats that can burn quickly when a fire is ignited. If a fire does occur, particularly on the western side of PTA, the effect could be catastrophic for a species so limited in range and abundance. To minimize this threat, the Army will implement the WFMP that will reduce fire frequency and intensity at PTA (see Project Description). One important aspect of the WFMP is that *Asplenium fragile* var. *insulare* occurrences will be separated by fuel corridors and fire breaks which subdivide the western portion of PTA in Fuel Management Areas (see Figure 7). The goal is that these corridors and other fuel management measures will inhibit the spread of a wildfire and contain it within a portion of the occupied area,

thus reducing the loss of *A. fragile* var. *insulare.* In addition, the impact of wildfires may be somewhat reduced for this species because the lava tube or crevice may provide a natural barrier such that some individuals may survive a fast-moving fire that does not penetrate below the surface.

A secondary effect of fire that has altered the surrounding habitat is subsequent invasion of non-native plants. These species degrade the surrounding habitat, particularly the noxious grass species, *Pennisetum setaceum,* and exacerbate the fire cycle by providing a higher fuel load for future fires. *Asplenium fragile* var. *insulare* can be affected due to competition from non-native species that are more vigorous and outcompete this fern for space, light and nutrients. In addition to spread of alien plant seeds post fire, invasive plants are inadvertently brought in on vehicles, clothing, construction equipment, ungulates and range maintenance. To reduce the spread of invasive plants the Army will implement all measures as outlined in the Project Description and the General Effects section of this opinion including developing and implementing an invasive plant management plan.

Five occurrences (totaling 39 to 49 plants) are found within 75 meters (246 feet) of existing fences and roads or proposed fences and fuel breaks. All of these individuals are susceptible to the effects of dust (from road use, fuel break, and fence construction and maintenance). However, for this species, the negative effect of dust is considered low because lava tubes provide natural protection and dust is not as likely to accumulate as it is on surface-dwelling plants. In addition, the Army will follow current and future Standard Operating Procedures (as discussed in the General Effects section and the Project Description section) to reduce direct and indirect effects from construction of the fuel/fire breaks and fence exclosures. All remaining occurrences of *Asplenium fragile* var. *insulare* (556 to 566 individuals) are found more than 75 meters (246 feet) from any man-made feature or human activity. Therefore, there will not be any indirect or direct training impacts in the vicinity of these plants.

The construction of the western fence unit will protect nine occurrences of *Asplenium fragile* var. *insulare* from ungulate browsing, in addition to the 16 occurrences already protected by existing fence units. Without the constant pressure from browsing goats and sheep, it is anticipated that *A. fragile* var. *insulare* will naturally recruit into new areas and expand in density and abundance within both eastern and western fence units. The Implementation Team will address additional measures for this species such as propagation and outplanting in appropriate locations within the various Fuel Management Areas.

Summary

Army training activities that will directly affect *Asplenium fragile* var. *insulare* include live-fire training, foot patrol, and bivouac which can result in the crushing of ferns or lava. Indirect effects include dust, fire, invasive plants and browsing from feral ungulates. These impacts will be offset by the construction of additional fence units that will enclose the majority of *A. fragile* var. *insulare* occurrences at PTA. Fencing will remove the ongoing browsing pressure from ungulates

and allow for natural recruitment of the species. An Implementation Plan will be completed to define additional conservation measures to be implemented by the Army for *A. fragile* var. *insulare* and will include: non-native plant control near *A. fragile* var. *insulare* occurrences, maintenance of genetic stock *ex situ*, reproduction *in situ*, and augmentation or outplanting of this fern to increase species distribution and abundance. Twenty lava tubes, on the eastern side of PTA (outside existing or proposed fences) will be fenced (or grated) to exclude feral ungulates and humans (*e.g.* hunters, troops). All of these actions benefit *A. fragile* var. *insulare* thereby reducing the adverse effects of Army training on this species. Annual monitoring will be conducted by the Natural Resources Office to ensure that the goals of this biological opinion and the Implementation Plan are being met.

The WFMP will be implemented to reduce the frequency, intensity and size of fires at PTA. Several key aspects of the WFMP include: the construction of fire breaks and corridors that subdivide the western portion of PTA into Fuel Management Areas; implementation of the Fire Danger Rating System that will restrict training according to weather and fuel conditions and be monitored hourly by Range Control; fuel load reduction by invasive plant control; and construction of additional dip tanks and increase in fire-trained personnel and fire fighting equipment. Therefore, based upon measures in the Project Description, implementation of the WFMP and Standard Operating Procedures promulgated specifically to reduce impacts of Army actions on listed plant species, adverse impacts associated with Army actions will be minimized and offset by fencing, ungulate removal, propagation, outplanting, and threat abatement.

Haplostachys haplostachya

There are an estimated 13,956 *Haplostachys haplostachya* individuals located in 458 occurrences at PTA and the Keamuku Parcel. These individuals represent all of the naturally occurring plants remaining in the State of Hawaii (Evans 2003a). *Haplostachys haplostachya* occurs within Training Areas 7, 13, 17, 18, 19, 20, and 22 and the Keamuku Parcel (see Figure 38 in the Transformation Biological Assessment). Legacy and Transformation training actions that will affect this species include construction, off-road maneuver, dismounted maneuver, reconnaissance, bivouac, on-road mounted maneuver, and live-fire.

The construction of the Battle Action Course in Training Area 7 (see Figure 5) will impact 17 occurrences of *Haplostachys haplostachya* (totaling between 232 and 334 individuals and representing one to two percent of the total population). This will be a permanent loss of plants. These 17 occurrences represent the eastern-most distribution of *H. haplostachya* and when these occurrences are extirpated the current range of the species will be reduced. To minimize this impact, vegetative cuttings and seed collection will be conducted to acquire genetic material from these occurrences prior to any Transformation activities. Plants will be grown in the greenhouse and be outplanted to other locations as directed by the Implementation Team. Species distribution will be increased with oversight by the Implementation Team as proper soils are needed for long-

term viability of this species. Enough material is expected is be collected, grown and established to adequately replace the individuals impacted by the construction of the Battle Action Course.

Several small occurrences of *Haplostachys haplostachya* will be directly or indirectly impacted from off-road vehicular maneuvers in northern PTA. As discussed in the General Effects section, most of northern PTA and the Keamuku Parcel will become off-road training grounds for the Stryker vehicle (see Figure 6). The largest occurrence (totaling fewer than 10 individuals and representing less than one percent of the total population) is located in the off-road maneuver area in Training Area 13. We have determined that these plants will be lost through time due to the high intensity off-road activity anticipated from Stryker off-road training in northern PTA. The 250 plants on Puu Kapele will be protected from off-road maneuvers due to an existing fence which shall remain post-Transformation. A second area will be permanently fenced (now only single-strand fence) near Puu Ahi that protects approximately 1,860 to 2,785 individuals from direct training impacts. Another consequence of off-road training in northern PTA and throughout the Keamuku Parcel is increased habitat fragmentation for *H. haplostachya* occurrences on Puu Nohonaohae (northern Keamuku), Puu Ahi and Kapele. These plants will literally become "island" occurrences and may become even more genetically isolated than under the current land uses (military and ranching). Habitat fragmentation and isolation may inhibit genetic transference for these individuals. To offset this impact, the Implementation Team will develop an outplanting strategy for *H. haplostachya* to augment existing occurrences and initiate new occurrences.

Dismounted maneuvers and reconnaissance and bivouac sites may occur in any of the above Training Areas; however, they will only occur in open usable areas such as firing points, ranges and along Redleg Trail. Mounted and dismounted training activities may affect *Haplostachys haplostachya* due to direct trampling or crushing from foot traffic or indirect impacts from increased dust and invasive plant dispersal. All of these factors can degrade surrounding habitat and impact plant viability. While a plant may be directly crushed from foot traffic, the risk is considered very low because reconnaissance or cross-country maneuvers is infrequent in Training Areas 19, 20 and 22 and the area is vast, covering approximately 11,400 hectares (28,170 acres). In addition, soldiers are briefed regarding sensitive resources at PTA and are instructed not to cut or impact vegetation. Bivouac currently occurs on established ranges and firing points and any new bivouac site will be surveyed and approved by the Natural Resources Office to ensure that *H. haplostachya* will not be impacted. To minimize threats from bivouacking in Training Area 13, the Army will convert a single-strand "people" fence near Puu Ahi to an ungulate fence to further reduce human and ungulate pressure on the *H. haplostachya* in this area.

Another major consequence and indirect effect of off-road maneuvers is the creation of dust (see General Effects section). Dust created from off-road maneuvering can be a major training impact particularly in the Keamuku Parcel due to friable soils that are easily pulverized into airborne particles. *Haplostachys haplostachya* may be particularly affected by dust due to its phenology and the presence of puberulent leaves that will trap small soil particles. Rainfall levels at PTA are low (the average annual precipitation is 37 centimeters; five inches) and is usually in small amounts

at any one time. Therefore, dust that settles on *H. haplostachya* leaves has the potential to remain for long periods of time. Over 5,000 *H. haplostachya* individuals occur in the southeastern corner of the Keamuku Parcel adjacent to future Stryker training areas (see Figure 3). These plants are also adjacent to a movement corridor to be used for transit of Stryker vehicles in training formation (not single-file) from northern PTA into the Keamuku Parcel. Due to the large percentage (37) of *H. haplostachya* in this area, the effect of dust could be significant and diminish plant health and vigor over time. If the Keamuku Parcel is acquired by the Army, these individuals will be included within the western fence unit which will eliminate the threat of direct impact and plant loss from off-road vehicular maneuvers. Another very important measure that will offset indirect effects of dust on this large concentration of *H. haplostachya* will be the inclusion of a 75-meter (246-foot) buffer within the fence unit to prevent dust deposition in the large concentration of *H. haplostachya* (see Figure 3).

One-hundred twelve occurrences (totaling between 2,902 to 2,927 individuals and representing about 21 percent of the total population) are found within 75 meters (246 feet) of roads and trails, existing and proposed fences, and proposed fuel/fire breaks. There is the potential that some of these individuals could be adversely affected by dust, trampling, herbicide drift, and/or construction of the fence units. However, projects such as fence construction (a one-time event) and fuel modification (construction plus occasional clearings) will have only a minimal impact on *Haplostachys haplostachya* as these activities will be located to avoid direct impact. Indirect impacts such as herbicide drift and dust will be minimized by utilizing Best Management Practices and Standard Operating Procedures when applying herbicides or constructing the fenceline. Dust will be generated as Strykers and other vehicles utilize unpaved roads and trails in Training Areas 17, 19, 20, and 22. We anticipate there will be an effect from dust, such as reduced plant vigor, on individuals closer to the source of dust that will diminish as the distance away from the dust source increases. However, construction of future fire/fuel breaks and fence exclosures are positive actions that will benefit the species in the long-term. The Army will follow current and future Standard Operating Procedures as discussed in the General Effects section, and implement other measures (see Project Description) that will further abate these more minor negative impacts. Therefore, any potential effects such as trampling of plants by humans, herbicide drift, and destruction of plants during construction of the fuel/fire breaks or the proposed fences will be minimized to a very low impact level. In addition, a dust study will be developed by the Implementation Team and initiated by the Army to determine the long-term effect of dust deposition on listed plants and native vegetation at PTA. Depending upon the results of this study, the Implementation Team will determine what measures are necessary to reduce dust in certain areas and could include measures such as revegetation of exposed areas or placement of palliatives on dirt roads.

The majority of *Haplostachys haplostachya* (12,421 individuals representing 79 percent of the species) are found at distances greater than 75 meters (246 feet) from man-made features (*e.g.* roads, fences, fuel and fire breaks). These plants are currently impacted by existing threats such as competition from non-native plants (particularly *Pennisetum setaceum*) and direct browsing

and trampling from feral ungulates. Both these impacts are considered significant. One of the measures to offset adverse impacts to *H. haplostachya* is the construction of the western fence unit which will protect 321 occurrences from ungulate browsing impacts. An additional existing fence unit on Puu Kapele will remain that protects approximately 250 individuals. The single-stranded wire fence encircling over two thousand plants near Puu Ahi will be upgraded to an ungulate exclosure (see Figure 3). Without the constant pressure from browsing goats and sheep, it is anticipated that *H. haplostachya* will naturally recruit to new areas and expand in density and distribution within the fence units and outplanting efforts will be more successful.

Additional minimization measures the Army will implement to offset training actions at PTA include the WFMP that will reduce the risk of fire as outlined in the Project Description. *Haplostachys haplostachya* is susceptible to fire and is more prone to ungulate browsing after fire damage has occurred (U.S. Army 2003a). Minimizing the threat of fire will also reduce the spread of non-native plants and other non-native species. While the threat of fire can never be completely eliminated at PTA due to fuel load, wind, and human error, implementation of the WFMP will reduce the frequency and intensity of future wildfires at PTA.

In addition to avoidance and minimization measures found in the Project Description, and the WFMP, several additional measures will be implemented to offset training impact to *Haplostachys haplostachya* within the action area. The Implementation Team will develop an invasive plant control plan to minimize competition from non-native plants and enhance habitat quality. Reduction in non-native vegetation also reduces the fuel bio-load which minimizes the threat of fire. The Army will also strive to achieve species reproduction *in situ*, establish *H. haplostachya* at additional sites within PTA through outplanting and natural recruitment to achieve a minimum plant density to be determined by the future Implementation Team at PTA. These actions have the beneficial effect of increasing genetic variability of the species by augmenting existing occurrences and increasing the distribution via outplanting. Annual monitoring will be conducted by the Natural Resources Office to ensure that this biological opinion, including its conservation measures and future Implementation Plan, are being met.

Summary

Army training activities that will directly affect *Haplostachys haplostachya* include live-fire training, reconnaissance, mounted and dismounted maneuvers and bivouac. We have determined that these actions may permanently impact less than three percent of the extant individuals remaining in the action area. Indirect effects include dust, fire, invasive plants and browsing from feral ungulates. These impacts will be offset by the construction of additional fence units that will encompass the majority of *H. haplostachya* occurrences at PTA. Fencing will remove the ongoing browsing pressure from ungulates and allow for natural recruitment of the species. A buffer will be included in the fence unit adjacent to the off-road maneuver area to minimize dust deposition on the large occurrence of *H. haplostachya* on the Keamuku Parcel. An Implementation Plan will be completed to address additional conservation measures for *H. haplostachya* within the action area such as non-native plant control to minimize adverse effects to

habitat quality and to reduce the threat of fire. The Army will also strive to achieve reproduction *in situ*, maintain a genetic stock *ex situ,* and establish plants at additional sites to increase species distribution and abundance. The Implementation Plan will include plant and seed collection prior to Transformation from occurrences that will be permanently lost. All of these actions will benefit *H. haplostachya* thereby reducing the adverse effects of Army training on this species. Annual monitoring will be conducted by the Natural Resources Office.

The WFMP will be implemented to reduce the frequency, intensity and size of fires at PTA. Key aspects of the WFMP include the construction of fuel corridors and fire/fuel breaks which subdivide the western portion of PTA in Fuel Management Areas; implementation of the Fire Danger Rating System that will restrict training according to weather and fuel conditions and monitored hourly by Range Control; fuel load reduction by invasive plant control; construction of additional dip tanks; and an increase in fire-trained personnel and fire fighting equipment. Therefore, based upon measures in the Project Description, implementation of the WFMP and Standard Operating Procedures promulgated specifically to reduce impacts of Army actions on listed plant species, adverse impacts associated with Army actions will be minimized and offset by fencing, ungulate removal, propagation, outplanting, and threat control.

Hedyotis coriacea

There are an estimated 90 *Hedyotis coriacea* individuals located at PTA. These plants represent 99 percent of the *H. coriacea* remaining in the State of Hawaii (Evans 2003a). *Hedyotis coriacea* occurs in Training Areas 22 and 23 and the area designated as the limited access buffer area (see Figure 39 in the Transformation Biological Assessment). Twenty-five individuals are currently protected within existing fence units (Kalawamauna and Alala) and the rest have emergency hog-wire fencing around each plant to preclude ungulate browsing. Legacy and Transformation training actions that will affect this species include dismounted maneuvers, reconnaissance, bivouac and live-fire training.

Dismounted maneuvers, reconnaissance patrols or bivouac may affect *Hedyotis coriacea* due to foot traffic (direct crushing or trampling). The overall risk of trampling is very low for this species because the majority of adult *H. coriacea* plants are currently enclosed within hog-wire fencing. However, seedlings or juvenile plants growing outside the emergency enclosures, or any individual located within the larger fence units (Alala and Kalawamauna) are still susceptible to foot traffic. However, we anticipate that the risk of direct impact for the plants outside emergency fencing to be low primarily because reconnaissance and dismounted maneuvers will occur over a vast area (13,000 hectares; 32,123 acres) which reduces the probability of human contact with a plant. In addition, upon arrival at PTA soldiers are, and will continue to be, briefed regarding sensitive resources and to avoid impacting native vegetation.

Bivouac is conducted at existing ranges and firing points suitable for camp establishment within Training Areas 22 and 23. There is minimal risk of directly impacting a plant from trampling if a

soldier wanders out of the encampment. However, as previously discussed, most of these individuals are enclosed within emergency fencing that would prevent any trampling by a wayward soldier. Another potential bivouac site in Training Area 23 is the Multi-Purpose Range Complex located within Kipuka Alala (see Figure 2). There are existing bivouac sites within the Multi-Purpose Range Complex suitable for bivouac (graded and leveled) and these sites do not conflict with known occurrences of *H. coriacea*. Any new bivouac site will be surveyed and approved by the Army Natural Resources staff to ensure *H. coriacea* will not be impacted. On-road mounted maneuvers with Stryker and other vehicles will be restricted to existing and proposed trails and roads in Training Areas 22 and 23 and the majority of *H. coriacea* individuals are over 75 meters (246 feet) from roads or trails thereby likely eliminating any effect from dust along the roadsides.

Thirty-eight occurrences (totaling 38 individuals and representing 42 percent of the species in the wild) are found within 75 meters (246 feet) of existing fences, and future fence lines and fuel/fire breaks. These plants could be adversely affected by fence construction and/or fuel modification activities in the form of workers inadvertently trampling plants or wind-induced herbicide drift and dust. However, construction of the fence is a one-time event and the final placement of the fenceline will avoid listed plants. The potential adverse effect from dust is reduced by the fact that the majority of the *Hedyotis coriacea* at PTA occur on pahoehoe or aa lava which is not as likely to pulverize into airborne particulates. To minimize these effects, extreme care will be taken and Best Management Practices will be applied to minimize herbicide drift (application in optimum conditions). While there are some negative impacts that may occur during the construction and maintenance of future fire/fuel breaks and fence lines, both these actions are beneficial for *H. coriacea* in the long-term.

Fifty-three individuals of *Hedyotis coriacea* (representing 58 percent of the species in the wild) are found at distances greater than 75 meters (246 feet) from any man-made feature (*e.g.*, fence, fuel/fire break, firing point). In addition to impacts already described for reconnaissance and bivouac, these individuals may be affected by existing threats such as competition with non-native plants (particularly *Pennisetum setaceum*) and habitat degradation from feral ungulates. Construction of the western fence unit and removal of ungulates will permanently protect 51 occurrences (in addition to the 25 occurrences already protected by the existing fence units) from ungulate browsing. Without the constant pressure of browsing goats and sheep, it is anticipated that *H. coriacea* will naturally recruit and expand in density and abundance within the fence units and outplanting efforts will be more successful.

Fire is an ongoing risk on a live-fire training installation surrounded by dry vegetation that can ignite and burn readily. A fire at PTA could ignite inside or outside the Impact Area due to training error (an errant round or pyrotechnic), cigarettes, catalytic converter, cookstoves at bivouac; or an unforeseen event. If a fire does occur, particularly on the western side of PTA, the effect could be catastrophic for a species so limited in range and abundance (90 individuals). To minimize this threat, the Army will implement the WFMP that will reduce fire frequency and intensity at PTA (see Project Description). One important aspect of the WFMP is that *Hedyotis coriacea*

occurrences will be separated by fuel corridors and fire breaks which subdivide the western portion of PTA into Fuel Management Areas (see Figure 7). The goal is that these corridors and other fuel management measures will inhibit the spread of a wildfire and contain it within a portion of the occupied area, thus reducing the loss of *H. coriacea*. Once a fire has occurred and the habitat has been altered, there is high likelihood of invasion of non-native plants, particularly *Pennisetum setaceum*. Not only can *P. setaceum* outcompete young *H. coriacea* seedlings by utilizing space and resources, it also increases the bio-fuel load thereby exacerbating the fire cycle.

There is a probability that *Hedyotis coriacea* occurs within the Impact Area due to the presence of 3,755 hectares (9,278 acres) of Open *Metrosideros* treeland with sparse shrub understory (see General Effects-Impact Area). It is anticipated that all occurrences of *H. coriacea* located in the Impact Area will be lost through time due to munitions explosions and subsequent fires in that area. This is a permanent impact and an unknown number of individuals will be lost from this action.

Additional measures included in the Project Description to help offset project impacts to *Hedyotis coriacea* include: development of a non-native invasive plant control plan; species reproduction *in situ*; maintenance of genetic stock *ex situ*; and establishment of *H. coriacea* at additional sites within PTA through outplanting or natural recruitment to achieve a minimum plant density to be determined by the future Implementation Team. Outplanting is a high priority for this plant due to its low numbers and limited distribution. These actions will increase the genetic variability of *H. coriacea* and reduce the risk currently associated with natural and/or man-made stochastic events. The Army will also conduct annual monitoring of extant and outplanted individuals.

Summary

The Army training impacts to *Hedyotis coriacea* are minimal (bivouac, dismounted maneuvers, and reconnaissance) except for fire that can never be eliminated and will always have a devastating impact to listed native plants and their habitats at PTA. The most critical issue for *H. coriacea* is the extremely low number of extant individuals and any loss therefore is critical. The Implementation Team will address the propagation and outplanting needs of this species to increase *H. coriacea* abundance and distribution. No direct loss of *H. coriacea* individuals will occur due to Transformation projects. Indirect effects include dust, fire, invasive plants and browsing from feral ungulates. These impacts will be offset by construction of additional and permanent fence units that will encompass all *H. coriacea* individuals at PTA. Fencing will remove the ongoing browsing pressure on seedlings from ungulates and allow for natural recruitment of the species. An Implementation Plan will be completed and include additional conservation measures for *H. coriacea* within the action area: non-native plant control to minimize adverse effects on habitat, maintenance of genetic stock *ex situ*, reproduction *in situ*, and outplanting of plants at additional sites on PTA. All of these actions have the direct beneficial effect of increasing genetic variability of the species and reducing the adverse effects of non-native species and other threats. The Army will also perform annual monitoring to document whether the measures outlined in the Project Description and future Implementation Plan are being met.

The WFMP will be implemented to reduce the frequency, intensity and size of fires at PTA. Key aspects of the WFMP include the construction of fuel corridors and fire/fuel breaks that subdivide the western portion of PTA into Fuel Management Areas; implementation of the 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 by invasive plant control; construction of additional dip tanks; and an increase in fire-trained personnel and fire-fighting equipment. Therefore, based upon measures in the Project Description, implementation of the WFMP and Standard Operating Procedures promulgated specifically to reduce impacts of Army actions on listed plant species, adverse impacts associated with Army actions will be minimized and offset by fencing, ungulate removal, propagation, outplanting, and threat abatement.

Isodendrion hosakae

There are an estimated 871 *Isodendrion hosakae* individuals found in 101 occurrences in the action area, representing 97 percent of all naturally occurring plants remaining in the State of Hawaii (Evans 2003a). *Isodendrion hosakae* occurs only in the Keamuku Parcel on Puu Nohonaohae (one individual plant) and Puu Papapa (870 individuals) cinder cones (see Figure 40 in the Transformation Biological Assessment). Currently the land is owned by Parker Ranch, and there are no Legacy training activities in the vicinity of these occurrences. If Transformation actions occur on this land, *I. hosakae* will be affected by off-road maneuvers, and the indirect impacts associated with this action such as fire, dust, and habitat fragmentation.

Currently only Puu Papapa is fenced to exclude cattle. If the Keamuku Parcel is purchased or leased by the Army in the future, then both cinder cones will be fenced (to exclude ungulates) and training will be excluded from these fence units. However, the remainder of the Keamuku Parcel is slated to become a high-use training area which will include off-road Stryker maneuvers. As Stryker vehicles drive off-road, they will crush and uproot existing vegetation (pastureland) exposing the soil. As more vehicles drive over the exposed land, dust plumes will be created that may migrate over large areas depending on wind velocity and direction. The majority of the soils in the Keamuku parcel are sandy and very fine sandy loams thus exacerbating the creation of airborne particles created by Stryker training. There is a possibility that due to the amount of dust that will be generated from Stryker off-road activities near the cinder cones that the health and vigor of *Isodendrion hosakae* will be compromised. A dust study will be developed by the Implementation Team and initiated by the Army to determine the long-term effect of dust deposition on listed plants and native vegetation at PTA. Depending upon the results of this study, the Implementation Team will determine what measures are necessary to reduce dust in certain areas and could include measures such as revegetation of exposed areas or placement of palliatives on dirt roads. Listed plants on the Keamuku cinder cones will be included in the study.

Another indirect effect from future training activities in the Keamuku Parcel is the increased risk of wildfire. *Isodendrion hosakae* is subject to extirpation by a catastrophic event such as an uncontrolled wildfire due to its small, isolated locations on only two cinder cones. In Keamuku a

fire could ignite from training activities, human error, cigarettes, catalytic converter, cookstoves at bivouac, or an unforseen event. Also, there is high potential for wildfire in Keamuku due to the predominance of non-native grassland habitat. A wildfire would burn readily and spread quickly due to the high fuel load. For example, in 1999, fire consumed 95 percent of the Nohonaohae cinder cone vegetation and eight *I. hosakae* individuals were reduced to a single plant (the only remaining individual on Nohonaohae) (U.S. Army 2003a). Eighty percent of *I. hosakae* occurrences are found within 75 meters (246 feet) of man-made features (*e.g.*, fence or fuel/fire break) and occur on cinder cones surrounded by proposed high-use military activities making them more susceptible to a stochastic event such as fire.

The WFMP addressed future fire management for the Keamuku Parcel assuming Army acquisition (lease or purchase) will occur in the future. The WFMP will reduce the risk of fire pursuant to all the measures outlined in the Project Description plus creation of fire/fuel breaks along the Keamuku boundary and fire breaks around each of the occupied cinder cones. In addition, a new dip tank will be constructed on the parcel so that available water for fire-fighting is in close proximity.

Invasion of non-native plant species has occurred along the bottom portion of the cinder cones and will continue to invade if active eradication or control is not undertaken (S. Gleason, pers. comm. 2003). In particular, *Isodendrion hosakae* is likely to be affected by existing threats from competition with several non-native plant species, particularly *Pennisetum setaceum*, *Salsola kali*, and *Senecio madagascariensis*. The Implementation Team will develop an invasive plant control plan to minimize competition and curtail the encroachment of non-native plants, particularly *Pennisetum setaceum*, *Salsola kali*, and *Senecio madagascariensis*, onto the cinder cones.

Sixty-five occurrences (totaling 720 individuals and representing 80 percent of the species) are found within 75 meters (246 feet) of the existing fence (which encircles Papapa) and future fire breaks. There is a low threat potential that some plant occurrences within this 75 meters (246 feet) could be adversely affected by trampling from humans, herbicide drift, and dust during construction or maintenance of the fences/fire breaks. To offset this impact, a 75-meter (246-foot) buffer shall be established between the *Isodendrion hosakae* occurrences and the new fence and fuel modification area (see Figure 6). In addition, fences and fire breaks are positive actions that have long-term positive benefits of removing browsing pressure from ungulates and reducing the risk of fire traveling up the cinder cones.

Due to grazing and ranch activities, the Keamuku Parcel habitat has already been degraded and ranching pressure has effectively isolated the occupied cinder cones. Although a change in land use, Army training in the Keamuku Parcel will continue this trend. The entire area surrounding the occupied cinder cones will become an off-road maneuver area and the remnant occurrences will continue to be separated from other occupied areas by a large expanse of disturbed non-native grassland. Such isolation could depress the species' ability to naturally pollinate, and increase in abundance, as appropriate habitat will continue to be unavailable to the species.

The Army proposes to implement a number of conservation measures to minimize or eliminate additional threats to *Isodendrion hosakae* within the action area. These include upgrading the existing fence to exclude ungulates (currently only a cattle fence), and fence Puu Nohonaohae. The Implementation Team will develop a non-native invasive plant control plan to minimize adverse effects from invasive plants in order to maintain the cinder cones relatively weed-free. Outplanting will be a high priority for this species due to its very limited distribution and this may occur within other appropriate areas on PTA such as the eastern or western fence units (as determined by the Implementation Team). All these actions have the beneficial effect of increasing genetic variability of the species and reducing the risk of adverse effects from training and stochastic events. The Army will also strive to achieve species reproduction *in situ*; and establish *I. hosakae* at additional sites within PTA through outplanting or natural recruitment to achieve a minimum plant density (to be determined by the future Implementation Team). The goal is to increase *I. hosakae* in abundance and distribution in order to reduce the risk of species loss due to man-made or natural stochastic events. The Army will also conduct annual monitoring.

Summary

Off-road maneuver is the primary training activity in the Keamuku Parcel that will affect *Isodendrion hosakae;* however, there will be no direct plant loss from this training action. Indirect effects include dust, habitat fragmentation and invasive species. In addition, all training activities on Keamuku will increase the risk of fire. Plants within Puu Papapa may be subject to browsing by feral ungulates because the existing fence may not preclude access by feral goats. These effects will be offset by construction of new fence units around both cinder cones with a minimum of a 75-meter (246-foot) buffer between the plants and the fenceline. Outplanting will be conducted onsite to increase the distribution and abundance of *I. hosakae*. The Army will assist recovery efforts by providing seeds and/or plants to appropriate agencies or private organizations to increase occurrences offsite (see Conservation Measures). An Implementation Plan will be completed and include additional measures for *I. hosakae* within the action area: non-native plant control to minimize adverse effects to habitat, maintenance of genetic stock *ex situ*, reproduction *in situ*, and establishment of plants at additional sites within the action area to increase species distribution and abundance. These actions will benefit the species because they will increase genetic variability and reduce adverse effects due to non-native species and other threats. The Army will also perform annual monitoring to document whether the measures outlined in the Project Description and future Implementation Plan are being met.

The WFMP will be implemented to reduce the frequency, intensity and size of fires on Keamuku Parcel (if leased or purchased). Key aspects of the WFMP include: implementation of the Fire Danger Rating System that will restrict training according to weather and fuel conditions and includes hourly monitoring by Range Control; fuel load reduction by invasive plant control and construction of additional fuel and fire breaks; construction of additional dip tanks; and an increase in fire-trained personnel and fire fighting equipment. Therefore, based upon measures found in the Project Description, implementation of the WFMP and Standard Operating Procedures promulgated specifically to reduce impacts of Army actions on listed plant species, adverse

impacts associated with Army actions in those training areas where *I. hosakae* occurs are minimized and offset by fencing, ungulate removal, propagation, outplanting, and threat abatement.

Lipochaeta venosa

There are an estimated 3,346 *Lipochaeta venosa* found in 201 occurrences at PTA. This represents 98 percent of the species remaining in the wild (Evans 2003a). *Lipochaeta venosa* occurs in the Keamuku Parcel on Nohonaohae cinder cone (see Figure 41 in the Transformation Biological Assessment). Currently Legacy training is not conducted in the northern portion of the Keamuku Parcel. Transformation training will take place only on Keamuku if the Army acquires the land by lease or purchase. If Transformation actions occur on this land, *L. venosa* will be affected from off-road maneuvers and the indirect impacts associated with this action such as fire, dust, and habitat fragmentation.

Lipochaeta venosa is similar to *Isodendrion hosakae* in that both species are relegated to a few cinder cones on Parker Ranch and the Keamuku Parcel. Within the action area, *L. venosa* is found only on Puu Nohonaohae and this puu will be excluded from any direct training activities if Transformation includes the Keamuku Parcel. However, the remainder of the Keamuku Parcel will be used for off-road maneuvers especially with Stryker vehicles that will degrade existing pastureland vegetation and expose the soil. As more vehicles drive over the exposed land, dust plumes will be created that may migrate over large areas depending on wind velocity and direction. The majority of the soils in the Keamuku Parcel are very fine sandy loams thus exacerbating the creation of airborne particles that will be created by repeated Stryker off-road maneuvers. Health and vigor of these plants may be compromised due to the amount of dust that will be generated from Stryker off-road activities. A dust study will be developed by the Implementation Team and implemented by the Army to determine the long-term effect of dust deposition on listed plants and native habitats at PTA. Listed plants on the Keamuku cinder cones will be included in the study. Depending upon the results of this study, the Implementation Team will determine what measures are necessary to reduce the effect of dust such as increasing revegetation of exposed areas or placement of palliatives on roadways.

Habitat within the Keamuku Parcel has already been degraded by grazing and ranch activities that effectively isolate the occupied cinder cones. Although it would be a change in land use, Army training in the Keamuku Parcel will continue this trend. The entire area surrounding the occupied cinder cones will become an off-road maneuver area and the remnant occurrences will continue to be separated from other occupied areas by a large expanse of disturbed non-native grassland. Such isolation could depress the species' ability to naturally pollinate and increase in abundance as appropriate habitat will continue to be unavailable to the species. *Lipochaeta venosa* is also likely to be affected by existing threats from competition with, and habitat degradation by, non-native plant species, particularly *Pennisetum setaceum*, *Salsola kali*, and *Senecio madagascariensis*.

Approximately 49 individuals (representing just over one percent of the species in the wild) are found within 75 meters (246 feet) of proposed fences and fire breaks. These individuals could be adversely affected by construction and/or maintenance of the proposed fences and fire break. Effects could occur directly from inadvertent trampling of a plant or indirectly from herbicide drift and/or dust. To offset these potential impacts, a 75-meter (246-foot) buffer will be established between the occurrences of *Lipochaeta venosa* and the fence and/or fire break (see Figure 6). In addition, such conservation measures associated with the establishment of future fire breaks, along with fence exclosures, are positive actions that will benefit the species in the long-term. While some short-term negative effects may occur, the long-term benefit of ungulate removal, non-native invasive plant control, and reduction of the risk of wildfire are positive actions.

There will be a risk of wildfire from Transformation activities on Keamuku due to training actions, discarded cigarettes, catalytic converter, cookstoves at bivouac, or an unforeseen event. Keamuku is highly disturbed from ongoing cattle ranching and the dominant habitat is non-native grassland. If a fire does occur, the effect could be catastrophic for a species so limited in range. To minimize this threat, the Army will implement the WFMP that will reduce fire frequency and intensity at PTA (see Project Description). The threat of fire can never be completely eliminated at Keamuku due to fuel load (disturbed grassland), wind, and human error therefore we have determined the threat of fire to be high for this species. The WFMP will minimize the risk of fire on Keamuku by constructing fire/fuel breaks around each puu and along both eastern and western boundaries of the parcel (see Figure 7). Fuel and fire breaks not only may help in impeding the movement of fire but they also provide staging and attack areas to combat a fire once ignited. Implementation of the WFMP includes the construction of a new dip tank on or near the Keamuku Parcel.

The Army proposes to implement additional measures to minimize or offset training actions that pose threats to *Lipochaeta venosa* within the action area. The Implementation Team will develop an invasive plant control plan to curtail the encroachment of aggressive invasive plant species on to the cinder cones. In addition, the Implementation Team will address outplanting strategies for this species. This will be a high priority for *L. venosa* due to this species' very limited distribution. Translocation may occur within other appropriate fenced areas at PTA (eastern or western fence units) if these areas are determined to be appropriate by the Implementation Team. The Army will also strive to achieve species reproduction *in situ*, and propagate plants in the greenhouse for distribution to other agencies or private entities for offsite translocation (see Conservation Measures). These actions will benefit *L. venosa* by increasing species abundance and distribution and enhance the genetic variability of this currently isolated species. The Army will also conduct annual monitoring of the species' locations.

Summary

As is the case for *Isodendrion hosakae*, off-road maneuver is the primary training activity in the Keamuku Parcel that will affect *Lipochaeta venosa*. Off-road activities with Stryker vehicles will increase airborne dust, habitat fragmentation and invasion of non-native plant species. All training

activities within the Keamuku Parcel will increase the risk of fire. Feral ungulate grazing has also impacted the Keamuku Parcel because only Puu Papapa is fenced to exclude cattle. These effects will be offset by construction of additional fence units around the cinder cones with a minimum of a 75-meter (246-foot) buffer between the plants and the new fenceline or fuel modification area. These effects will be offset by the construction of additional fence units at PTA proper and the outplanting of this species at PTA (if appropriate) to increase species distribution and abundance. In addition, due to the limited known occurrences and low numbers for *L. venosa*, the Army will assist by providing seeds and/or plants of this species to agencies or private organizations to increase number of occurrences offsite. An Implementation Plan will be completed that will include, at a minimum, the following additional conservation measures for *L. venosa*: non-native plant control to minimize adverse effects to habitat and to reduce the threat of fire, and maintenance of genetic stock *ex situ*. The Army will also perform annual monitoring to document whether the measures outlined in the Project Description and future Implementation Plan are being met.

The WFMP will be implemented to reduce the frequency, intensity and size of fires at PTA and Keamuku. Several key aspects of the WFMP on Keamuku include: implementation of the 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 by invasive plant control and construction of additional fuel and fire breaks; construction of an additional dip tank; and an increase in fire-trained personnel and fire-fighting equipment. Therefore, based upon measures found in the Project Description, implementation of the WFMP and Standard Operating Procedures promulgated specifically to reduce impacts of Army actions on listed plant species, adverse impacts associated with Army actions in those training areas where *Lipochaeta venosa* occurs are considered minimized and offset by fencing, ungulate removal, propagation, outplanting, and threat abatement.

Neraudia ovata

There are approximately 10 *Neraudia ovata* found in 10 occurrences at PTA. These plants represent 83 percent of *N. ovata* remaining in the wild (Evans 2003a). *Neraudia ovata* occurs only in the western portion of Training Area 22 (see Figure 42 in the Transformation Biological Assessment). Legacy and Transformation training actions that could affect this species include live-fire training, dismounted maneuvers and reconnaissance.

Isolated populations are subject to extirpation by man-made or natural events, such as fire or drought. *Neraudia ovata* is at extreme risk due to the small size and isolation of the remaining individuals. Any wildfire from live-fire training or accidental causes that impacts even one individual constitutes a significant loss of genetic variability for this species. Therefore, we have determined the risk of fire to be high for this species. While the isolated and clustered nature of the remaining *N. ovata* makes the species more vulnerable to fire, the threat of fire originating in the Impact Area from live-fire training and spreading to the extreme western border of the

installation has been minimized by adoption of the WFMP. The WFMP will reduce the risk of fire ignition (see Project Description) and if a fire does ignite on western PTA, there are measures in the plan that improve the fire-fighting capabilities of the crew at PTA. For example, a military helicopter with a certified and trained aircrew capable of performing fire bucket operations must be onsite during live-fire training and a backup helicopter under contract with the Army will be available and able to arrive at PTA within 90 minutes after notification. In addition, a minimum of six trained fire-fighting personnel are required onsite during expected high fire danger rating days and any scheduled live-fire training operation. These measures will help prevent a wildfire from traveling to the western border of PTA and burning *N. ovata*. To minimize the risk of fire originating from the west (offsite) and moving east to impact these occurrences, a fuel/fire break will be constructed along the western border between State land and PTA (see Figure 7).

Small groups of soldiers, such as squads, may conduct dismounted maneuvers or reconnaissance in Training Area 22 which could impact these plants by direct contact or trampling. Because the *Neraudia ovata* are located on the western border of the action area (away from roads and landing zones), the probability of this type of impact is very low. Indirect effects from foot traffic include degradation of the surrounding habitat by soil compaction and inadvertent spreading of non-native seeds. However, Standard Operating Procedures and soldier awareness training will help reduce the risk of these concerns. Overall, the risk of trampling the plant directly or affecting surrounding habitat from foot patrol or reconnaissance is very low in Training Areas 22 because cross-country hiking is very infrequent and the plants are quite removed from the more active training locations.

Seven individuals (representing 54 percent of the species in the wild) are found within 75 meters (246 feet) of proposed fencelines. However, extreme care will be taken not to impact any of the last remaining individuals by maintaining an adequate buffer (as determined by the Army Natural Resources staff in the field) while constructing the western fence unit adjacent to these individuals (see Conservation Measures).

The remaining occurrences of *Neraudia ovata* (three individuals representing 23 percent of the species in the wild) are found at distances greater than 75 meters (246 feet) from the proposed fence. Ongoing threats for all *N. ovata* include competition with, or habitat degradation by, non-native plants, particularly *Pennisetum setaceum* and *Kalanchoe tubiflora*, and browsing, seedling trampling, or habitat degradation by feral ungulates. The construction of the western fence unit will reduce ungulate browsing and offset the aforementioned training actions that may adversely affect this species. All individuals, except one located on State land, will be enclosed within this fenced area. Without the constant browsing pressure from sheep and goats, we anticipate that *N. ovata* will naturally recruit into new areas and expand in density and abundance within the fence unit.

In addition, due to the extremely low numbers (10 individuals) and limited range of *Neraudia ovata*, the Implementation Team will prioritize development if an outplanting plan for this species

in order to reduce the risk of losing individuals to a stochastic event such as drought or wildfire. The Army will increase the population and distribution of this species by outplanting individuals in various Fuel Management Areas so that plants are spread between distinct areas thus minimizing the loss of individuals should a catastrophic fire event occur.

Summary

Army training impacts to *Neraudia ovata* are minimal (bivouac, dismounted maneuvers, reconnaissance) except that fire can never be eliminated and will always have a devastating impact to listed native plants and their habitats at PTA. Due to the precipitously low number of *N. ovata* remaining in the wild, this species is extremely vulnerable to stochastic events. The Implementation Team will address the propagation and outplanting requirements for this species to increase *N. ovata* abundance and distribution. No direct loss of any individuals will occur due to the proposed action. Indirect effects include fire, invasive plant competition and browsing from feral ungulates. These impacts will be offset by construction of the western fence unit that will enclose *N. ovata* occurrences (except potentially one individual), remove ongoing browsing pressure and allow for natural recruitment of the species. An Implementation Plan will be completed to include additional conservation measures for *N. ovata* within the action area: non-native plant control to minimize adverse effects on habitat quality, maintenance of genetic stock *ex situ*, reproduction *in situ*, and outplanting of plants at additional sites at PTA to achieve a minimum plant density. The Army will monitor this species annually ensure that the measures outlined in the Project Description and future Implementation Plan are being met. If not, then the Implementation Team will reassess the issue and alter the plan to address the problem.

The WFMP will be implemented to reduce the frequency, intensity and size of fires at PTA. Key aspects of the WFMP include construction of fuel corridors and fire/fuel breaks that subdivide the western portion of PTA into Fuel Management Areas; implementation of the Fire Danger Rating System that will restrict training according to weather and fuel conditions that will be monitored hourly by Range Control; fuel load reduction by invasive plant control; construction of additional dip tanks; and an increase in fire-trained personnel and fire-fighting equipment. Therefore, based upon the implementation of measures in the Project Description, the WFMP, and Standard Operating Procedures promulgated specifically to reduce impacts of Army actions on listed plant species, adverse impacts associated with Army actions will be minimized and offset by fencing, ungulate removal, propagation, outplanting, and threat abatement.

Portulaca sclerocarpa

There are approximately 22 individuals of *Portulaca sclerocarpa* found in 11 occurrences at PTA. These individuals represent two percent of the population in the State (Evans 2003a). *Portulaca sclerocarpa* occurs in Training Area 22 and the unnamed area between Training Area 22 and the Impact Area (see Figure 43 in the Transformation Biological Assessment). Legacy and Transformation training actions that will affect this species include live-fire training, on-road mounted maneuvers, dismounted maneuvers, and bivouac.

Two *Portulaca sclerocarpa* individuals are located within 75 meters (246 feet) of a road used for on-road mounted maneuvers with Stryker and other vehicles. However, these maneuvers are restricted to existing roads in Training Area 22, reducing the probability of direct impact to these individuals. Dust can be an issue from on-road vehicular travel but because *P. sclerocarpa* occurs primarily on aa and pahoehoe lava (substrates not prone to dust production), it is very unlikely to adversely affect this species. Dismounted and reconnaissance maneuvers may occur throughout Training Area 22 (and the area adjacent to it) and foot fall could possibly directly impact individuals, particularly since this species is succulent-like and susceptible to breakage. However, with so few plants within these training areas the risk is very low that inadvertent direct foot fall will affect these plants, especially given that soldiers will be briefed on sensitive resource locations.

Bivouac occurs on established firing point and ranges or at the Multi-Purpose Range Complex (Training Area 23). However, no occurrences of *Portulaca sclerocarpa* are within these established bivouac areas. While it is possible that a soldier could walk outside established bivouac areas, the risk is reduced by the Army's Standard Operating Procedures. In addition, the Army Natural Resources staff will survey and approve any future bivouac locations to ensure avoidance of *P. sclerocarpa* individuals.

One individual (representing less than one percent of the species in the wild State-wide) was found within 75 meters (246 feet) of the future western fence unit. There is the potential for this individual to be adversely affected by fence construction or maintenance; however, measures as described in the Project Description will be implemented during fence construction and future maintenance to avoid directly impacting this individual.

The majority of the occurrences of *Portulaca sclerocarpa* at PTA (19 individuals representing two percent of the total population) are found at distances greater than 75 meters (246 feet) from any man-made feature (*e.g.*, fence, fuel/fire break, firing point) and, therefore, are likely to only be affected by currently existing threats such as competition with, and habitat degradation by, non-native plants, particularly *Pennisetum setaceum*, and direct browsing, trampling, or habitat degradation by feral ungulates. One of the measures to reduce impacts to *P. sclerocarpa* is construction of the western fence unit that will help protect all known occurrences from ungulate impacts. Without the constant pressure from browsing goats and sheep, it is anticipated that *P. sclerocarpa* will naturally recruit to new areas and expand in density and abundance within the fence units largely without the need for outplanting. *Portulaca sclerocarpa* was found in the Keamuku parcel on Nohonaohae cinder cone as recently as 1991. When ungulate-proof fencing is placed around this puu and ungulates are removed from within this fence, there is the possibility that *P. sclerocarpa* could return on its own from an existing seed bank.

Fire is a risk to all listed plants within an installation that utilizes live-fire training. The WFMP will implement measures and new Standard Operating Procedures to reduce the risk of wildfire within the action area. PTA is a mosaic of dry habitats that can burn quickly when a fire is ignited. After

a fire, habitat conditions may be degraded due to the invasion of non-native plants, particularly *Pennisetum setaceum*, which can outcompete young *Portulaca sclerocarpa* plants. In addition, *P. setaceum* exacerbates the fire cycle by increasing the fuel load for future fires. Additional minimization measures for fire from all ignition sources are outlined in the Project Description which includes the implementation of the WFMP and the construction of fuel/fire breaks and corridors to reduce the risk of a catastrophic fire event. Reduced risk of fire events will result in reduced spread of non-native plants and other non-native species.

Summary

Army training activities that may directly or indirectly affect *Portulaca sclerocarpa* include live-fire training, on-road mounted maneuvers, dismounted maneuvers, and bivouac. We anticipate that with implementation of the proposed action, there is low likelihood of loss of any of the 22 individuals. Therefore, impacts to this species are considered to be minimal. In addition, the Army has committed to maintain ungulate-free fence units, fire breaks and fuel corridors at PTA that will result in long-term positive effects. *Portulaca sclerocarpa* occurs in two of the fuel management areas, thus reducing the risk of extirpation due to catastrophic fire event. The Service is assuming that this species will undergo natural recruitment as a result of the removal of ungulates in the western fence unit.

The WFMP will reduce the frequency, intensity and size of fires at PTA. Key aspects of the WFMP include: fuel modification; implementation of the Fire Danger Rating System that will restrict training according to weather and fuel conditions that will be monitored hourly by Range Control; invasive plant control; construction of additional dip tanks; and an increase in fire-trained personnel and fire fighting equipment. We anticipate that the proposed actions as outlined in the Project Description section, General Effects section, and the WFMP will offset adverse impacts from Legacy and Transformation training activities.

Silene hawaiiensis

There are approximately 14,835 individuals of *Silene hawaiiensis* found in 232 occurrences at PTA. These individuals represent 71 percent of the naturally occurring individuals remaining in the State of Hawaii (Evans 2003a). *Silene hawaiiensis* occurs in Training Areas 3, 9, 10, 11, 12, 13, 16, 21, 23, Bradshaw Army Airfield, and the Impact Area (see Figure 44 in the Transformation Biological Assessment). Legacy and Transformation training actions that will affect this species include on- and off-road mounted maneuvers, dismounted maneuvers, reconnaissance, live-fire training, bivouac, and construction.

Eighteen occurrences (76 individuals) of *Silene hawaiiensis* are located in the off-road maneuver area in the northern portion of PTA. These occurrences will be destroyed by the prolonged use of this area by Stryker vehicles as described in the General Effects section. The construction of the Anti-Armor Live-Fire Tracking Range and the Battle Action Course will impact approximately 1,175 *S. hawaiiensis* plants. In total, these three actions, off-road training, and both construction

projects, will result in the loss of 1,251 individuals (approximately eight percent) and eliminate the seedbank of the known individuals due to construction and high-use of troops and vehicles in these areas. To offset this loss, seeds will be collected from these plants prior to impact. Plants will be propagated in the greenhouse and transplanted to other sites to augment known occurrences and enhance genetic mixing. At a minimum, the number of plants lost from construction and off-road maneuvers will be propagated and outplanted. The Implementation Team will define the methodology and timing for these actions.

One of the effects on this species of ongoing and Transformation training activities is the continued risk of fire due to extensive live-fire training at PTA. It is anticipated that an unknown number of occurrences of *Silene hawaiiensis* in the Impact Area will be lost through time due to munitions explosions and subsequent fires in this area. In addition, there is always the risk that fire could ignite in the Impact Area and spread to areas outside the Impact Area, or a fire could ignite from human error (an errant round or pyrotechnic), cigarettes, catalytic converter, cookstoves at bivouac, or an unforeseen event. The fire risk also includes training activities and/or accidental ignition that could impact a large percentage of *S. hawaiiensis*. PTA is a mosaic of dry habitats that can burn quickly when a fire is ignited. The proposed fuel corridors and fuel/fire breaks will help reduce the risk of a single catastrophic fire event impacting a large portion of the occurrences.

A secondary effect of fire is the degradation of habitat and subsequent invasion of non-native plants. Species such as the noxious grass species, *Pennisetum setaceum*, exacerbate the fire cycle by providing a higher fuel load for future fires. Non-natives also tend to outcompete *Silene hawaiiensis* for space, light and nutrients. In addition, seeds of invasive plants may be inadvertently spread within the action area, especially within post fire areas, as they may be accidentally brought in on vehicles, clothing, and other equipment used during training and habitat maintenance activities. To reduce the potential expansion of invasive plants and introduction of new species to the action area, the Army will implement all measures described in the Project Description section of this opinion. Implementation of the WFMP will minimize the fire threat and reduce fire frequency and intensity at PTA (see Project Description).

Dismounted and bivouac sites may occur in the above Training Areas with occurrences of *Silene hawaiiensis*. Each of these training activities may affect *S. hawaiiensis* due to direct trampling or crushing from foot traffic or indirect impacts from increased dust and invasive plant dispersal. All these factors can degrade habitat and reduce plant viability. While a plant may be directly crushed from foot traffic, the risk is considered very low because reconnaissance or cross-country hiking is infrequent in these Training Areas. In addition, soldiers are briefed on sensitive resources at PTA and are instructed not to cut or impact vegetation.

Bivouac is currently conducted at firing points, ranges, and along Redleg Trail. There are approximately 11 occurrences that are on, or adjacent to, Redleg Trail. There is a high probability that these occurrences could be affected from bivouac. Most bivouac occurs within 20 to 50 meters (66 to 144 feet) of Redleg Trail. However, there are no occurrences of *S. hawaiiensis*

within the bivouac sites and soldiers generally stay within the designated encampment area. Although minimal, some foot traffic may occur outside the encampment areas. To minimize this impact, five exclosures will be constructed in Training Area 21 (see Figure 3) to protect the majority of occurrences of *S. hawaiiensis*. Fencing and ungulate removal will help protect these occurrences by removing the ongoing threat of browsing by feral sheep and goats thus increasing the opportunity for natural recruitment. Any future bivouac sites will be surveyed for *S. hawaiiensis* before approval by the Natural Resources Office.

Off-road maneuvers and live-fire exercises will result in large-scale habitat loss and degradation (Training Areas 3, 9, 12, 13, and 16 and the Impact Area) that may result in fragmentation of habitat. This could happen because *Silene hawaiiensis* occurrences within the Impact Area and northern PTA will be adversely affected, resulting in fragmentation of the remaining occurrences in the east and west. There are 71 occurrences (totaling 335 to 1,275 plants representing two to six percent of the species) west of Redleg Trail that have been identified within the Impact Area. Although pollinators for this species are not known, fragmentation could reduce genetic variability.

Fifty-six occurrences (totaling between 471 to 528 individuals and representing from two to three percent of the species in the wild) are found within 75 meters (246 feet) of roads and trails, landing zones, existing and proposed fences, and proposed fuel/fire breaks. On-road mounted maneuvers with Stryker and other vehicles are restricted to existing and proposed trails and roads. These individuals could be adversely affected by contamination, helicopter downdraft, dust, trampling, herbicide drift, and/or destruction from construction. As previously discussed in the General Effects section, the Army has existing Standard Operating Procedures in place and has proposed new Standard Operating Procedures that, when implemented, will reduce to very low probability the effects of contamination, trampling, herbicide drift, and destruction.

The majority of *Silene hawaiiensis* (14,280 individuals representing 68 percent of the species in the wild) are found at distances greater than 75 meters (246 feet) from man-made features (*e.g.* roads, fences, fire/fuel breaks). In addition to impacts already described for reconnaissance and dismounted maneuvers, these individuals are likely to be affected by currently existing threats such as competition with, and habitat degradation by, non-native plants, in particularly *Pennisetum setaceum*, and direct browsing, trampling, or habitat degradation by feral ungulates. The adverse effect from existing non-native species, especially ungulates, on *S. hawaiiensis* is considered high. However, the fence units (approximately 607 hectares; 1,500 acres) to be constructed on the eastern side of PTA (see Figure 3) will protect 61 occurrences (in addition to the 12 occurrences already protected by an enclosure) from training and ungulate impacts. In addition, the western fence unit will protect 21 occurrences (in addition to the 17 occurrences already protected by existing fence units). The small fence unit near Mackenzie Trail and Saddle Road that protects approximately 5,000 individuals will remain (see Figure 3). Without the constant pressure from browsing goats and sheep, it is anticipated that *S. hawaiiensis* will naturally recruit to new areas and expand in density and abundance within the fence units.

In addition the Army will also strive to achieve species reproduction *in situ* and will outplant *Silene hawaiiensis* at additional sites within PTA. The density and distribution of these plantings will be determined by the future Implementation Plan team. These actions have the positive effect of increasing genetic variability of the species and reducing the adverse effects of fire and other threats. The Army will also perform annual monitoring of the species' locations to assess the validity of assumptions made as part of the Project Description, the WFMP, the Standard Operating Procedures, and Conservation Measures.

Summary

Army training activities that will directly affect *Silene hawaiiensis* include live-fire training, reconnaissance, mounted and dismounted maneuvers, construction and bivouac. We have determined that these actions may permanently impact approximately eight percent of the extant individuals known in the action area. Indirect effects include dust, fire, invasive plants and browsing by feral ungulates. These impacts will be offset by the construction of additional fence units that will encompass 82 percent of *S. hawaiiensis* occurrences at PTA. Fencing will remove the ongoing browsing pressure from ungulates and allow for natural recruitment of the *S. hawaiiensis*. An Implementation Plan will be completed and include, at a minimum, the following additional conservation measures: non-native plant control to minimize adverse effects to habitat and reduce the threat of fire, and maintenance of genetic stock *ex situ*. The Army will also strive to achieve reproduction *in situ*, establish plants at additional sites, and maintain individual numbers of *S. hawaiiensis* at a level that would increase species distribution and abundance. The Implementation Plan will also address plant and seed collection prior to Transformation from occurrences that would otherwise be permanently lost. All of these actions benefit *S. hawaiiensis* thereby reducing the adverse effects of Army training on this species. The Army will also perform annual monitoring of the species' locations to assess the validity of assumptions made as part of the Project Description and conservation measures and based on the results, appropriately adapt management prescriptions as necessary and feasible.

The WFMP will be implemented to reduce the frequency, intensity and size of fires at PTA. Key aspects of the WFMP include: construction of fuel/fire breaks and corridors that subdivide the action area into several Fuel Management Areas; implementation of the 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 by invasive plant control; construction of additional dip tanks; and an increase in fire-trained personnel and fire fighting equipment. Therefore, based upon measures found in the Project Description, implementation of the WFMP and Standard Operating Procedures promulgated specifically to reduce impacts of Army actions on listed plant species, adverse impacts associated with Army actions in those training areas where *Silene hawaiiensis* occurs are considered to be minimized and offset by fencing, ungulate removal, propagation, outplanting, and threat abatement.

Silene lanceolata

There are an estimated 500 to 1,000 *Silene lanceolata* found in 61 occurrences within the action area at PTA. Depending upon the number of individuals, this represents between 78 and 90 percent of the species in the wild (Evans 2003a). *Silene lanceolata* occurs in Training Areas 17, 19, 20, 22, and 23 and buffer area limited access site (see Figure 45 in the Transformation Biological Assessment). Legacy and Transformation training actions that will affect this species include on-road mounted maneuvers, dismounted maneuvers, reconnaissance and bivouac.

Several occurrences of *Silene lanceolata* will be directly impacted by off-road vehicular maneuvers in northern PTA (Training Area 17). As discussed in the General Effects section, most of northern PTA and the Keamuku Parcel will become off-road training grounds for Stryker vehicles (see Figure 6). It is anticipated that if the Keamuku Parcel is acquired, the majority of the 145 individuals in Training Area 17 will be protected in the northern portion of the western fence unit. At this time, the exact location of the northern boundary of the western fence unit has not been determined; however, based upon preliminary design, we anticipate that no more than a few individuals will be destroyed. Dust resulting from off-road maneuvers may effect some of the remaining 146 to 151 individuals in Training Area 17. Accumulation of dust on *S. lanceolata* is a concern at PTA because the area receives little rainfall and the soils are friable soils and easily pulverized into airborne particles. To offset this potential effect, the Army will provide a 75-meter (246-foot) buffer along the fence unit to allow dust deposition prior to reaching a majority of the plants.

Twelve occurrences (approximately 159 individuals) are found within 75 meters (246 feet) of roads and trails in the remaining training areas. All vehicles, including Strykers, must remain on roads and trails as they move through these training areas; therefore; no plants will be directly crushed due to this activity. However, dust may be generated from vehicles traversing dirt roads and trails. There is a low probability that dust may accumulate on adjacent plants and reduce their health and vigor. In addition, a dust study will be developed by the Implementation Team and initiated by the Army to determine the long-term effect of dust deposition on listed plants and native vegetation at PTA. Depending upon the results of this study, the Implementation Team will determine what measures are necessary to reduce dust in certain areas and could include measures such as revegetation of exposed areas or placement of palliatives on dirt roads.

Silene lanceolata could also be affected by dismounted maneuvers, reconnaissance, and bivouac training as described in the Project Description section. These training activities may result in plants being trampled or crushed from foot traffic or occurrences indirectly impacted due to invasion of non-native plants and resulting habitat degradation. While there is the possibility that a plant may be directly crushed from foot traffic, the risk is considered to be low since reconnaissance or cross-country hiking is infrequent in Training Areas 22 and 23. Training in the other areas (Training Areas 17, 19 and 20) is more frequent and there is a moderate risk that

soldiers may directly or indirectly impact plants in these areas. To minimize these impacts, soldiers are briefed regarding sensitive resources at PTA and are instructed not to cut or impact vegetation.

Bivouac is currently conducted only at ranges and firing points that are suitable for camp establishment with open, non-vegetated, flat terrain. There are no occurrences of *S. lanceolata* within any bivouac site, and soldiers generally stay within the designated encampment area although the possibility of someone venturing outside of the bivouac site cannot be completely disregarded. Bivouac is restricted within two kilometers (one mile) of Kona Road (between Training Areas 20 and 22) and there are no occurrences of *S. angustifolia* within this bivouac approved area. Soldiers are instructed to use latrines at bivouac sites in order to curtail habitat disturbance outside the direct camp area. Any future bivouac sites will be surveyed and approved by the Natural Resources Office prior to selection and use.

Fourteen occurrences (161 individuals or between 14 and 26 percent of species) could be adversely affected by trampling, dust, and herbicide drift as a result of fence construction and fuel modification activities. As previously discussed in the General Effects section, the Army has existing Standard Operating Procedures in place and has proposed new Standard Operating Procedures that, when implemented, will reduce the negative effects of trampling, dust, and herbicide spray to very low levels In addition, the adverse effects of dust are further reduced by the fact that the majority of the *Silene lanceolata* at PTA occur on aa or pahoehoe lava. Forty-seven (47) occurrences of *S. lanceolata* (339 to 839 individuals or 68 to 84 percent of the species) are found at distances greater than 75 meters (246 feet) from any man-made feature (*e.g.*, fence, fire/fuel break, firing point) or activity.

Fire is an ongoing risk on a live-fire training installation surrounded by dry vegetation that can ignite and burn readily. A fire at PTA could ignite inside or outside the Impact Area due to training error (an errant round or pyrotechnic), discarded cigarettes, catalytic converter, cookstoves at bivouac or unforeseen event. If a fire does occur, particularly on the western side of PTA, its effect could be significant on *Silene lanceolata*. To minimize the threat of fire, the Army will implement the WFMP to reduce fire frequency and intensity at PTA. An important aspect of the WFMP is that *S. lanceolata* occurrences will be separated by fuel corridors and fire breaks that subdivide the western portion of PTA into Fuel Management Areas (see Figure 7). The goal is that these corridors and other fuel management measures will inhibit the spread of a wildfire and contain it within a portion of the occupied area, thus reducing the loss of *S. lanceolata*and other species. Once a fire has altered the habitat, there is high likelihood of invasion of non-native plants, particularly *Pennisetum setaceum*. Not only can *P. setaceum* outcompete young *S. lanceolata* seedlings by utilizing space and resources, it also increases the fuel load thereby increasing the fire risk.

Silene lanceolata occurrences outside of existing fence units at Kipuka Alala and Kalawamauna may be subject to browsing by feral ungulates. One of the measures to reduce this impact to *S.*

lanceolata is the construction of the western fence unit. This fence unit will protect 34 occurrences (in addition to the 27 occurrences already protected by existing fence units) from ungulate impacts. Without the pressure from browsing goats and sheep, it is anticipated that *S. lanceolata* will naturally recruit to new areas and expand in density and abundance within the fence units. The Army will reduce the threat of invasion by non-native plants, particularly *Pennisetum setaceum*, by developing and implementing an invasive plant control program.

Summary

Army training activities that will directly affect *Silene lanceolata* include live-fire training, reconnaissance, mounted and dismounted maneuvers, and bivouac. We have determined that off-road maneuvers in northern PTA may destroy three occurrences (25 individuals or less than one percent of the population) of *S. lanceolata* located just north of the western fence unit. Indirect effects include dust, fire, invasive plants and browsing from feral ungulates. All these impacts will be offset by the construction of additional fence units that will encompass the majority of *S. lanceolata* occurrences on PTA. Fencing will remove the ongoing browsing pressure from ungulates and allow for natural recruitment of the species. A buffer will be included in the fence unit adjacent to the off-road maneuver area to minimize dust deposition on *S. lanceolata* in Training Area 17. An Implementation Plan will be completed to address additional measures for *S. lanceolata* within the action area such as non-native plant control to minimize adverse effects on habitat quality and to reduce the threat of fire. The Army will also strive to achieve reproduction *in situ*, maintain a genetic stock *ex situ,* and establish plants at additional sites to increase species distribution and abundance. All of these actions will benefit *S. lanceolata* thereby reducing the adverse effects of Army training on this species. Annual monitoring of species' locations will be conducted by the Natural Resources staff.

The WFMP will be implemented to reduce the frequency, intensity and size of fires at PTA. Key aspects of the WFMP include the construction of fuel corridors and fire/fuel breaks which subdivide the western portion of PTA in Fuel Management Areas, implementation of the Fire Danger Rating System that will restrict training according to weather and fuel conditions and hourly monitoring by Range Control, fuel load reduction by invasive plant control, construction of additional dip tanks, and an increase in fire-trained personnel and fire fighting equipment. Based upon measures in the Project Description, implementation of the WFMP and Standard Operating Procedures promulgated specifically to reduce impacts of Army actions on listed plant species, adverse impacts associated with Army actions will be minimized.

Solanum incompletum

There are an estimated 40 individuals of *Solanum incompletum* found in six occurrences at PTA. These 40 plants represent all of the individuals remaining in the wild (Evans 2003a). *Solanum incompletum* occurs only in Training Area 22. Figure 46 in the Transformation Biological Assessment identifies the location of six occurrences (totaling 36 plants); however, an additional

occurrence of four plants was recently discovered northeast of the mapped occurrences (Evans 2003b; S. Evans, pers. comm. 2003). All occurrences are located at the western edge of the action area and one occurrence may be beyond the actual PTA border. Legacy and Transformation training actions that will affect this species include live-fire training, dismounted maneuvers, and reconnaissance.

Isolated populations are subject to extirpation by man-made or natural events, such as fire or drought. *Solanum incompletum* is at extreme risk due to the small size and isolation of the remaining individuals (all individuals relegated to approximately 13 hectares; 32 acres). Any stochastic event such as wildfire from live-fire training or accidental causes, could impact these occurrences and further imperil an already high-risk species. With only 40 individuals remaining, the loss of even one individual will further depress genetic variability of the species. Therefore, we have determined there is a significant risk to this species due to fire affecting even some of these individuals.

While the isolated and clustered nature of *Solanum incompletum* makes it more vulnerable to fire, the threat of fire originating in the Impact Area and spreading to the extreme western border of the installation will be minimized by implementation of the WFMP. The WFMP will reduce the risk of fire ignition (see Project Description), and if a fire does start in the western portion of PTA there are measures in the plan that will improve the fire-fighting capabilities of the crew at PTA. For example, a military helicopter with a certified and trained aircrew capable of performing fire bucket operations must be onsite during live-fire training and a backup helicopter under contract with the Army will be available and able to arrive at PTA within 90 minutes after notification. In addition, a minimum of six trained fire-fighting personnel are required onsite during expected high fire danger rating days and any scheduled live-fire training operation. These measures will help prevent a wildfire from traveling across the western expanse of PTA and burning *S. incompletum*. To minimize the risk of fire originating from the west (offsite) and moving east to impact these occurrences, a fuel/fire break will be constructed along the western border between State land and PTA (see Figure 7).

Small groups of soldiers, such as squads, may conduct dismounted maneuvers or reconnaissance in Training Area 22 which could impact these plants directly by crushing or trampling. Because *Solanum incompletum* individuals are located on the western border of the action area (away from roads and landing zones), the probability of this type of impact is very low. Indirect effects from foot traffic include degradation of the surrounding habitat by soil compaction and inadvertent spread of non-native seeds. However, Standard Operating Procedures and soldier awareness training should help reduce the risk of these concerns. Overall, the risk of trampling the plant directly or affecting surrounding habitat from foot patrol or reconnaissance is very low in Training Areas 22 because cross-country hiking is very infrequent and the plants are quite removed from more active training areas.

Two of the six occurrences (two individuals or five percent of the species) are within 75 meters (246 feet) west of the proposed western fence and could be affected as a result of fence construction or maintenance activities. However, extreme care will be taken not to impact any of the few remaining individuals by maintaining an adequate buffer (as determined by the Army Natural Resources staff) while constructing the western fenceline or maintaining the fence. The newly located *S. incompletum* occurrence is located approximately 2,500 to 3,000 meters (8,202 to 9,843 feet) northeast of the original six occurrences and emergency fencing (temporary) has been placed around these individuals. All of the *S. incompletum* occurrences are found on aa lava, a substrate that is not prone to dust production which will also minimize the effect of dust to these individuals during fuel modification or fence construction activities.

Solanum incompletum is browsed by feral ungulates which poses another threat to a species with so few individuals remaining. Construction of the western fence unit and subsequent removal of ungulates will greatly benefit this species. All occurrences (except possibly one) would be encompassed within the western fence unit. As previously discussed in the General Effects section, without the constant browsing pressure of goats and sheep, we anticipate that *S. incompletum* will naturally recruit to new areas and expand in density and abundance within the fence unit. The Implementation Team will address the special needs of this plant and develop an outplanting plan for this species in order to reduce the risk of species extinction to stochastic events due to low numbers and small distribution.

The Natural Resources staff at PTA observed several individuals of *Solanum incompletum* that appeared to be failing apparently due to sun exposure and heat which may be a consequence of recent drought conditions on Hawaii over the last few years. A shade covering was erected over several *S. incompletum* plants to reduce heat and sunlight, and this measure has appeared to improve their condition (S. Gleason, pers. comm. 2003). Other beneficial actions that will be implemented to increase the density and abundance of this species include: development of a non-native invasive plant species control plan; species reproduction *in situ*; maintenance of genetic stock *ex situ*; and outplanting at other suitable sites within fence units at PTA.

Summary

Solanum incompletum is very susceptible to a stochastic event such as fire due to the low number of individuals remaining in the wild and due to the isolated nature of these occurrences at PTA. Construction of the western fence unit will encompass all individuals of *S. incompletum* occurrences at PTA (except possibly one located on State land). Fencing will remove ongoing browsing pressure from ungulates and allow for natural recruitment of the species. An Implementation Plan will be completed that will include at a minimum the following additional conservation measures for *S. incompletum* within the action area: non-native plant control to minimize adverse effects on habitat quality, maintenance of genetic stock *ex situ*, reproduction *in situ*, and outplanting *of S. incompletum* at additional sites. Shade will be provided when plants appear to be flagging due to heat or water-loss stress. In addition, the Implementation Team will

address plant and seed collection from extant occurrences and the appropriate means of propagation since to date this species appears to have low reproductive success. All of these actions benefit *S. incompletum* thereby reducing the adverse effects of Army training on this species. The Army will also perform annual species' location monitoring to document whether the measures outlined in the Project Description and future Implementation Plan are being met.

The WFMP will be implemented to reduce the frequency, intensity and size of fires at PTA. Key aspects of the WFMP include: construction of fuel/fire breaks and corridors that subdivide the western portion of PTA into Fuel Management Areas; implementation of the Fire Danger Rating System that will restrict training according to weather and fuel conditions that will be monitored hourly by Range Control; fuel load reduction through invasive plant control; construction of additional dip tanks; and an increase in fire-trained personnel and fire-fighting equipment Therefore, based upon implementation of measures found in the Project Description, the WFMP, and Standard Operating Procedures promulgated specifically to reduce impacts of Army actions on listed plant species, adverse impacts associated with Army actions will be minimized and offset by fencing, ungulate removal, propagation, outplanting, and threat abatement.

Spermolepis hawaiiensis

There are an estimated 27 individuals of *Spermolepis hawaiiensis* found in 14 occurrences within the action area at PTA. These individuals represent approximately three percent of the species in the wild (Evans 2003a). *Spermolepis hawaiiensis* is only found in Training Areas 22 and 23 (see Figure 47 in the Transformation Biological Assessment). Legacy and Transformation training actions that have the potential to affect this species include live-fire training, dismounted maneuvers, and reconnaissance.

Thirteen occurrences of *Spermolepis hawaiiensis* occur in the southwest section of PTA in Training Area 23 within the existing Kipuka Alala fence unit (see Figure 3). One occurrence is located in Training Area 22 approximately 275 meters (902 feet) from the western border and is not within a fence. None of the 14 occurrences are located within 75 meters (246 feet) of a road, fuel break, fence, or other man-made feature. There is the potential for a soldier to inadvertently trample or crush a plant during cross-county reconnaissance or dismounted training activities; however, this threat is considered to be very low for this species as only 27 plants occur in an area of over 13,000 hectares (32,195 acres). In addition, soldiers are briefed regarding sensitive resources on PTA and are instructed not to cut or impact the vegetation. An aerial hunt was conducted in 2003 to remove the remaining ungulates from the Kipuka Alala fence unit (S. Gleason, pers. comm. 2003) which will reduce the risk of browsing to individuals of *S. hawaiiensis*.

As with all plants on PTA, there is a risk of impact from fire ignition either from live-fire training or accidental ignition. Ever-present is the risk that fire could ignite in the Impact Area and spread to areas outside of the Impact Area, or that a fire could ignite due to human error (an errant round or

pyrotechnic), discarded cigarettes, catalytic converter, cookstoves at bivouac sites or an other unforseen event. PTA is a mosaic of dry habitats that can burn quickly when a fire is ignited. Given that only three percent of the total population of *Spermolepis hawaiiensis* occurs within the action area, the threat from a catastrophic fire is considered to be lower for this species than others. To minimize the threat of fire, the Army will implement the WFMP that will reduce fire frequency and intensity at PTA (see Project Description). *Spermolepis hawaiiensis* will benefit by the construction of fuel/fire breaks and corridors that will separate occurrences into separate, smaller Fuel Management Areas, and inhibit the spread of a wildfire.

Other threats that could affect *Spermolepis hawaiiensis*, as with all other listed plants on PTA, include browsing pressure from feral ungulates and competition from non-native invasive plants. Currently, the majority of the *Spermolepis hawaiiensis* occurrences are located within pahoehoe lava in *Myoporum-Sophora* Shrublands in Kipuka Alala and this area is still relatively free of invasive plants. In addition, removal of the last ungulates within this fence unit will further reduce browsing pressure on the species.

Summary

Only three percent of the State-wide population of *Spermolepis hawaiiensis* is found within the action area. Any adverse impacts from potential trampling or fire ignition from live-fire training will be offset by the implementation of the WFMP and Standard Operating Procedures promulgated specifically to reduce impacts of Army actions on listed plant species. The construction of additional fence units and removal of ungulates will benefit this species by enhancing the opportunity for natural recruitment and plant dispersal. This species has not been identified as a priority species for additional conservation measures; however, the Implementation Team will determine if any additional measures could be implemented to increase species abundance and distribution at PTA.

The WFMP will be implemented to reduce the frequency, intensity and size of fires at PTA. Key aspects of the WFMP include the construction of fuel corridors and fire/fuel breaks which subdivide the western portion of PTA in Fuel Management Areas, implementation of the Fire Danger Rating System that will restrict training according to weather and fuel conditions and hourly monitoring by Range Control, fuel load reduction by invasive plant control, construction of additional dip tanks, and an increase in fire-trained personnel and fire fighting equipment. Based upon measures in the Project Description, implementation of the WFMP and Standard Operating Procedures promulgated specifically to reduce impacts of Army actions on listed plant species, adverse impacts associated with Army actions will be minimized and offset.

Stenogyne angustifolia

There are an estimated 5,011 to 7,511 individuals of *Stenogyne angustifolia* found in 291 occurrences within the action area at PTA. These individuals represent 100 percent of all of the *S. angustifolia* occurring in the wild (Evans 2003a). *Stenogyne angustifolia* occurs in Training

Areas 18, 19, 20, 22, 23, the limited access buffer area between Training Area 22 and the Impact Area and in the Impact Area itself, as well as the Keamuku Parcel (see Figure 48 in the Transformation Biological Assessment). Legacy and Transformation training actions that will affect this species include on and off-road mounted maneuvers, dismounted maneuvers, reconnaissance, and bivouac.

There are two occurrences (11 individuals or less than one percent of the species) of *Stenogyne angustifolia* located in the off-road maneuver training area in northern PTA and the southeast corner of Keamuku Parcel (see Figure 6). The number of Stryker vehicles and the frequency of their off-road training is not known at this time, however, we have determined that the risk of permanent loss or damage either from direct crushing or long-term intense dust and habitat degradation is inevitable.

Mounted on-road maneuvers with Strykers and other vehicles will be restricted to existing and proposed trails and roads in Training Areas 18, 19, 20, 22, 23, and the limited access buffer area between the Impact Area and Training Area 22. There are 41 occurrences (91 to 111 individuals representing one to two percent of the species) of *Stenogyne angustifolia* that are found within 75 meters (246 feet) of a road or trail. Rainfall levels at PTA are low and indirect impacts associated with driving on dirt roads would be the accumulation of dust overtime that could reduce plant vigor. In addition, a dust study will be developed by the Implementation Team and initiated by the Army to determine the long-term effect of dust deposition on listed plants and native vegetation at PTA. Depending upon the results of this study, the Implementation Team will determine what measures are necessary to reduce dust in certain areas and could include measures such as revegetation of exposed areas or placement of palliatives on dirt roads.

Stenogyne angustifolia is concentrated in the northwest portion of PTA clustered in the area designated as Kipuka Kalawamauna Endangered Plants Habitat (see Figure 3). Twenty-two of these occurrences are located within the Kipuka Kalawamauna fence unit. Only one occurrence of *S. angustifolia* occurs within Training Area 20. Dismounted maneuvers reconnaissance will occur off roads and trails in Training Areas 18, 19, 22, and 23. These training activities may directly effect *S. angustifolia* by crushing plants during cross-country maneuvers due to foot traffic. The risk of trampling from foot patrol or reconnaissance is very low in Training Areas 22 and 23 because cross-country hiking is infrequent in these areas and the training area is vast, thus reducing the risk of direct contact with an individual plant. Training in the other areas (Training Area 19 and north 22) is more frequent and, therefore, the risk is moderate that soldiers may directly or indirectly impact plants in these areas.

Bivouac primarily occurs at ranges and firing points that are suitable for camp establishment (*i.e.*, open, unvegetated, flat terrain). This may occur in most of the training areas occupied by *Stenogyne angustifolia* (e.g., Training Areas 18, 19, 22, 23 and limited access buffer area). There is a moderate potential for direct and indirect impacts to four occurrences (four individuals) that are located within 75 meters (246 feet) of a firing point in Training Area 19. Soldiers may

wander from the main bivouac area and inadvertently step on a plant. To minimize this potential, soldiers are instructed when they arrive at PTA to avoid vegetated areas and to use latrines. In addition, bivouac is restricted within two kilometers (one mile) of Kona Road (between Training Areas 20 and 22) and there are no occurrences of *S. angustifolia* within this area approved for bivouac. In Training Areas 22 and 23, sites within Multi-Purpose Range Complex will be used for bivouac; these areas are already graded and leveled and there are no known occurrences of *S. angustifolia*. Any new bivouac site will be surveyed and approved by the Natural Resources staff to ensure no *S. angustifolia* will be impacted.

Within the action area, there are a total of 93 occurrences (238 to 317 individuals or between four and five percent of the total population) that could be adversely affected by trampling, dust and/or herbicide drift due to the construction or maintenance of the fenceline or fuel modification areas. There is the potential that some individuals of *Stenogyne angustifolia* may be adversely affected by workers inadvertently trampling plants or wind-induced herbicide drift and dust. The construction of fuel modification areas and fence exclosures are positive actions that will benefit the species in the long-term and the Army will follow Standard Operating Procedures and Best Management Practices to reduce direct and indirect effects from these actions. The effect of dust from fence construction and fuel modification will be minimal in Training Areas 20 and 22 (approximately 65 occurrences) because substrate in these areas are primarily aa or pahoehoe lava flow and these soils do not pulverize as readily as sandy or loamy soils.

There is the continued risk of wildfire from Legacy and Transformation activities due to extensive live-fire training at PTA. There is a risk that fire could ignite in the Impact Area and spread to areas outside of the Impact Area, or a fire could ignite from human error (an errant round or pyrotechnic), discarded cigarette, catalytic converter, cookstoves at bivouac, or other unforseen events. Vegetation on PTA is a mosaic of dry habitats that burn quickly when a fire is ignited. If a fire does occur, particularly on the west side of PTA, the effect could be significant for those species only found at PTA. To minimize this threat, the Army will implement the WFMP to reduce fire frequency and intensity at PTA (see Project Description). One important aspect of the WFMP is that *Stenogyne angustifolia* occurrences will be separated by fuel corridors that subdivide the western portion of PTA into smaller Fuel Management Areas. The intent is that these corridors and other fuel management measures will inhibit the spread of wildfire, containing it to only a portion of the occupied area and reducing the loss of *S. angustifolia*.

A secondary effect of fire is the alteration of habitat from invasion of non-native plant species. These plants, particularly the noxious grass species *Pennisetum setaceum*, degrade the surrounding habitat and exacerbate the fire cycle by providing a higher fuel load for future fires. *Stenogyne angustifolia* could be affected due to competition from non-native species that are more vigorous and outcompete this species for space, light and nutrients. In addition to the spread of alien plant seeds after a fire, invasive plants are inadvertently brought in on vehicles, clothing, construction equipment, by ungulates, and range maintenance activities. To reduce the spread of

invasive plants the Army will implement all measures as outlined in the Project Description section and the General Effects section of this opinion.

The remaining 198 occurrences (4,773 to 7,194 individuals or 95 to 96 percent of the species) are located at a distance greater than 75 meters (246 feet) from roads, trails, or other man-made features. In addition to impacts already described for reconnaissance and bivouac, *Stenogyne angustifolia* may be affected by existing threats such as competition with non-native plants and habitat degradation from feral ungulates. Construction of the western fence unit and subsequent removal of ungulates will protect all but three occurrences (three individuals) within the western fence unit. Without the constant pressure of browsing goats and sheep, it is anticipated that *Stenogyne angustifolia* will naturally recruit and expand in density and abundance within the fence units and outplanting efforts will be more successful.

Additional measures included in the Project Description to help offset project impacts to *Stenogyne angustifolia* include: development of a non-native invasive plant control plan, species reproduction *in situ*, maintenance of genetic stock *ex situ*, and establishment of *S. angustifolia* at additional sites within PTA through outplanting or natural recruitment. These actions will increase the genetic variability of *S. angustifolia* and reduce the risk currently associated with natural and/or man-made stochastic events. The Army will also conduct annual monitoring of extant and outplanted individuals.

Summary

Three percent (150 individuals) of the current population of *Stenogyne angustifolia* could potentially be impacted due to direct effects (off-road maneuver areas and bivouac). Indirect effects include dust, fire, invasive plant competition and ungulate browsing. These impacts will be offset by the construction of the western fence unit which will enclose almost all of the *S. angustifolia*. An Implementation Plan will be developed to define additional measures to be implemented by the Army and will, at a minimum, include: non-native plant control plan, maintenance of genetic stock *ex situ*, reproduction *in situ*, and augmentation or outplanting to increase abundance and distribution. All of these actions are intended to benefit *S. angustifolia* and reduce the adverse effects of Army training on this species. The Army will conduct annual surveys to monitor species abundance and distribution.

The WFMP will be implemented to reduce the frequency, intensity and size of fires at PTA. Key aspects of the WFMP include: implementation of the Fire Danger Rating System that will restrict training according to weather and fuel conditions and include hourly monitoring by Range Control, fuel load reduction by invasive plant control and construction of additional fuel and fire breaks, construction of additional dip tanks, and an increase in fire-trained personnel and fire fighting equipment. Based upon measures found in the Project Description, implementation of the WFMP and Standard Operating Procedures promulgated specifically to reduce impacts of Army actions on listed plant species, adverse impacts associated with Army actions in those training areas where

S. angustifolia occurs will be minimized and offset by fencing, ungulate removal, propagation, outplanting, and threat abatement.

Tetramolopium arenarium* ssp. *arenarium

There are 260 *Tetramolopium arenarium* ssp. *arenarium* within 22 occurrences at PTA. These individuals represent 100 percent of all naturally occurring individuals remaining in the State of Hawaii (Evans 2003a; U.S. Army 2003a). These 22 occurrences are found in Training Areas 19 and 22 (see Figure 49 in the Transformation Biological Assessment). Legacy and Transformation training actions that could affect this species include mounted maneuvers, dismounted maneuvers, reconnaissance, bivouac, and live-fire training.

The majority of the *Tetramolopium arenarium* ssp. *arenarium* plants (250 individuals) are located within the Kipuka Kalawamauna fence unit. Mounted maneuvers with Stryker and other vehicles are restricted to existing and proposed trails and roads in Training Areas 19 and 22, therefore, direct impact to this species from this activity will not occur. There is the potential, however, that repetitive driving on dirt roads will generate dust affecting the plants adjacent to the roadways. Dust may accumulate over time particularly because rainfall levels at PTA are low (the average annual precipitation is 37 centimeters; 5 inches) and is usually in small amounts at any one time. Dust could affect plant health and vigor over time. A dust study will be developed by the Implementation Team and initiated by the Army to determine the long-term effect of dust deposition on listed plants and native vegetation at PTA. Depending upon the results of this study, the Implementation Team will determine what measures, if any, are necessary to reduce the effect of dust which could include revegetation of exposed areas or placement of palliatives on roadways.

Dismounted maneuvers, bivouac and reconnaissance could occur in Training Areas 19 and 22. These training activities may directly affect *Tetramolopium arenarium* ssp. *arenarium* by crushing a plant from foot traffic during cross-country maneuvers or from constructing an encampment in close proximity to an occurrence. The potential indirect effects of these Army actions on *T. arenarium* ssp. *arenarium* include invasion of non-native plants (from clothing or boots) and dust. The risk of trampling from dismounted maneuvers or reconnaissance activity is low in Training Area 22, however, since cross-country hiking is very infrequent in this area. Three occurrences of *T. arenarium* ssp. *arenarium* (three individuals) are at greater risk from foot traffic due to their proximity to Bobcat Trail (see Figure 4). Bivouac primarily occurs at ranges and firing points that are suitable for camp establishment (*i.e.*, open, flat terrain). Bivouac could occur in both Training Areas 19 and 22; however, no direct impact to this species will occur within bivouac approved areas because *T. arenarium* ssp. *arenarium* is not present in these areas. However, soldiers may wander from the main bivouac area and thus inadvertently step on a plant. As mentioned above, there is a greater risk that bivouac activities could impact the two occurrences near Bobcat Trail (Training Area 19). To minimize this risk, soldiers are instructed when they arrive at PTA to avoid vegetated areas and to use latrines. Any new bivouac site will

be surveyed and approved by the Natural Resource staff to ensure *T. arenarium* ssp. *arenarium* will not be impacted.

Five occurrences (six individuals) of *Tetramolopium arenarium* ssp. *arenarium* are located within 75 meters (246 feet) of existing or proposed man-made features such as existing or proposed fence units, roads or trails, and fuel/fire breaks. These individuals constitute approximately two percent of the total population. Some of these individuals could be adversely affected by dust, trampling, and/or herbicide drift as part of fence or fuel break construction and maintenance. However, fence construction is a one-time event, and fuel modification may only have a minimal effect to this species as these activities will be located to avoid direct impact to the maximum extent possible. In addition, Best Management Practices will be utilized to minimize the potential for airborne drift of construction dust and herbicide spraying. The remaining occurrences (256 individuals or 98 percent of the species) are at distances greater than 75 meters (246 feet) from any man-made feature.

Fire is considered to be the greatest threat to *Tetramolopium arenarium* ssp. *arenarium* especially because the entire population occurs within the action area and it is concentrated in one area. There is a risk that fire could ignite in the Impact Area and spread to areas outside of the Impact Area, or a fire could ignite from human error (an errant round or pyrotechnic), discarded cigarette, catalytic converter, cookstoves at bivouac or an unforseen event. PTA is a mosaic of dry habitats that can burn quickly when a fire is ignited. For example, in 1994, a fire destroyed 118 individuals of *Tetramolopium arenarium* ssp. *arenarium* eliminating approximately a third of the total population (U.S. Army 2003a). Once a fire has occurred and the native habitat has been burned, there is the potential for subsequent invasion of non-native plant species (particularly *Pennisetum setaceum*). These invasive plants increase competition with native plants and degrade the surrounding habitat. To minimize this threat, the Army will implement the WFMP that will reduce fire frequency and intensity. A very important aspect of WFMP is that fuel/fire breaks and corridors will subdivide the western portion of PTA into Fuel Management Areas (see Figure 7). The goal is that these corridors, along with other fuel management measures, will inhibit the spread of a wildfire and contain it to within a portion of the occupied areas, thus reducing the loss of *T. arenarium* ssp. *arenarium.* Additional minimization measures for reduction of fire risk are outlined in the Project Description. To minimize the impact of non-native plant species, the Implementation Team will develop an invasive plant control plan to be implemented by the Army.

Another adverse impact to *Tetramolopium arenarium ssp. arenarium*, as with all other listed plants at PTA, is the continual browsing pressure from feral sheep and goats. Currently, approximately 250 individuals are enclosed within the Kipuka Kalawamauna fence unit. In 2003 an aerial hunt was conducted to remove the remaining ungulates within this fence unit (S. Gleason, pers. comm. 2003). Removal of the ungulates from this fence unit will benefit this species by eliminating a constant threat and allowing for natural recruitment and dispersal of this species.

Additional measures included in the Project Description to help offset project impacts to *Tetramolopium arenarium ssp. arenarium* include: species reproduction *in situ*; maintenance of

genetic stock *ex situ*; and establishment of *T. arenarium* ssp. *arenarium* at additional sites within PTA through outplanting or natural recruitment. These actions will increase the genetic variability of *T. arenarium* ssp. *arenarium* and reduce the risk currently associated with natural and/or man-made stochastic events since the entire population is limited to one location within the action area. The Army will also conduct annual monitoring of extant and outplanted individuals. When the western fence unit is constructed *T. arenarium* ssp. *arenarium* will be outplanted to increase population abundance and distribution.

Summary

The Army training impacts to *Tetramolopium arenarium* ssp. *arenarium* include bivouac, dismounted maneuvers, reconnaissance and live-fire training. Indirect effects include fire, invasive plant competition and browsing from feral ungulates. The risk of fire can never be eliminated and will always have a significant impact to listed native plants and their habitats on PTA. Due to the low number of individuals remaining in the wild, this species is extremely vulnerable to stochastic events. The Implementation Team will address the propagation and outplanting requirements for this species to increase abundance and distribution of *T. arenarium* ssp. *arenarium*. The construction of the western fence unit will provide additional protected areas (ungulate-free) for outplanting of this species. An Implementation Plan will be developed and implemented to include: non-native plant control to minimize adverse effects on habitat quality, maintenance of genetic stock *ex situ*, reproduction *in situ*, and outplanting of plants at additional sites at PTA to achieve a minimum plant density. The Army will perform annual monitoring of this species to ensure that the assumptions made as part of the Project Description and conservation measures are being met, and based on the results, appropriately adapt management prescriptions as necessary and feasible.

The WFMP will be implemented to reduce the frequency, intensity and size of fires at PTA. Key aspects of the WFMP include the construction of fuel corridors and fire/fuel breaks that subdivide the western portion of PTA into Fuel Management Areas; implementation of the Fire Danger Rating System that will restrict training according to weather and fuel conditions that will be monitored hourly by Range Control; fuel load reduction by invasive plant control; construction of additional dip tanks; and an increase in fire-trained personnel and fire-fighting equipment. Therefore, based upon measures in the Project Description, implementation of the WFMP and Standard Operating Procedures promulgated specifically to reduce impacts of Army actions on listed plant species, adverse impacts associated with Army actions will be minimized and offset by fencing, ungulate removal, propagation, outplanting, and threat abatement.

Vigna o-wahuensis

There are an estimated 71 individuals of *Vigna o-wahuensis* within six occurrences in the action area. These individuals represent 83 percent of the species remaining in the wild (Evans 2003a). *Vigna o-wahuensis* occurs on the Keamuku Parcel on Puu Nohonaohae, Puu Papapa, and one in southwest Keamuku Parcel (see Figure 50 in the Transformation Biological Assessment). Currently there are no Legacy activities that are conducted in the vicinity of these occurrences. If

Transformation occurs on Keamuku, the only direct impact from training would be off-road mounted maneuvers and live-fire training. In the future, the entire area that surrounds both cinder cones, extending into the southern boundary of the Keamuku Parcel, will become an off-road maneuver area for Stryker vehicles (see Figure 6). The cinder cones themselves would be off-limits to Stryker vehicles and surrounded by fire/fuel breaks and fencing.

As with *Isodendrion hosakae* and *Lipochaeta venosa*, *Vigna o-wahuensis* is primarily relegated to several cinder cones on Parker Ranch and Keamuku except the one occurrence growing in the lowlands in southeastern Keamuku. The majority of the habitat in the Keamuku Parcel is degraded from decades of ranching and cattle grazing activity. It is anticipated that the small occurrence of *V. o-wahuensis* (five individuals) along the southwestern border of Keamuku may be impacted over time due to Stryker maneuvers. Prior to Transformation in Keamuku, the Army will collect seeds and vegetative cuttings from this lowland occurrence. Plants will be grown in the PTA greenhouse and outplanted to increase the genetic variability of remaining *V. o-wahuensis* occurrences on the two cinder cones.

Currently only Puu Papapa is fenced to exclude cattle. If the Keamuku Parcel is included in the Transformation training actions, then these cinder cones will be fenced to exclude all ungulates and training actions will not be allowed within these fenced areas. However, the remainder of the Keamuku Parcel is slated to become a high-use off-road training area utilizing Stryker vehicles. As Stryker vehicles drive around the parcel, they will crush and uproot existing vegetation (pastureland) exposing the soil. As more vehicles drive over the exposed land, dust plumes will be created that may migrate over large areas, depending on wind velocity and direction. The majority of the soils in the Keamuku Parcel are sandy and very fine sandy loams thus exacerbating the creation of airborne particles created by Stryker training. There is a strong likelihood that due to the amount of dust that will be generated from Stryker off-road activities, health and vigor of these plants could be compromised. To minimize this impact, a 75-foot (246-foot) buffer will be established along the bottom of each puu creating a zone for dust deposition prior to reaching the *V. o-wahuensis* occurrences. This buffer will minimize the effect of dust deposition on listed plants on the cinder cones. In addition, a dust study will be developed by the Implementation Team and initiated by the Army to determine the long-term effect of dust deposition on listed plants and native vegetation at PTA. All listed plants on the Keamuku cinder cones will be included in the study. Depending upon the results of this study, the Implementation Team will determine what measures are necessary to reduce dust in certain areas and could include measures such as revegetation of exposed areas or placement of palliatives on dirt roads.

There is a potential negative effect from indirect effects such as trampling, dust, and herbicide drift due to the construction and maintenance of future fences and fire/fuel breaks. To offset this impact, a 75-meter (246-foot) buffer shall be established between construction activities associated with the fence or fuel modification area and the plants. This buffer will reduce the

negative effects of trampling, dust, and herbicide drift on *Vigna o-wahuensis* and other species to very low levels.

Another indirect effect from future training activities at the Keamuku Parcel is the increased risk of wildfire. *Vigna o-wahuensis* is subject to extirpation by a catastrophic event such as an uncontrolled wildfire due to its small, isolated locations in Keamuku Parcel and in Parker Ranch. We consider there to be a high potential for wildfire in Keamuku Parcel due to the predominance of non-native grassland habitat that burns readily and can spread quickly due to the high fuel load. For example, in 1999 fire consumed 95 percent of the vegetation on the Nohonaohae cinder cone (U.S. Army 2003a). To minimize the risk of fire, the Army has completed and will implement a comprehensive WFMP that includes fire reduction measures for Keamuku Parcel. Therefore, if this parcel is acquired by the Army (through lease or purchase) for Transformation, then the actions within the plan will be implemented. Measures to reduce the risk of fire include those outlined in the Project Description along with the creation of fire/fuel breaks at the Keamuku boundary which will inhibit fires ignited outside the parcel from moving onto the parcel. Fire breaks will also be constructed around each of the cinder cones where *V. o-wahuensis* is found. An additional dip tank will be constructed in the Keamuku Parcel so that water is available in closer proximity to a wildfire which may occur in this area.

Invasion of non-native plant species has occurred along the lower portion of the two cinder cones and will continue if active eradication or control measure are not undertaken (S. Gleason, pers. comm. 2003). *Vigna o-wahuensis* is likely to be affected by existing and future threats from competition with non-native plant species, particularly *Pennisetum setaceum*, *Salsola kali*, and *Senecio madagascariensis*. The Implementation Plan will address the issue of invasive plant species for these cinder cone areas and will include a plan for control of such species.

The Army will implement a number of conservation measures to minimize or eliminate additional threats to *Vigna o-wahuensis* within the action area. These include upgrading the existing fence around Puu Papapa to exclude all ungulates (currently there is only a cattle fence) and fencing of Puu Nohonaohae. The Implementation Team will develop and implement a non-native plant control plan to minimize adverse effects of invasive plants and to maintain the cinder cones in a relatively weed-free state. Outplanting will be a high priority for *V. o-wahuensis* due to its very limited distribution. These actions have a positive effect of increasing the genetic variability of the species and reducing adverse effects of natural and/or man-made stochastic events. The Army will also strive to achieve the following: species reproduction *in situ*, establishment of *V. o-wahuensis* at additional sites within the western fence unit through outplanting or natural recruitment to achieve a minimum plant density to be determined by the future Implementation Plan team at PTA, and to increase the abundance and distribution of *V. o-wahuensis* to reduce the risk of plant loss due to a natural, man-made, or stochastic event. The Army will perform annual surveys to monitor the population trend of this species. Based upon the results of these surveys, appropriate adaptive management prescriptions will be implemented as necessary to ensure an increase in species distribution and abundance.

Summary

Off-road maneuvers constitute the primary training activity that will effect *Vigna o-wahuensis* in the Keamuku Parcel. These activities conducted with multiple Stryker vehicles will increase airborne dust, habitat fragmentation, and invasion of non-native plant species. The Keamuku Parcel is also affected by grazing of feral ungulate even though Puu Papapa is fenced for cattle. Construction of additional fence units and outplanting of this species onsite will offset these adverse effects. In addition, the Army will provide seeds and/or plant material of this species to agencies or private organizations to assist the increase of offsite occurrences of *V. o-wahuensis*. An Implementation Plan will be completed and, at a minimum, include: non-native plant control to minimize adverse effects to habitat quality, maintenance of a genetic stock *ex situ*, reproduction *in situ*, and establishment of the species at additional sites to maintain individual numbers at a level that would increase species distribution and abundance. All of these actions have the positive effect of increasing genetic variability in the species and reducing adverse effects of non-native species, feral ungulates, and other threats.

All training activities will increase the risk of fire. If leased or purchased, the WFMP will be implemented to reduce the frequency, intensity, and size of fires in the Keamuku Parcel. Key aspects of this plan which relate specifically to the Keamuku Parcel include: implementation of the Fire Danger Rating System that will restrict training according to weather and fuel conditions and be monitored hourly by Range Control, fuel load reduction by control of non-native plant species, construction of additional fuel/fire breaks, construction an additional dip tank on Keamuku Parcel, and an increase in fire-trained personnel and fire-fighting equipment. Based upon measures found in the Project Description and implementation of the WFMP and Standard Operating Procedures promulgated specifically to reduce impacts of Army actions on listed plant species, adverse impacts to *V. o-wahuensis* associated with Army actions in those training areas where *V. o-wahuensis* occurs are considered to be minimized.

Zanthoxylum hawaiiense

There are an estimated 225 individuals of *Zanthoxylum hawaiiense* found in 188 occurrences within the action area. These individuals represent between 72 and 86 percent of the species in the wild (Evans 2003a). With the exception of one individual in the Impact Area, *Zanthoxylum hawaiiense* occurs almost entirely in Training Areas 18, 19, 22, 23, and the limited access buffer area between Training area 23 and the Impact Area (see Figure 51 in the Transformation Biological Assessment). Legacy and Transformation training actions that will affect this species include on and off-road mounted maneuvers, live-fire training, dismounted maneuvers, and bivouac.

One individual *Zanthoxylum hawaiiense* will be directly impacted as a result of the construction of the Battle Action Course. Prior to construction, seeds will be collected and germinated from this tree. Seedlings will be grown under nursery conditions for use in outplanting efforts at a later date. Twenty-one occurrences (21 individuals or between seven and eight percent of the species) which could be adversely affected by workers inadvertently trampling young plants or by dust

and/or herbicide drift generated by construction or maintenance of fence lines and fuel/fire breaks. Direct trampling is not a concern for adult *Z. hawaiiense* because of their size; however, seedlings and juvenile plants could be impacted from foot traffic. The construction of the fence is a one-time event and the placement of the western fence unit will avoid listed plants, including *Z. hawaiiense*. To minimize drift of dust and herbicide, the Army will follow Standard Operating Procedures and Best Management Practices during construction or maintenance of the fence lines or fuel modification areas. Fire/fuel breaks and fence exclosures are considered to be positive actions that will benefit the species in the long-term.

On-road mounted maneuvers with Strykers and other vehicles will be restricted to existing and proposed trails and roads in Training Areas 18, 19, 22, 23 and within the limited access buffer area (see Figure 4). Dismounted maneuvers and bivouac sites may occur in any of the above Training Areas; however, bivouac will only occur in open, non-vegetated areas such as firing points, ranges and within the Multi-Purpose Range Complex (Training Area 23). Each of these training activities may effect *Zanthoxylum hawaiiense* seedlings by direct trampling or crushing from foot traffic or indirect impacts from increased dust and invasive plant dispersal. All these factors can degrade surrounding habitat and adversely affect tree recruitment. While a plant may be directly crushed from foot traffic, this risk is considered to be very low as reconnaissance or dismounted maneuvers will be infrequent in Training Areas 22 and 23 due to the areas vast size (13,500 hectares; 33,060 acres) which minimizes the risk of contact with an individual plant. In addition, soldiers are briefed regarding sensitive resources on PTA and are instructed not to cut or impact vegetation. Bivouac currently occurs only at established ranges and firing points. Any new bivouac sites will be surveyed and the proposed location approved by the Natural Resources staff to ensure that no *Z. hawaiiense* will be impacted.

Repeated on-road mounted maneuvers on dirt roads by vehicles, particularly Strykers, can produce a large amount of dust. This indirect effect of dust could impact listed plants which occur near roads. Rainfall levels at PTA are low (the average annual precipitation is 37 centimeters; five inches) and is usually in small amounts at any one time. Dust that settles on *Zanthoxylum hawaiiense* leaves has the potential to remain for long periods of time and diminish plant health and vigor over time. A dust study will be developed by the Implementation Team and initiated by the Army to determine the long-term effect of dust deposition on listed plants and native vegetation on PTA. Depending upon the results of this study, the Implementation Team will determine what additional measures are necessary to reduce the adverse effects of dust, these could include the revegetation of exposed areas or placement of palliatives on roadways. In addition, almost all of the occurrences of *Z. hawaiiense* are found on aa or pahoehoe lava flow substrates which reduces the potential for the creation of dust near the trees. The majority of *Z. hawaiiense* (167 occurrences or approximately 93 percent of the species) are located further than 75 meters (246 feet) from any man-made features (*e.g.*, roads, fences, fuel/fire breaks).

There is always a risk of fire on an installation that practices live-fire training. Fire is considered to be a significant threat to *Zanthoxylum hawaiiense* due to its low population numbers and limited distribution. Fire could ignite in the Impact Area and spread to areas outside of the Impact Area,

or a fire could ignite from human error (an errant round or pyrotechnic), discarded cigarette, catalytic converter, cookstoves at bivouac or other unforseen event. Once a fire has altered the habitat, there is a high likelihood of invasion of non-native plants, particularly *Pennisetum setaceum*. These invasive species increase the fuel load, compete with native seedlings, and degrade the surrounding habitat. To minimize this threat, the Army will implement the WFMP to reduce fire frequency and intensity. One very important aspect of the WFMP is that fuel/fire breaks and corridors will divide the western portion of PTA into Fuel Management Areas (see Figure 7) and inhibit the spread of a wildfire by containing it within a portion of the occupied areas, thus reducing the loss of *Z. hawaiiense* and other plant species. Additional minimization measures to reduce fire risk are contained in the Project Description. The Implementation Team will also develop an invasive plant control plan to be implemented by the Army to minimize the impact of non-native plant species.

Ongoing threats that impact *Zanthoxylum hawaiiense* include competition with non-native plants and direct browsing, trampling, or habitat degradation by feral ungulates. One of the measures to reduce ungulate impacts to *Z. hawaiiense* is the construction of the western fence unit which will protect the majority of the trees from browsing. Without the pressure of browsing by goats and sheep, it is anticipated that *Z. hawaiiense* will naturally recruit to new areas and expand in abundance and distribution within the fence units and that outplanting efforts will be more successful. Another threat that adversely effects the recruitment of *Zanthoxylum hawaiiense* is the consumption of the seeds by rodents. It is thought that seed loss from rodents is significant for this species and bait stations are currently being used to reduce rodent numbers in the vicinity of the trees (U.S. Army 2003c). In addition, the Implementation Team will assess the extent of rodent impact on this species and devise a strategy to control the rodent populations near *Z. hawaiiense* trees.

All but three occurrences (three individuals) of this species will be within the proposed western fence unit where ungulates will be removed over time. The Army will also strive to achieve species reproduction *in situ* and to establish *Zanthoxylum hawaiiense* within various Fuel Management Areas through outplanting or natural recruitment to achieve a minimum plant density determined by the future Implementation Team. The Army will perform annual surveys to monitor the population trend of this species and, based on the results, implement adaptive management prescriptions as necessary to ensure the species is increasing in distribution and abundance.

Summary

Army training activities that will directly affect *Zanthoxylum hawaiiense* includes live-fire training, reconnaissance, mounted and dismounted maneuvers, and bivouac. Indirect effects include dust, fire, invasive plants and browsing by feral ungulates. These impacts will be offset by the construction of the western fence unit that will encompass all but three individuals of *Z. hawaiiense* occurrences at PTA. Fencing and removal of feral ungulates will allow for natural recruitment of the species. An Implementation Plan will be prepared and implemented to address additional measures for *Z. hawaiiense* within the action area and, at a minimum, include: non-

native plant control to minimize adverse effects on habitat quality, maintenance of a genetic stock *ex situ*, reproduction *in situ*; establishment of plants at additional sites, and increase species distribution and abundance. Prior to Transformation, seeds will be collected from the one occurrence that will be permanently lost due to construction of the Battle Action Course. All of these actions have a positive effect of increasing genetic variability of the species and reducing the adverse effects of non-native species and other threats. The Army will conduct annual species monitoring to ensure the validity of assumptions made as part of the Project Description and Implementation Plan are being met. If not, then the Implementation Team will reassess the issue and alter the plan to address the problem.

The WFMP will be implemented to reduce the frequency, intensity, and size of fires at PTA. Key aspects of the WFMP include the construction of fire/fuel breaks and corridors which subdivide the western portion of PTA into smaller Fuel Management Areas, implementation of the Fire Danger Rating System that will restrict training according to weather and fuel conditions and be monitored hourly by Range Control, fuel load reduction by non-native plant control, construction of additional fuel/fire breaks, construction of additional dip tanks, and an increase in fire-trained personnel and fire-fighting equipment. Based upon measures found in the Project Description, implementation of the WFMP and Standard Operating Procedures promulgated specifically to reduce impacts of Army actions on listed plant species, adverse impacts associated with Army actions in those training areas where *Zanthoxylum hawaiiense* occurs are considered to be low and offset by fencing, ungulate removal, propagation, outplanting, and threat control.

EFFECTS OF THE ACTION TO PALILA CRITICAL HABITAT

Overview

The effects of Legacy training on palila critical habitat were addressed in the 1978, 1981 and 1983 section 7 consultations. This consultation only addresses the effects of Transformation training on palila critical habitat south of the planned realigned Saddle Road in the area designated as Palila Critical Habitat Area B and Mauna Kea State Park (see Figure 2). These two areas combined total approximately 758 hectares (1,873 acres) which is about three percent of all palila critical habitat.

As previously discussed in the Status of the Species section, the primary constituent elements of palila critical habitat include large and intermediate-sized mamane and naio trees, enough space for the palila population to expand, and the full range of altitudinal and geographical sites needed by the palila for normal life cycle movements in response to shifting seasonal and annual patterns of flowering, seed set, and ensuing pod development of mamane.

The portion of Palila Critical Habitat Area B within the action area for Transformation consists of approximately 758 hectares (1,873 acres) of open mamane and naio woodland with a grass understory. This is the only palila critical habitat at PTA that will be affected by SBCT Transformation. Under Legacy, the area is used for on-road and dismounted maneuvers, bivouac

(up to battalion-sized units), and digging of firing positions (individual and crew) at previously disturbed sites. There are 11 firing points in this area. Landing Zone Rob and Brad are just south of the southern border of Area B (see Figure 2). Approximately 24 helicopter maneuvers occur in the landing zones for each battalion-sized maneuver. Existing training restrictions within palila critical habitat are outlined in the project description and provided in Appendix B and shall remain in place for SBCT Transformation.

Transformation includes the use of Stryker vehicles that will use existing roads, including those in the portion of Palila Critical Habitat Area B and Mauna Kea State Park lands south of the realigned Saddle Road (see Figure 2). Direct and indirect impacts to palila critical habitat may result from the Stryker off-road maneuvers along the southern portion of Critical Habitat Area B and there will be an increase in Legacy training in the portion of Palial Critical Habitat Area B south of the planned realigned Saddle Road. No Stryker activity or other form of Transformation training will occur north of realigned Saddle Road. The following is a more detailed discussion of anticipated impacts to palila critical habitat from SBCT Transformation training.

Fire

Fire destroys forests which contain those primary constituent elements required by palila for foraging and nesting. Increased intensity of certain Legacy training activities such as on-road and dismounted maneuvers, bivouac by battalion-sized units, and digging of firing positions at previously disturbed sites within the portion of Palila Critical Habitat Area B south of the planned realigned Saddle Road will increase the risk of fire in this area. The risk of wildfire within the portion of Palila Critical Habitat Area B and Mauna Kea State Park south of planned realigned Saddle Road is also increased by the driving of Stryker vehicles on roads within these areas.

There is also a greater risk of fire ignition in Stryker maneuver areas due to the increased intensity of training (*e.g.*, more vehicles and increased frequency of maneuvers) in these areas. The most likely source of fire ignition is live-fire training and pyrotechnics, but other potential ignition sources include cigarette smoking, sparks from vehicles (catalytic converters), training equipment, bivouac, and construction and maintenance activities. Because of the close proximity of the Stryker maneuver areas to the southern portion of Palila Critical Habitat Area B, a fire started in the Stryker maneuver areas could spread into the critical habitat. In addition, Landing Zones Rob and Brad are directly south of Critical Habitat Area B (see Figure 4) which increases the risk of fire in this area due to an aviation training mishap or helicopter crash.

After fires occur, invasive non-native grass species (*e.g.*, *Pennisetum setaceum*) reestablish more quickly and outcompete native plants. Once such grasses invade an area it is more susceptible to subsequent fires due to the increased fuel load. After a second fire, the native woodland vegetation shifts to a non-native grassland. It is likely that fire risk in critical habitat adjacent to Stryker vehicle maneuver areas will continue to increase over time due to the spread of fire-adapted non-native grassland communities in these areas.

Two small wildfires occurred within palila critical habitat in 2003. Both fires occurred at a firing point and were quickly extinguished; however, the exact cause of the fires was never determined. The Wildland Fire Incident Report (U.S. Army letter, March 6, 2003) indicates that the cause may have been an improperly discarded cigarette or heat from a vehicle exhaust system. To reduce risk of fire ignition from discarded cigarettes, the Army will restrict smoking in palila critical habitat to only designated, non-vegetated areas. Cigarettes will also be disposed of only in metal containers that will be provided at each designated smoking area.

To offset the increased risk of wildfire, the Army will implement its WFMP prior to the commencement of any SBCT Transformation actions at PTA. Measures for fire reduction on PTA are outlined in greater detail in the project description, but, in summary, the WFMP includes the following measures that are designed to reduce the risk of fire on PTA: 1) implementation of a Fire Danger Rating System to restrict training according to weather and fuel conditions; 2) construction and maintenance of fuel modification areas (*e.g.*, fire breaks, fuel breaks, and fuel corridors); 3) six 80,000-gallon-capacity dip ponds at 80 percent capacity; 4) two Humvees equipped with a 300-gallon slip-on pump unit and one Water Tender onsite; and 5) no live-fire training without a helicopter and certified crew present on station. All training exercises must follow the Army Standard Operating Procedures that specify restrictions based upon the potential fire danger. Wind speed data will be monitored daily and immediately prior to "Hot" range status. The Burn Index will be monitored hourly. Immediately prior to projected "Hot" range status, restrictions will be imposed as a result of unfavorable fire danger ratings. Range Control and fire department personnel will have the authority to stop live-fire training for noncompliance with any regulation.

The risk of fire within critical habitat will also be reduced by adherence to other minimization measures stipulated by the Service in Biological Opinion 1-2-81-F-211, Biological Opinion 1-2-83-F-39, and Army Regulation No. 210-11 (November 23, 1981). These include: 1) limiting the number of troops using the area to approximately 500; 2) prohibiting the use of pyrotechnics or simulators; 3) prohibiting cargo helicopters from flying over palila critical habitat; 4) limiting vehicle use to only roads and well-defined trails; 5) prohibiting the cutting of vegetation; 6) prohibiting open fires; 7) prohibiting all refueling, food preparation, and vehicle maintenance activities; 8) limiting the number of helicopters authorized in the critical habitat to seven at any given time; and 9) restrictions on battery firing.

Non-native Plant Species

Transport of non-native plants (*e.g.*, *Pennisetum setaceum*, *Salsola kali*) will increase with more on-road vehicular traffic within palila critical habitat and in the Styker maneuver areas adjacent to palila critical habitat. Seeds from invasive plants can adhere to training equipment, clothing and vehicles and become established in areas where vegetation or soil has been disturbed. With the introduction of non-native species, native habitat is altered and becomes colonized by invasive plants better adapted to disturbed conditions than the native species. As habitat is altered in the Stryker maneuver area adjacent to Palila Critical Habitat Area B, a seed source will establish that

could spread non-native species into the native *Sophora* woodland, precluding establishment of native seedlings. This slow but continued degradation of palila critical habitat could eliminate woodland species and preclude palila from returning to this area.

Minimization measures have been included in the project description to offset the spread of invasive plants. One measure is establishment of a 75-meter (246-foot) buffer between the Stryker maneuver area and the southern boundary of Palila Critical Habitat Area B (see Figure 2) to reduce the risk of invasive species spreading into the critical habitat. The Army is also constructing a new vehicle Tactical Wash Station that will remove soil and seeds that may adhere to tires (including Strykers) during training. In addition, the Implementation Team will develop a study to identify the vegetative changes that may occur in palila critical habitat post-Transformation. This study will focus on the effects of dust deposition; however, as plant transects are monitored, any increase in non-native plants will also be noted. If degradation of palila critical habitat increases with Stryker use within or adjacent to critical habitat, the Implementation Team will add a weed eradication program and habitat enhancement component to the Implementation Plan for the affected areas.

Dust

Off-road maneuvers with Stryker vehicles, trucks, Humvees, and other vehicles and equipment can cause severe environmental damage. In particular, the action of driving a Stryker (an eight-wheeled, light-armored, 17,235-kilogram; 38,000-pound) vehicle, either off-road or on dirt roads, will generate dust that may adversely affect portions of palila critical habitat by depositing a layer of dust on mamane, naio and other native species in the vicinity of vehicle on-road use and Stryker off-road training areas. Airborne dust can become so severe that it obscures vision to zero on dirt roadways and vehicles must halt to allow dust to settle before proceeding (P. Ashfield, pers. comm. 2003). Dust on vegetation may affect plants by reducing photosynthetic rates and inhibit pollinators which could affect primary constituent elements. Dust may impact mamane recruitment, growth rates, pod production, and the long-term habitat integrity. Stryker vehicles will be driving on designated dirt roads in the portions of Palila Critical Habitat Area B and Mauna Kea State Park south of the planned Saddle Road; however, the projected number and frequency of Stryker trips through this area is currently unknown. On-road use by Stryker vehicles within Area B will be additive to the already existing impacts of dust deposition from Legacy training (*e.g.*, 11 firing points, Humvees, helicopter flyovers). In addition, off-road maneuvers by Strykers and other vehicles will breakdown the lava substrate, creating dust, and adversely affect vegetation growing in the Styrker maneuver areas.

Dust deposition will be minimized by the following measures: 1) use of palliatives when and where dust is excessive; 2) adherence to the speed limits; 3) vegetating roadways, and 4) initiating research on the effect of dust on plants. In addition, as discussed above, the establishment of a 75-meter (246-foot) buffer zone between the Stryker maneuver areas and palila critical habitat will help reduce the impact of dust deposition on woodland habitat along the southern border of Critical Habitat Area B. The dust deposition study will investigate the dust impact from vehicles

and Strykers within palila critical habitat and assess the efficacy of the buffer in minimizing impacts adjacent to critical habitat.

Trampling

Although off-road Stryker maneuvers are not allowed in palila critical habitat, inadvertent intrusion by Strykers into this area is possible, especially in the Stryker maneuver areas along the southern border of Palila Critical Habitat Area B (see Figure 2). Even accidental off-road driving within critical habitat could result in significant damage to mamane/naio woodland habitat. The 75-foot buffer between the Stryker maneuver areas and the southern border of Critical Habitat Area B will protect against accidental vehicle egress into critical habitat. The coordinates of this area will be added to the on-board navigation system of all Strykers used at PTA. If this method is ineffective at keeping vehicles out of the buffer area, the buffer boundary will be demarcated using some form of visible demarkation such as Seibert stakes placed along the buffer edge to delineate the palila critical habitat boundary.

Habitat Degradation

Currently, mamane and naio trees are declining in overall health and vigor, particularly recruitment rate, within palila critical habitat on PTA (S. Gleason, pers. comm. 2003). The reason for this decline is unknown. Several factors could be contributing to this habitat degradation and include ungulate browsing, military training, recent drought conditions, mamane seed predation by rodents, as well as the possible introduction of a parasite or pathogen of mamane.

A study will be developed and implemented to address the habitat degradation in palila critical habitat on PTA. The Implementation Team will review the issue, develop a study, including determination of the appropriate methodology, time frame, and participants for this study. Based on the results of this study, the Implementation Team will devise a strategy to combat the problem.

Summary

Adverse impacts to palila critical habitat south of the planned realigned Saddle Road from Transformation training include an increased risk of fire, invasion of non-native plants, dust, trampling, and possibly habitat degradation. These adverse impacts will be offset by restrictions on activities within critical habitat (see Appendix B), the implementation of the WFMP and adherence to existing fire risk reduction measures, use of vehicle wash racks, and establishment of a 75-meter buffer along the southern boundary of Palila Critical Habitat Area B. These measures will reduce the training threat to palila critical habitat. Fencing and ungulate removal elsewhere on PTA will also improve mamane-naio habitat for palila outside of critical habitat.

EFFECTS OF THE ACTION ON HAWAIIAN HOARY BATS

Activities that could affect Hawaiian hoary bats in the action area include live-fire and maneuver exercises, and aviation training. Current training restricts vehicle use to established roads, trails, and designated or approved firing positions. Based on the limited information available, Hawaiian

hoary bats are present in low numbers throughout PTA at all times of year. The existing information is inadequate to determine the abundance and distribution of bats on PTA; however, we do know that bats roost, forage, and breed on PTA. Individual bats require live, foliated trees for roosting during the day, and predominantly natural areas with a plentiful insect prey base for foraging during the night. Certain military activities will occur within treeland, shrubland, and grassland vegetation types on PTA/Keamuku Parcel that would destroy or adversely affect available roosting and foraging habitat for the Hawaiian hoary bat. In particular, availability of suitable roost trees is thought to be the major limiting factor in the survival of hoary bat populations, including the Hawaiian hoary bat. Therefore, the effects analysis for this biological opinion will focus on potential available roosting habitat.

Based on the limited information available on habitat selection by Hawaiian hoary bats, the Service makes the following assumptions about bat habitat use on PTA. For the purposes of this biological opinion, until research demonstrates that Hawaiian hoary bats also roost in shrub vegetation, all treeland vegetation types and shrubland vegetation types with mamane or naio as dominant or codominant components are assumed to provide available roosting habitat for Hawaiian hoary bats in the action area. All other shrubland vegetation types and grassland vegetation types in the action area are assumed to provide available foraging habitat. Project impacts to these treeland and shrubland vegetation types, including the other impacts of non-native invasive plants and feral ungulates, would result in conversion of much of the existing treeland and shrubland vegetation to grasslands. Although bats frequently forage over open grasslands, that vegetation type is not considered a foraging habitat at risk in the action area. The Transformation Biological Assessment provides no information on existing amounts of any of these vegetation types or on future levels that will persist under ongoing military activities.

Although bats readily forage in open shrublands and grasslands, regeneration of shrubland vegetation is not considered a suitable replacement for lost treeland roosting habitat. Wildfire, construction, and military training in treeland vegetation types likely would be followed by regeneration of shrubland and grassland vegetation types as a result of modified fire regimes, erosion, invasion of non-native invasive plants, and the presence of feral ungulates. For this biological opinion, the Service considers that all potential available roosting and foraging habitat in the Impact Area eventually would be impacted over time, and that these impacts could result in a cumulative loss of all available roosting habitat in this area.

Direct effects of the proposed action on the Hawaiian hoary bat would primarily involve injury and death of bats resulting from habitat destruction or degradation that significantly impairs essential behavioral patterns such as breeding, feeding, and sheltering (Table 3). These effects would occur within potential available roosting habitat in PTA treeland vegetation types. Treeland and shrubland vegetation would be burned as a result of weapons live-fire and by wildfires ignited by live-fire and other military construction and training activities. Trees and shrubs also would be damaged or removed during construction, live-fire, and maneuver activities. Loss of suitable roosting and foraging habitat would induce short-term physiological and nutritional stress in

displaced bats by forcing them to fly further in search of new roosting or foraging areas (Service 2002). Individual bats possibly would find and adopt new roosting and foraging areas in a matter of days, but the actual time required and the severity of physiological stress are unknown. This extra energy demand may be critical for some bats, especially pregnant or lactating females. Some may not successfully produce young, or may give birth to pups with lower birth weights, delayed development, and reduced survival. The effect of habitat loss would differ for individual bats, with some bats remaining unaffected and others suffering varying degrees of injury, or death. The potential overall effect of habitat loss on the abundance and distribution of Hawaiian hoary bats in the action area would be lower reproductive fitness, reduced juvenile recruitment, and a decline in numbers.

Table 4. Adverse impacts of Legacy and Transformation actions (without implementation of minimization measures) to treeland and shrubland vegetation representing potential available roosting and foraging habitat for Hawaiian hoary bats in the PTA action area (excluding Keamuku Parcel).

Project Effects on Hawaiian Hoary Bats	Treeland Vegetation Destroyed/Degraded[1] hectares (acres)	Shrubland Vegetation Destroyed/Degraded[1] hectares (acres)
Live-Fire and Wildfire (PTA)	19,966 (49,317)	10,001 (24,704)
[Impact Area]	[7,999 (19,766)]	[5,309 (13,119)]
Off-Road Maneuvers – High-Probability Area[2]	956 (2,361)	1,379 (3,407)
Construction and Training Use of BAX and AALFTR[2]	Unknown	Unknown
Construction and Maintenance of Fire breaks/Fuel breaks[2]	Unknown	Unknown
Total	19,966 (49,317)	10,001 (24,704)

[1]Cumulative impacts to existing areas of treeland or shrubland vegetation (without implementation of minimization measures).

[2]BAX (Battle Area Course); AALFTR (Anti-Armor Live-Fire Tracking Range)

Direct effects also would include the injury or death of individual bats by flames, heat, and smoke; collisions with vehicles, aircraft, and structures; falling trees and branches; and munitions impacts. All roosting bats would be vulnerable to the direct effects of military activities throughout the year, especially lethargic or torpid roosting bats, pregnant and lactating female bats, and non-volant young. North American hoary bat females do not carry their young on foraging flights but leave them at the roost tree until the pups are old enough to fly (see Menard 2001), a behavior likely shared by Hawaiian hoary bats. In addition, lethargic and torpid roosting bats, pregnant females, lactating females, and non-volant young with reduced flight capability or maneuverability may fall when forced to abandon their roost trees or be crushed by the downed tree. These grounded bats would likely die from injuries sustained by the fall or by vehicle strikes, trampling by personnel,

exposure, or predation. The direct effects of night training on foraging bats would be less severe, as active bats likely would flee areas of intense human disturbance, although escape may incur an additional energy demand.

Indirect effects of the proposed action would result primarily from the future reduced availability of treeland roosting habitat for Hawaiian hoary bats and from degradation of the treeland vegetation that remains. A major factor that would indirectly impact the quality of treeland vegetation is fragmentation of native vegetation communities as a result of fire and military training activities, particularly off-road maneuvers. Due to increased wildfire frequency and modification of vegetation fuel loads, military activities could alter the natural fire regime in the action area, with adverse effects to the structure, composition, and function of treeland vegetation communities. Tree regeneration also would be impeded by project-induced effects of erosion, dust, soil compaction, and root injury caused by vehicle and foot traffic, and the deleterious effects of non-native invasive plants, seed predators (*e.g.*, rats), and feral ungulates. Foraging habitat probably would not be as seriously affected as roosting habitat. The historic and future loss of this habitat, and associated occurrences of Hawaiian hoary bats, are considered important.

Indirect effects also would include disturbance (*i.e.*, harassment) of individual bats that creates the likelihood of injury to such an extent as to significantly disrupt normal behavioral patterns such as breeding, feeding, or sheltering. Disturbances that flush individual roosting bats from their trees may occur due to the presence and noise of vehicles, heavy equipment, and human activity; munitions and maneuvers that shake trees and terrain; and helicopter downdrafts that damage roost-tree foliage. Lethargic or torpid bats that fall from their roost trees while trying to escape these disturbances would be exposed to the potentially lethal effects of fire, vehicle collisions, trampling, exposure, and predators. If pregnant or lactating females and non-volant young are forced to seek other roost trees, the additional energy stress could lead to lower reproduction, survival, and juvenile recruitment. Bats at PTA already are exposed to the noise and disturbance of existing Legacy Force training. Although these effects will increase with SBCT Transformation, the Service considers habitat loss, not noise and disturbance, as the major factor affecting the abundance and distribution of Hawaiian hoary bats in the action area. Furthermore, the Service considers the loss of potential available treeland roosting habitat as the major limiting factor to the Hawaiian hoary bat on PTA.

The potential direct and indirect effects anticipated to occur as a result of Legacy and Transformation Training actions are summarized in Table 4 and discussed below.

Table 5. Potential direct and indirect effects expected to occur to Hawaiian hoary bats as a result of Legacy and Transformation training in the PTA action area.

Activity	Direct Effects	Indirect Effects
Live-Fire Training and Wildfire	Destruction/loss of roosting and foraging habitat	Degradation and fragmentation of roosting habitat

Off-Road and Dismounted Maneuver Training	Destruction/loss of roosting and foraging habitat	Degradation and fragmentation of roosting habitat
Construction and Training Use of BAX and AALFTR[1]	Destruction/loss of roosting and foraging habitat	Degradation and fragmentation of roosting habitat
Construction and Maintenance of Fire breaks/Fuel breaks and Fence Units	Destruction/loss of roosting and foraging habitat	Degradation and fragmentation of roosting habitat
Disturbance from Human Activity	Injury and death of bats	Reduced reproductive fitness, juvenile recruitment, and population numbers
Vehicle and Structure Collisions	Injury and death of bats	Reduced reproductive fitness, juvenile recruitment, and population numbers
Aircraft Strikes	Injury and death of bats	Reduced reproductive fitness, juvenile recruitment, and population numbers
Noise	Harassment of bats	Reduced reproductive fitness, juvenile recruitment, and population numbers
Fence Units with Ungulate Control	Enhanced survival of roosting habitat	Enhanced regeneration of roosting habitat
Avoidance Measures in Palila Critical Habitat	Enhanced survival of roosting habitat	Enhanced regeneration of roosting habitat
Fire Management Areas	Reduced destruction/loss of roosting habitat	Reduced degradation and fragmentation of roosting habitat

Habitat Loss Resulting from Wildfire

The primary effect of Legacy and Transformation training on the Hawaiian hoary bat would result from the eventual loss of potential available roosting and foraging habitat within PTA. Without implementation of the Army's proposed WFMP, this cumulative habitat loss could amount to approximately 11,645 hectares (28,775 acres) of treeland vegetation, or about 58 percent of that currently existing on PTA. Roosting habitat may be destroyed and remaining habitat degraded due to increased fragmentation and disturbance resulting from wildfire.

Wildfire is a significant threat to native vegetation throughout the action area and risk of wildfire is increased due to ongoing and future live-fire training actions. The Impact Area (see Figure 4) is the danger area where all rounds and mortars from the firing points land. The Impact Area has been used for decades and is off-limits to unauthorized personnel due to fired munitions hazards. Fires are not controlled in the Impact Area (due to the presence of unexploded ordinance) and uncontrolled fires may potentially spread from the Impact Area to other areas of the installation or that a fire could ignite outside of the Impact Area due to training error (an errant round or pyrotechnic), discarded cigarettes, catalytic converter, cookstoves at bivouac, or other unforeseen event. Because the Impact Area is unsafe for human activity, surveys for listed species cannot be conducted, and the magnitude of habitat loss for the Hawaiian hoary bat cannot be accurately determined. Furthermore, vegetation destruction within this large, central Impact Area fragments natural habitats for bats, thereby diminishing the abundance and distribution of the subspecies on PTA. The Service has determined that there is a high probability that roosting habitat for the Hawaiian hoary bat within the Impact Area will be lost through time due to fire or direct impact of live-fire munitions. In addition, treeland habitat that is not directly destroyed by live-fire and wildfire could be degraded due to increased fragmentation and disturbance resulting from wildfire and military activities. The historic and future loss of this habitat, and associated occurrences of Hawaiian hoary bats, are considered important.

The significance and magnitude of wildfire threats could be more accurately predicted if the history of wildfire occurrence and frequency on PTA were better known. Currently, there is no information on the expected future annual losses of different vegetation types that would occur in the action area due to fire, predicted annual regeneration rates after fire, or the extent to which fire losses will be reduced in Fire Management Areas. Most records of past fires on PTA consist only of date, time, and location, with little or no information on fire size and extent of damage to vegetation; the greatest potential threat of wildfire, however, is in the western and northern parts of PTA. The WFMP states that over 3,238 hectares (8,000 acres) have burned on PTA outside the Impact Area over about the last 13 years (from July 1990 until April 2003, the date of the Transformation Biological Assessment). From this information, the Service computes an average of about 254 hectares (628 acres) per year could be burned on PTA outside the Impact Area.

Lacking adequate data on historical and potential habitat losses due to wildfire, the Service assumes that over time, fire damage would result in a cumulative, permanent loss of potential available roosting habitat for Hawaiian hoary bats. Based on what is known of PTA's past fire history, the Service anticipates that an average 254 hectares (628 acres) of all habitat types may burn per year outside the Impact Area. About 38 percent of the existing vegetation on PTA outside the Impact Area consists of treeland vegetation. Accordingly, we assume that 38 percent of the average annual burn area outside of the Impact Area, or approximately 97 hectares (240 acres), consists of treeland vegetation providing potential available roosting habitat for bats. In addition, project impacts to bat roosting habitat cannot be minimized or offset within the Impact Area or the high-probability Stryker off-road maneuver area, which together comprise approximately 8,955 hectares (22,128 acres) of treeland vegetation. The amount of treeland

habitat outside of the Impact Area and the high-probability Stryker off-road maneuver area that will not be fenced to exclude ungulates is approximately 2,690 hectares (6,647 acres); adverse impacts to bats will be offset in this area primarily by implementation of the WFMP. Due to the dynamic nature of habitat recovery from fire, over time a mosaic of burned and recovered areas would result with Transformation. Fence units and the removal of feral ungulates will enhance the regeneration of treeland vegetation; unfenced areas, however, likely would convert to grassland cover. With implementation of the WFMP and management of the fenced units, we anticipate that a majority of the treeland habitat outside of the Impact Area and the high-probability Stryker off-road maneuver area will be maintained to sustain the PTA bat population.

There is the potential that roosting habitat outside the Impact Area could also be impacted from a wildfire event. However, implementation of the Army's WFMP as outlined in the Project Description will contribute toward offsetting training actions at PTA by reducing the frequency, intensity and size of fires on PTA. Therefore, we anticipate that implementation of the WFMP will reduce the risk of fire ignition, or if a fire does ignite in native vegetation, the measures to combat the fire will curtail it from becoming a catastrophic event. A key aspect of the WFMP is that fuel corridors and fire/fuel breaks will subdivide the western portion of PTA into defensible areas and fire would not travel out of one of these management areas (see Figure 7). Thus, the effects of wildfire would be reduced and the loss of treeland vegetation minimized over the western portion of PTA due to Fire Management Areas in addition to all the other measures discussed in the General Effects and Project Description. The Army also proposes to construct and maintain approximately 9,307 hectares (23,000 acres) of fence units, including a large exclosure in PTA's western range and five small exclosures in PTA's eastern range. The areas that will be fenced currently contain approximately 5,406 hectares (13,359 acres) of treeland communities providing potential available roosting habitat for Hawaiian hoary bats. While fencing would not protect vegetation from the effects of fire, the Service assumes that the regeneration of potential available treeland roosting habitat would be enhanced in fence units due to removal of ungulates (reduced browsing pressure on new tree seedlings) combined with invasive non-native plant control. These measures would minimize and offset habitat potential losses from live-fire and wildfire.

Habitat Loss Resulting from Maneuver Exercises

Potential impacts to Hawaiian hoary bats associated with SBCT training include off-road vehicle traffic on PTA and the Keamuku Parcel; increased use of all ranges, especially live-fire ranges; and increased aircraft use. The SBCT off-road mounted maneuver area will be principally based on the Keamuku Parcel, and the northern portion of PTA (excluding Palila critical habitat). The Army currently identifies approximately 3,563 hectares (8,804 acres) on PTA proper as high-probability off-road maneuver areas, in addition to the approximately 9,704 hectares (23,979 acres) of the Keamuku Parcel. Off-road mounted maneuver exercises in these areas would directly affect roosting and foraging habitat for Hawaiian hoary bats through physical destruction of vegetation by munitions impacts, vehicles, and personnel. Off-road maneuvers would indirectly affect those habitats through erosion, soil compaction, and root injury; other effects in maneuver areas would result from the introduction of alien species and the presence of feral ungulates. The

identified PTA off-road maneuver area contains approximately 956 hectares (2,362 acres) of existing treeland vegetation providing potential available roosting habitat for bats, or about five percent of the total treeland vegetation now present on PTA. That off-road maneuver area also contains approximately 1,379 hectares (3,408 acres) of existing shrubland vegetation providing potential available foraging habitat for bats, or about 14 percent of the total shrubland vegetation now present on PTA. The Keamuku Parcel consists mostly of pastureland and contains little, if any, potential available treeland roosting habitat (although it likely provides some foraging habitat).

We do not know the frequency, or number of Stryker vehicles, that will utilize the off-road maneuver areas either within the northern portion of PTA, or the Keamuku Parcel, each year. It is our understanding that multiple Stryker vehicles will be driven in formations across any and all accessible land within these designated areas. Therefore, we determined that it there is a very high probability that off-road maneuver areas will be completely impacted over time. This loss of habitat also creates population and habitat fragmentation, essentially diminishing the roosting range of the Hawaiian hoary bat on PTA. The Stryker maneuver areas are not off-limits to Natural Resources staff conducting management actions, however it would not be prudent to invest time and resources into these high-use training areas because it is likely that remaining treeland roosting habitat will be lost in the long-term. The historic and future loss of this habitat, and associated occurrences of Hawaiian hoary bats, are considered important.

In addition to off-road vehicle use, other activities associated with day and night maneuver exercises that could impact bat habitat include dismounted movements of troops and individual soldiers, mechanical excavation, bivouac, and helicopter operations. Direct and indirect impacts to Hawaiian hoary bats associated with dismounted maneuvers, which may occur almost anywhere outside the Impact Area, and could result in some trampling of vegetation as soldiers move through an area providing available roosting and foraging habitat. Bivouac is another site-intensive activity that affects soil and vegetation through set-up and use of temporary field camps, vehicle traffic, and helicopter operations. The number and extent of bivouac sites that are established each year are unknown, and bivouac is restricted in areas such as palila critical habitat, Kipuka Kalawamauna, Kipuka Alala, and Puu Kapele. Bivouac would be restricted from areas with listed species and generally allowed only at pre-approved firing points and ranges or by requesting alternate sites from the Natural Resources office. To minimize the effect of training maneuvers within treeland and shrubland habitats, soldiers are, and will continue to be briefed to avoid impacting or cutting any native vegetation.

Habitat Loss Resulting from Construction Projects

Construction of the Battle Area Course and Anti-Armor Live-Fire Tracking Range would alter or destroy vegetation, including listed plants, over approximately 1,740 hectares (4,297 acres). Although the Anti-Armor Live-Fire Tracking Range area is described as mostly pahoehoe lava, the Transformation Biological Assessment provides no information on existing vegetation cover, including roosting and foraging habitat for Hawaiian hoary bats. However, the loss of habitat associated with the Anti-Armor Live-Fire Tracking Range is primarily located within the Impact

Area and loss of this area is anticipated through time. After construction, military training use of the Battle Area Course would impact approximately 840 hectares (2,075 acres); military training use of the Anti-Armor Live-Fire Tracking Range would impact 260 hectares (643 acres) per range. Indirect impacts associated with the risk of fire and the introduction of alien species resulting from military training use in the Anti-Armor Live-Fire Tracking Range and Battle Area Course include increased risk of wildfire and dust.

Construction impacts to non-woody listed plants resulting from these new training facilities will be minimized by implementation of fire minimization measures and by propagation and outplanting to establish new populations in their current locations. Outplanting of the non-woody species involved, however, would not replace lost treeland roosting habitat for bats. The Battle Area Course and Anti-Armor Live-Fire Tracking Range construction areas comprise only 1.8 percent and 1.4 percent, respectively, of the total PTA/Keamuku area, but impacts to treeland vegetation occurring there would contribute to the overall reduction of available roosting habitat for Hawaiian hoary bats in the action area. Because the Transformation Biological Assessment does not address potential impacts of training facility construction on Hawaiian hoary bats and does not propose any minimization measures to reduce potential construction impacts to bats, the Service assumes those impacts would exacerbate the destructive, habitat-fragmenting effects of live-fire, wildfire, and military training on existing treeland roosting habitat. Therefore, we evaluate the area of treeland vegetation impacted by construction of the Battle Area Course and Anti-Armor Live-Fire Tracking Range as incorporated into the overall, net project impacts to total treeland vegetation that would occur on PTA as a result of wildfire, as described above ("Habitat Loss Resulting from Weapons Live-Fire and Wildfire"). That net loss incorporates the Army's existing and proposed measures to protect and enhance vegetation within fence units, palila critical habitat, and Fire Management Areas.

Construction and annual maintenance of fire breaks, which would be kept as bare soil, would permanently remove an undetermined area of potential treeland roosting habitat and potential shrubland foraging habitat for Hawaiian hoary bats. All trees and shrubs in fire breaks and fuel breaks will be removed (except in palila critical habitat where trees may be limbed to two meters (six feet). Similarly, construction and annual maintenance of fuel breaks (fuel management corridors) would permanently remove an undetermined area of potential treeland roosting habitat and potential shrubland foraging habitat. Four major fire/fuel breaks will be aligned to contain wildfires and protect five designated Fire Management Areas. These five areas of reduced wildfire risk would protect an undetermined area of treeland roosting habitat and shrubland foraging habitat. The amount of protection provided to vegetation would depend upon the efficacy of fire breaks/fuel breaks in preventing the spread of wildfire into the Fire Management Areas. The Army also proposes to construct and maintain approximately 9,308 hectares (23,000 acres) of fence units, including a large exclosure in PTA's western range and five small exclosures in PTA's eastern range. The areas that will be fenced currently contain approximately 5,406 hectares (13,359 acres) of treeland communities providing potential available roosting habitat for Hawaiian hoary bats. Feral ungulates will be removed in the proposed fence unit through public

hunting programs and contracted aerial control, to enhance survival and regeneration of the unit's vegetation. Military uses within the fence units include on-road maneuvers or dismounted maneuvers. While fencing would not protect vegetation from the effects of fire, the Service assumes that the regeneration of potential available treeland roosting habitat would be enhanced in fence units, and will minimize and offset habitat losses from live-fire and wildfire. Locations of all fence alignments will be determined by the PTA Implementation Team, with approval of the Army and the Service.

Injury and Mortality of Hawaiian Hoary Bats: Disturbance

The Transformation Biological Assessment does not address the direct injury and death of individual bats due to the disturbing presence of intense human activity. Potential direct impacts to bats include disturbances from wildfire, live-fire, vehicles, equipment, and other training actions that inadvertently injure or kill roosting or flying bats. These disturbance impacts are likely throughout all training areas where bats are present, including the Impact Area. Disturbances that flush bats from their roost trees would disrupt normal sleep patterns or torpor. Lethargic or torpid bats may not be able to respond rapidly to the need to abandon the roost, increasing the risk of injury or death from heat, flames, and smoke. Bats also could be crushed in falling trees or struck by branches and foliage broken or blown by helicopter downdrafts. Bats dislodged from their roosts may not be able to fly due to injury or depleted energy reserves, and grounded bats would be vulnerable to fire, vehicle strikes, trampling, and predators. Injury and death of pregnant or lactating females and non-volant young would indirectly affect the PTA bat population by lowering reproductive fitness, juvenile recruitment, and abundance.

Bats are so small and cryptic that even experienced biologists are unable to locate them at roost sites. Bats emerge from their roosts around sunset to forage through the night, but the few existing studies of bats at PTA offer conflicting results on peak foraging times. Jacobs (1993a) noted bat activity remained constant, without any noticeable peak, until at least the end of the sampling period at 0230 hours. In contrast, Cooper *et al.* (1996) observed a peak in bat activity at 2000-2100 hours and no bats at all during the early morning; other biologists also have noted little or no bat activity in the early pre-dawn hours (*e.g.*, Kepler and Scott 1990). Therefore, training restrictions at certain times of night may not be effective in avoiding or minimizing disturbance impacts on foraging bats.

Injury and Mortality of Hawaiian Hoary Bats: Structure Collisions

The Transformation Biological Assessment does not address the potential that flying bats, stressed by noise and the disturbance effects of intense levels of human activity, may collide with vehicles and equipment. Hawaiian hoary bats occasionally are killed by vehicles, impaled on barbed wire fences, blown against structures or vehicles by strong winds, injured by collision with guy wires, and found dead under windmills (Belwood and Fullard 1984, Tomich 1986a, Kepler and Scott 1990, Menard 2001). Bat collisions have been documented at several locations in the United States, Canada, Europe, and Australia at wind-energy generation plants, television towers, communications towers, lighthouses, tall buildings, powerlines, and fences (Erickson *et al.* 2002).

Bats killed at wind turbines have been found since 1972 in several U.S. states. Most dead bats found at wind turbines are North American hoary bats and red bats (*Lasiurus borealis*); 62 percent of all documented collision fatalities (n=616) are North American hoary bats.

Nocturnal insectivorous bats locate their prey by echolocation, and can also detect large landscape features and navigate around obstacles. Some studies suggest bats can avoid colliding with moving objects better than stationary ones (Erickson *et al.* 2002). However, bat echolocation is a sonar system that works only over short distances. For long-distance orientation bats rely on sight (Kalko and Schnitzler 1998), which may not be as efficient in detecting obstacles (Erickson *et al.* 2002). North American hoary bats may be more susceptible to wind turbine collisions because their flight is rapid but less maneuverable (Erickson *et al.* 2002); however, the Hawaiian hoary bat seems capable of both rapid, less maneuverable flight in open habitats and slower, more maneuverable flight in vegetated areas (Jacobs 1993a). Lights on structures may increase the probability of bat collisions, either by causing temporary blindness or disorientation, or by attracting bats to swarming insects. The potentially deleterious effect of exterior lighting, and the potential for collision mortality in general, have not been investigated in Hawaiian hoary bats. The Transformation Biological Assessment proposes no minimization measures to avoid or reduce the collision potential of military activities on Hawaiian hoary bats in the action area.

Injury and Mortality of Hawaiian Hoary Bats: Aircraft Strikes

The Routine Biological Assessment notes that helicopters are more likely to affect bird behavior than fixed-wing aircraft, and that low-flying, fixed-wing aircraft are more likely to impact birds than those at high flight altitudes. These remarks likely also pertain to bats. Day and night activities associated with aviation training and support include takeoff/landing, maneuver, and aerial gunnery training; and normal, nap-of-the-earth, contour, and low-elevation flights. Nap-of-the-earth flights occur throughout PTA at altitudes no lower than 30 to 48 meters (100 to 158 feet) above ground level, and likely occur within bat flight space. Air Force and Naval aviation training at PTA consists of similar activities at altitudes restricted to above 229 meters (755 feet) above ground level, which would not affect flying bats. Fixed-wing aircraft are unlikely to significantly affect bats due to altitude of operation and infrequent use, and low-altitude flights are restricted to Bradshaw Army Airfield. Foraging Hawaiian hoary bats often fly 30 meters (100 feet) and more above tree canopy height and commuting bats fly 150 meters (495 feet) or more above the ground (Kepler and Scott 1990). The mean flight altitude for Hawaiian hoary bats observed at PTA ranges from 10 to 150 meters (33 to 495 feet), with an overall mean of 31±29 meters (103±96 feet) (n=37 bats) (Cooper *et al.* 1996). Bats at Bradshaw Army Airfield and surrounding habitat have been observed foraging at altitudes of 15 meters (50 feet) or more. According to the Transformation Biological Assessment, no bird or bat strikes have been reported at PTA, although unquantifiable, the likelihood of bird or bat strikes with Army training would be low. However, Peurach (2003) documented a wildlife strike by a U.S. Air Force T-37-B jet with a North American hoary bat over Lawton, Oklahoma. The bat strike occurred at an altitude of 2,438 meters (8,000 feet), an altitudinal record for this species, and the remains were identified microscopically by the U.S.G.S. Patuxent Wildlife Research Center.

According to the Transformation Biological Assessment, aviation impacts on listed species would be minimized to very low or insignificant levels by using dedicated landing and pick-up zones at pre-approved firing points and ranges or requesting alternate sites from the Army Natural Resources Office, reporting all bird or bat strikes to the Natural Resources Office, and reinitiating consultation for any unauthorized take. Helicopter insertions would occur at firing points throughout PTA/Keamuku Parcel but are prohibited in palila critical habitat and Kipuka Kalawamauna. In addition, aircraft are restricted in palila critical habitat to altitudes above 610 meters (2,013 feet) above ground level and a maximum of seven helicopters are allowed in the area at any given time. The Service agrees no other practical measures are available to avoid or minimize the incidence of aircraft strikes on Hawaiian hoary bats.

Harassment of Hawaiian Hoary Bats: Noise

Noise levels would increase in frequency and volume during various construction projects and with SBCT training activities. According to the Transformation Biological Assessment, noise considered harmful to humans (*i.e.*, louder than 120 decibels) is caused by artillery live-fire, small arms fire, grenades and grenade simulators, anti-armor weapons, and aircraft (helicopter and fixed-wing). Artillery probably is the most significant threat to noise-sensitive animals, and noise would be continuous in off-road maneuver areas. In addition, the physical presence of vehicles, aircraft, heavy equipment, and personnel would exacerbate noise disturbances. Noise levels would increase about three percent at Bradshaw Army Airfield with SBCT use of larger aircraft. Fixed-wing aircraft and helicopters could produce noise levels at about 85 decibels when operating at altitudes lower than 122 to 152 meters (400 to 500 feet) above ground level. No information is available on decibel levels that may adversely affect Hawaiian hoary bats. The Routine Biological Assessment describes helicopters as the most significant threat to noise-sensitive animals, especially during low-flight operations. Roosting bats during the day may be disturbed from their roosts, and foraging bats during the night may be deterred from preferred foraging areas.

As noted in the Transformation Biological Assessment, a few studies have investigated noise effects on birds. The species investigated responded differently to noise from ground sources and aircraft, both in the extent of flushing response or habituation to noise. The effect of behavioral responses on reproductive success also differed among the species investigated, with adverse effects ranging from less time spent by adults incubating eggs or feeding young to nest abandonment. Noise effects have been studied for only one Hawaiian species (a bird); elepaio were not significantly affected by noise generated from military activities on Oahu (VanderWerf 2000). No wildlife noise analysis has been conducted on PTA, and the response of Hawaiian hoary bats to military noise is unknown.

The Transformation Biological Assessment reports that military maneuvers near a gray bat (*Myotis grisescens*) roost cave in the continental United States resulted in abandonment of the cave, and that Indiana bat (*M. sodalis*) hibernation can be disrupted by disturbances in or near hibernacula (caves). Bats that are awakened prematurely from hibernation by noise disturbances suffer an

energetic cost in lost fat reserves that cannot be replaced. The Transformation Biological Assessment suggests that Hawaiian hoary bats probably do not hibernate on Hawaii (but provides no supporting data), so noise impacts may not be as important as they are to continental species. In fact, no information is available on hibernation or torpor in Hawaiian hoary bats, either on a seasonal or daily basis, although the subspecies apparently is capable of a torpid state (Tomich 1974; Tomich 1986a; Menard 2001). The Transformation Biological Assessment also notes that noise probably has not excluded native vertebrate species from PTA, but does not address whether noise has reduced the potential abundance and distribution of Hawaiian hoary bats there.

The Service evaluated the effects of noise on Indiana bats at a summer maternity roost located about 0.6 kilometers (one mile) from an interstate highway near the flight path of the Indianapolis International Airport, Indiana (Service 2002). Bats at the roost site were exposed to almost continuous highway noise above background levels and to high noise levels from aircraft over-flights. The Service concluded that noise levels detected at the roost were tolerated by the resident bat colony at least to the extent that summer roosting and foraging habitat were not abandoned. While this case indicates some bat species may habituate to noise in certain situations, the reaction of Hawaiian hoary bats to louder noises at closer quarters is unknown.

If Hawaiian hoary bats do react negatively to military training noise, many of the direct and indirect effects of noise would be similar to those associated with physical disturbance and in many instances would occur in conjunction with such disturbances. Noise harassment would create the likelihood of injury to individual bats, to such an extent as to significantly disrupt normal behavioral patterns such as breeding, feeding, and sheltering. Noise may startle bats from their roosts, disrupting sleep patterns or torpor. Lethargic or torpid bats may not be able to respond rapidly to the need to abandon the roost, increasing the risk they would be injured or killed by heat, flames, and smoke. Bats also could be crushed in falling trees or struck by branches and foliage broken or blown by helicopter downdrafts. Bats dislodged from their roosts may not be able to fly due to injury or depleted energy reserves, and grounded bats would be vulnerable to fire, vehicle strikes, trampling, and predators. These effects would be particularly serious for pregnant or lactating females and non-volant young. The indirect effects of physiological stress associated with noise disruption of normal behavioral patterns would result in reduced reproductive capacity, juvenile recruitment, injury, or death. Nothing is known about the response of Hawaiian hoary bats to noise generated by different intensities and durations of military activities, or the extent to which bats may become habituated to noise disturbances. Bats possibly would be deterred from using daytime roosting or nighttime foraging areas because of intense levels of noise associated with human activity.

SBCT Transformation Minimization Measures

The Transformation Biological Assessment provides no specific measures to protect or replace lost or damaged roosting habitat for Hawaiian hoary bats. The Army proposes to ameliorate adverse impacts to populations or occurrences of listed plants by preparing a PTA Implementation Plan to enhance the distribution and abundance of listed plant species. Those measures include

control and management of wildfire, erosion, dust, and non-native species (*i.e.*, invasive plants, small mammals, invertebrates, and feral ungulates), as well as propagation and outplanting of native plants. Potential adverse impacts to bat habitat will be offset as a result of the Army's proposed general minimization measures such as fencing and removing ungulates from an additional 9,307 hectares (23,000 acres). These proposed measures will enhance the woodland and shrubland habitats which will provide additional roosting and foraging habitat for bats.

The greatest benefit of Army minimization measures to Hawaiian hoary bats will result from the construction and maintenance of fence units to control the adverse effects of feral ungulates on native vegetation. The Army also intends to survey the fence sites for federally listed species. The fence units (including fenced portions of the Kipuka Alala) will enhance the survival and regeneration of approximately 6,953 hectares (17,180 acres) of treeland vegetation providing potential available roosting habitat for bats. This amount represents about 35 percent of the total treeland area of PTA proper (excluding the Keamuku Parcel) that will be protected within fence units. In addition, approximately 1,369 hectares (3,382 acres) of other palila critical habitat areas are unfenced but receive varying degrees of protection through training restrictions.

The Army's WFMP includes a Fire Danger Rating System and a Wildfire Prevention Analysis to prioritize areas for pre-suppression funding and implementation. Five priority pre-suppression areas, or Fire Management Areas, are designated through the establishment and annual maintenance of fire breaks and fuel breaks (fuel management corridors). All Standard Operating Procedures to minimize training impacts will be reviewed for SBCT Transformation, and the PTA Environmental Office will review all training plans for potential impacts to listed species. In addition, the PTA Implementation Team will develop and implement a PTA Implementation Plan, although the Army has not proposed any specific measures to reduce threats to the Hawaiian hoary bat. Finally, the Army will reinitiate consultation with the Service each time fire affects lands beyond the action area.

Summary

The Service anticipates incidental take of Hawaiian hoary bats will be difficult to detect and quantify. Individuals are small and cryptic, and roost solitarily in tree foliage, so finding dead or injured bats is unlikely. The Service does not consider inspecting individual standing or downed trees as a practical survey method and does not recommend it as a means to determine incidental take (Service 2000). Monitoring to determine the presence of individual bats over an extensive area is not feasible either for solitary, tree-roosting bats using current technology (O'Shea and Bogan 2000). However, the level of adverse impacts can be anticipated by the area of suitable habitat affected. These impacts will be offset by the construction of additional fence units that will remove the ongoing browsing pressure from ungulates and allow for natural recruitment of treeland vegetation, and by implementation of the WFMP. (The total amount of habitat loss shown in Table 5, as indirectly measured by impacted treeland roosting habitat, does not account for the future reduction in habitat loss anticipated to result from WFMP implementation.) The Service considers the use of potential available habitat to indirectly measure project effects on the

Hawaiian hoary bat as a reasonable approach to conservatively estimate the range of a species in an area when extensive surveys have not been conducted (Service 2000). The validity of using habitat measures is corroborated by the documented presence of Hawaiian hoary bats in several locations on PTA throughout the year.

The direct and indirect effects of SBCT Transformation are expected to result in a cumulative loss of the available roosting habitat for Hawaiian hoary bats in the Impact Area and off-road maneuver area, due to habitat destruction, degradation, and fragmentation. There is also the possibility that treeland roosting habitat could be lost outside of the Impact Area but the risk of this loss will be reduced by the WFMP. The severity of these effects on Hawaiian hoary bats would largely depend upon the frequency, intensity, location, and extent of wildfire, live-fire, and dismounted maneuvers that would occur repeatedly in the same areas. The ongoing adverse effects of roosting habitat loss would accumulate over time with the continuation of military training in the action area. The magnitude of direct and indirect effects of habitat loss (particularly of roosting habitat), however, and the number of bats actually injured or killed, is unknown. It is our biological opinion that all direct and indirect impacts of the proposed action, when considered over the entire PTA/Keamuku Parcel action area, would be of concern over time without the implementation of minimization measures.

The Service analyzes the effects of the proposed action based on the assumption that the Army's existing and proposed minimization measures will be implemented to offset project-induced impacts to listed species. These measures will only partially offset the negative effects of military training and wildfire on bats. Neither the Routine nor the Transformation Biological Assessments propose specific measures or guidelines to address potential impacts to bats or their habitat. The Army also proposes no monitoring protocols to identify the presence of bats in particular habitat types, no procedures to protect bats from direct harm or harassment, and no reforestation is specifically identified to enhance or restore bat roosting habitat. However, the proposed fencing activities will remove the ongoing browsing pressure from ungulates and allow for natural recruitment of damaged treeland vegetation. In addition, implementation of the WFMP will reduce the frequency, intensity, and size of fires on PTA outside the Impact Area. Consequently, adverse impacts to the Hawaiian hoary bat associated with Army actions will be minimized and offset by fencing, ungulate removal, and wildfire threat abatement. This determination is based upon measures contained in the Project Description, implementation of the WFMP, and Standard Operating Procedures promulgated specifically to reduce impacts of Army actions on listed plant species.

Impacts to bat roosting habitat would be minimized by the construction of six fence units over approximately 9,308 hectares (23,000 acres) on PTA and the subsequent removal of ungulates from these areas. These fence units contain approximately 5,406 hectares (13,359 acres) of treeland communities providing potential available roosting habitat for Hawaiian hoary bats, and the existing fenced portions of the Kipuka Alala contain approximately 1,547 hectares (3,823 acres) of treeland communities. Thus, proposed and existing fence units will contain approximately

6,953 hectares (17,181 acres) of treeland vegetation. (Note that existing fence units for Kipuka Kalawamauna and Kipuka Alala will be encompassed within the western portion of the new, proposed fence unit.) Feral ungulates will be removed in the proposed fence units through public hunting programs and contracted aerial control, to enhance survival and regeneration of native vegetation. In particular, the western fence unit when completed will enclose a large, contiguous area that contains the best-quality remaining native woodland and shrubland habitats on the installation, including approximately 5,190 hectares (12,825 acres) of treeland vegetation providing potential available roosting habitat for bats. The removal and continued control of non-native ungulates in fence units will contribute toward the restoration of damaged vegetation, and will enhance the survival and regeneration of treeland roosting habitat for bats.

Locations of all fence alignments will be determined by the PTA Implementation Team, with approval of the Army and the Service. In addition, the PTA Implementation Team, will develop management protocols for rare plant conservation, augmentation, and reintroduction; rodent and invertebrate control; and invasive plant control. Standard Operating Procedures will be revised to minimize the additional environmental impacts associated with SBCT Transformation and emphasize protection of the vegetation. All these measures will further enhance the foraging and roosting habitats used by bats.

Table 6. Area of treeland vegetation types where take of Hawaiian hoary bats is possible/likely, as measured indirectly by potential available roosting habitat, in the PTA action area (excluding the Keamuku Parcel).

Project Effects on Hawaiian Hoary Bats	Treeland Vegetation Destroyed/Degraded[1] (hectares [acres])	Treeland Vegetation Maintained/Enhanced[2] (hectares [acres])
Live-Fire and Wildfire (PTA)[3]	19,966 (49,317)	--
[Impact Area]	[7,999 (19,766)]	--
Off-Road Maneuvers – High-Probability Area[4]	956 (2,361)	--
Construction and Training Use of BAX and AALFTR[4,5]	?	?
Construction and Maintenance of Fire breaks/Fuel breaks[4]	?	?
Fence Units[4,6]	--	6,953 (17,180)
Unfenced Palila Critical Habitat Areas	--	1,369 (3,382)
Fire Management Areas	?	?
Total	19,966 (49,317)	8,321 (20,562)
Net Treeland Vegetation Destroyed or Degraded	11,645 (28,754)	--

[1]Cumulative impacts to existing treeland vegetation; includes subset effects associated with the Impact area, Off-Road Maneuvers, fire breaks/fuel breaks.
[2]Survival and regeneration of treeland vegetation enhanced through ungulate control.
[3]Excluding Keamuku Parcel.
[4]Additional impacts expected to occur in areas affected by live-fire and wildfire.
[5]Battle Area Course (BAX); Anti-Armor Live-Fire Tracking Range (AALFTR).
[6]Including fenced portions of Kipuka Alala.
[7]Undeterminable from information provided in the Transformation Biological Assessment.

Treeland vegetation trends should be monitored in military training areas, fence units, and Fire Management Areas outside the Impact Area. The Service considers monitoring as a term and condition necessary to evaluate the underlying assumptions made about the presence of bats and their use of roosting and foraging habitats. Such monitoring will provide a more specific measure of the protective adequacy of the Army's minimization measures and the terms and conditions of this biological opinion. Information gained from monitoring will be used to readjust strategies for avoiding and minimizing take of Hawaiian hoary bats in the action area. Monitoring also will collect valuable scientific data that would contribute to recovery of the Hawaiian hoary bat.

CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, local or 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. According to the Transformation Biological Assessment, two non-Federal actions are reasonably certain to occur on lands adjacent to the PTA/Keamuku action area: a private residential development is planned at Waikii Ranch, and a State capital improvement project is planned by the Hawaii Department of Land and Natural Resources. No further information is available for the Waikii Ranch project. The State project will establish a fire break along a previously disturbed power line corridor that will connect to the northern PTA fire break. The direct and indirect impacts of vegetation destruction would be minimized by surveying the proposed fire break route for listed species; altering the route where necessary to avoid direct habitat impacts; limbing trees rather than removing them; and leaving a patchy mosaic of fuel-reduction cover types that will include native grasses, shrubs, and trees. The Service is unaware of any other future State, local, or private actions that are reasonably certain to occur within the action area covered in this biological opinion and that would not be subject to Army section 7 review.

CONCLUSION

After reviewing the current status, the environmental baseline, the effects of the proposed action, and the cumulative effects, it is the Service's 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 palila critical habitat. This conclusion is based on the following factors:

1. The Service anticipates that the direct and indirect effects of the proposed action will result in a decline in the number of Hawaiian hoary bats in the action area. This conclusion is based on the eventual, cumulative loss of all potential available treeland roosting habitat in the action area as a result of Legacy and SBCT Transformation training. However, the adverse effects of the proposed actions will be minimized by such measures as the construction of 9,307 hectares (23,000 acres) of new fence units, removal of ungulates, implementation of the WFMP, inclusion of Hawaiian hoary bat conservation and management into the Implementation Plan, and monitoring Hawaiian hoary bat presence and abundance.

2. The Service does not expect that Hawaiian hoary bats occur in large concentrations at PTA and only a small proportion of the bat's overall range on the island of Hawaii is likely to be affected by the proposed actions on the installation. This loss of bats at PTA is not likely to affect the status of the subspecies on Hawaii or throughout the State because this represents a small proportion of the Hawaiian hoary bat's overall range. The entire PTA/Keamuku action area comprises only about 13 percent of the bat's current range on Hawaii and approximately seven percent of its current State-wide range.

3. There will be direct and indirect adverse impacts to listed plant species from Legacy and Transformation training. Several measures have been included in this consultation to offset training impacts to plants. Approximately 9,307 hectares (23,000 acres) of fence units will be constructed and ungulates removed to allow natural habitat restoration and recruitment of these listed plant species. The Implementation Plan will address outplanting for each species to increase species distribution and abundance. In addition, the Implementation Plan will include: invasive plant and rodent control; dust study; buffers and new Standard Operating Procedures to minimize Army training on these species and their habitats.

4. All Legacy land-use and training activities in palila critical habitat will remain as currently stipulated under Army Regulations. However, the portions of Palila

Critical Habitat Area B and Mauna Kea State Park located south of the planned realigned Saddle Road will be affected by future Transformation training activities. SBCT training action will include Stryker vehicles driving through these areas on dirt roads that will generate large amounts of dust that will accumulate on plant leaves. This dust deposition may reduce photosynthetic rates thereby reducing plant health and vigor. In addition, Transformation actions include an off-road maneuver training area adjacent to the southern border of Palila Critical Habitat Area B. Adverse effects of repetitive driving over dirt roads and open land by Strykers include: increased dust, opportunity for non-native plant encroachment and increase risk of fire due to additional training. To minimize the indirect effects of dust, invasive species and fire, adjacent to mamane/naio woodland, a 75-meter (246-foot) buffer will be situated along the southern boundary of Palila Critical Habitat Area B. In addition, the Implementation Team will develop, and the Army will implement, a study to determine the effect of dust on mamane/naio woodland from on-road vehicular dust accumulation. If it is determined that dust is detrimental to the woodland habitat then measures will be instigated such as gravel or palliatives on roadways to curtail dust generation and drift.

5. The WFMP has been finalized and fuel modification at PTA is currently underway. The WFMP addresses the methods and protocols necessary to control the frequency, intensity, and size of fires at PTA. This will include the construction of fuel breaks and fuel corridors that will help reduce the risk of a catastrophic loss of habitat and listed plants. Implementation of the Fire Danger Rating System is expected to significantly reduce the frequency and severity of wildland fires at PTA.

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 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 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 adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to any permit or grant document, 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 Hawaiian hoary bat 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

The Service anticipates that take of Hawaiian hoary bats will occur in the form of direct take resulting in the death or injury of individual bats, harm due to significant loss of potential available treeland roosting habitat, and harassment by noise and ground disturbance. Take is anticipated to be incidental, and not the purpose of, the carrying out of otherwise lawful activities related to the military activities described in this biological opinion.

1. The Service anticipates that take of Hawaiian hoary bats will occur in the form of harm (due to the loss of habitat), harassment, and injury or death as a result of Army activities described in the biological opinion. Take in the action area will include all bats associated with the loss of potential available treeland roosting habitat. Based on the past fire history of PTA, we anticipate that an average 254 hectares (628 acres) of all habitat types may burn per year outside the Impact Area, of which approximately 97 hectares (240 acres) consist of treeland vegetation providing suitable roosting habitat for bats. Therefore, the Service anticipates the proposed action will result in the take of all bats associated with the loss of no more than 97 hectares (240 acres) per year of treeland habitat outside the Impact Area for the first 5 years after this biological opinion is finalized. After the first 5 years, we anticipate that the effective implementation of the WFMP will result in the take of all bats

associated with the loss of no more than 48 hectares (119 acres) per year of treeland habitat outside the Impact Area. We further anticipate that no more than 1,345 hectares (3,324 acres) of treeland habitat will be cumulatively lost in the action area outside the Impact Area and the high-probability Stryker off-road maneuver area. In addition, over time all treeland habitat within the Impact Area and the high-probability Stryker off-road maneuver area, which together comprise approximately 8,955 hectares (22,127 acres) of treeland habitat, will be lost. Take will be indirectly monitored for this incidental take statement by determining the area, in hectares, of treeland roosting habitat that is destroyed each year on PTA outside the Impact Area.

Effect of the Take

The Service determines that the level of take quantified above is not likely to jeopardize the continued existence of the Hawaiian hoary bat or result in the destruction or adverse modification of palila 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 Service believes the following Reasonable and Prudent Measures are necessary and appropriate to minimize incidental take of Hawaiian hoary bat. The measures described below are non-discretionary and must be implemented.

1. Minimize direct and indirect effects on survival and reproduction of Hawaiian hoary bats in the action area.

2. Minimize loss and degradation of roosting habitat for Hawaiian hoary bats in the action area.

3. Minimize noise and ground disturbance to Hawaiian hoary bats associated with military activities in the action area.

Terms and Conditions

In order to be exempt from the prohibitions section 9 of the Act, the Army must comply with the following terms and conditions to avoid or minimize take of Hawaiian hoary bats in the action area. The terms and conditions implement the reasonable and prudent measures described above and outline reporting and monitoring requirements. These terms and conditions are non-discretionary.

Terms and conditions that implement reasonable and prudent measure (1) are as follows:

1. Minimize direct and indirect effects on the survival and reproduction of Hawaiian hoary bats in the action area.
    - 1.1. Avoid construction activities for the Battle Area Course, Anti-Armor Live-Fire Tracking Range, and fuel modification areas during the breeding season of the Hawaiian hoary bat (April through August), and particularly during the peak lactation period (June through August), to the maximum extent practicable.
    - 1.2. Develop and implement a species conservation plan for the Hawaiian hoary bat as part of the PTA Implementation Plan to address implementation of these terms and conditions. The bat conservation plan shall be determined in consultation with the Service, the State, and the PTA Implementation Team, which shall include a Service-approved team of bat experts.
    - 1.3. Dedicate one or more of the Army Natural Resources staff to become familiar with the biology and habitat requirements of the Hawaiian hoary bat, including appropriate monitoring techniques. This individual will become the point of contact for all bat issues and concerns.
    - 1.4. Report any incidental take of Hawaiian hoary bats by notifying the Service within three working days if any take of Hawaiian hoary bats occurs, or upon finding a dead, injured, or sick bat. Provide reports of incidental take to the Service's Pacific Islands Fish and Wildlife Office, P.O. Box 50088, Honolulu, HI 96850, (telephone 808/792-9400). Handle any dead specimens carefully to preserve biological material in the best possible state. The depository designated to receive specimens of Hawaiian hoary bats is the Bernice Pauahi Bishop Museum, 1525 Bernice Street, Honolulu, HI 96817 (telephone 808/547-3511). If the B.P. Bishop Museum declines to accession the specimens, the Army should contact the Service's Division of Law Enforcement in Honolulu, HI (telephone 808/541-2681, fax 808/541-3062) for instructions on disposition.

Terms and conditions that implement reasonable and prudent measure (2) are as follows:

2. Minimize loss and degradation of roosting habitat for Hawaiian hoary bats in the action area.
   - 2.1. Monitor the annual amount of incidental take, as measured indirectly by hectares of treeland vegetation destroyed outside the Impact Area, and provide an annual report of the results to the Service for assessment of whether the estimated annual level of take has been exceeded.
   - 2.2. Monitor trends in treeland vegetation cover in fence units and Fire Management Areas to determine the extent of enhanced survival and regeneration of tree species. Appropriate monitoring and reporting protocols will be developed by the Implementation Team with assistance from bat ecologists. These measures shall be incorporated into the Implementation Plan.
   - 2.3. Monitor trends in numbers of Hawaiian hoary bats present in the action area. Appropriate monitoring and survey methodologies plus reporting protocols will be developed by the Implementation Team with assistance from bat ecologists. These measures shall be incorporated into the Implementation Plan.
   - 2.4. The Army will notify the Service within 24 hours of any instance in which training was not conducted in accordance with the WFMP and a wildfire occurred that impacted bat foraging or roosting habitat outside of the Impact Area.
   - 2.5. Determine the number of bats per area of treeland roosting habitat in selected vegetation types within the action area, in order to refine take estimates measured indirectly by the amount of lost roosting habitat and to determine when those take levels are exceeded. Appropriate research methodologies shall be developed by the PTA Implementation Team and incorporated as part of the PTA Implementation Plan.
   - 2.6. The Implementation Team shall address enhancement and restoration of habitat utilized for bat roosting to offset any significant event (such as a wildfire or training mishap) that results in woodland or shrubland habitat degradation.
   - 2.7. Develop and implement a species conservation plan for the Hawaiian hoary bat as part of the PTA Implementation Plan to address implementation of these terms and conditions. The bat conservation plan shall be determined in consultation with the Service, the State, and the PTA Implementation Team, which shall include a Service-approved team of bat experts. The PTA Implementation Team will review the progress of the Implementation Plan annually, and make recommendations to the Army regarding needed adaptive management changes to the Hawaiian hoary bat conservation plan. The Service will have final approval regarding changes to the Implementation Plan to ensure they meet the goals of this consultation.
   - 2.8. Components of the Hawaiian hoary bat conservation plan must include, but are not limited to, the following: (a) time frame for completing its implementation

phase; (b) identification of priority areas and actions; (c) definitions of success for bat population and habitat management; (d) methods for bat population and habitat management; (e) methods for monitoring, data tracking, analysis, and feedback; (f) a gross-scale estimate of the maximum acceptable decline in trends of bat population numbers and/or loss of available treeland roosting habitat that will trigger development and implementation of additional minimization measures not contained in the terms and conditions of this biological opinion; and (g) a cost estimate for plan implementation. The PTA Implementation Plan shall follow the conceptual model and protocols developed for the Makua Implementation Plan.

2.9. The PTA Implementation Team will assist in identifying minimization measures needed to offset impacts to the Hawaiian hoary bat in the action area. Additional surveys of the action area are likely to reveal the presence of bats in places not previously documented at PTA and the Keamuku Parcel. If such is the case, changes in species status will be considered when appropriate stabilization sites and actions are identified by the PTA Implementation Team.

2.10. Within six months from the issuance date of this biological opinion, Army, State and Service biologists shall meet and review the status of the Hawaiian hoary bat as part of the PTA Implementation Plan. The PTA Implementation Team shall determine what, if any, additional conservation actions shall be implemented to reduce the potential decline of bats due to military actions in the action area. The Army will implement any determined urgent actions within one year from the issuance date of the biological opinion in order to minimize the risk of species loss prior to the finalization of the PTA Implementation Plan.

2.11. The PTA Implementation Plan will be completed by December 31, 2005, with conservation measures intended to offset impacts to the Hawaiian hoary bat beginning within six months of the completion date of the Implementation Plan.

2.12. Provide all annual reports and monitoring results to the Service's Pacific Islands Fish and Wildlife Office, P.O. Box 50088, Honolulu, HI 96850, no later than six months after the end of the previous fiscal year's activities.

Terms and conditions that implement reasonable and prudent measure (3) are as follows:

3. Minimize noise and ground disturbance to Hawaiian hoary bats resulting from military activities in the action area.

3.1. Include Hawaiian hoary bat in the Environmental Awareness Program to inform installation users of the need to avoid and minimize impacts to bats on PTA/Keamuku.

3.2. Develop and implement a species conservation plan for the Hawaiian hoary bat as part of the PTA Implementation Plan to address implementation of these terms and conditions. Components of the bat conservation plan are further described under term and condition 2.11 and must include, but are not limited to,

identification and implementation of appropriate training restrictions to avoid or minimize take (*i.e.*, harm and harassment) of Hawaiian hoary bats when feasible. The bat conservation component of the Implementation Plan shall be determined in consultation with the Service, the State, and Service-approved bat experts.

The Service concludes that all Hawaiian hoary bats associated with the loss of treeland vegetation in PTA will be incidentally taken as a result of the proposed action. The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize the impact of incidental take that might otherwise result from the proposed action. If during the course of the action the level of incidental take is exceeded, such incidental take represents new information requiring reinitiation of consultation and a review of the reasonable and prudent measures. The Army must immediately provide an explanation of the cause of the taking and review with the Service the need for possible modification of the reasonable and prudent measures.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Endangered Species Act 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. In order for the Service to be kept informed of actions that avoid or minimize adverse effects, or benefit listed species or their habitats, the Service requests notification of the implementation of any conservation recommendations.

1. Pursue additional funding and partnership opportunities to implement additional surveys and research needed to better understand the Hawaiian hoary bat's abundance and distribution, life history and habitat ecology, and response to management. Such research would produce valuable information that would contribute to the bat's conservation and recovery. For example, radio-telemetry studies on habitat selection by Hawaiian hoary bats in the action area would provide information on what characteristics bats use to select roosting sites, in particular, if bats at PTA are roosting in both trees and shrubs.

2. Reforest native treeland communities in fence units to provide roosting habitat for the Hawaiian hoary bat.

3. Participate as an active member of the public-private Hawaiian Hoary Bat Research Cooperative sponsored by the Service, the Hawaii Department of Land and Natural Resources - Division of Forestry and Wildlife, and Bat Conservation International.

4. Fence all palila critical habitat on PTA with subsequent removal of ungulates from fenced areas.

5. If experiments to determine seed predation by rodents show rodents are eating mamane seeds, conduct a large scale rodent control program at appropriate sites on the PTA to reduce rodent numbers. Monitor effects of large scale rodent control on mamane productivity and mamane/naio forest regeneration.

6. Assist the State Department of Land and Natural Resources - Division of Forestry and Wildlife with the repair and maintenance of the Mauna Kea Forest Reserve fence on the northern boundary of PTA.

7. The Army should devise and test different methods for converting disturbed habitat to native habitats such as prescribed burns versus herbicide applications (aerial spraying, pony-pack spraying and/or hand-removal) to rid large areas of *Pennisetum setaceum*.

8. The Army should establish protocols for hydromulching or other large-scale native plant seeding to be used in native habitat restoration efforts.

9. Increase nursery facilities on PTA with the goal of creating a production-scale facility that is capable of producing large quantities of native plant materials for use in revegetation projects undertaken by Integrated Training Area Management staff.

10. All roads on PTA should be paved or graveled to eliminate dust generated from on-road maneuvers and activities.

11. The same level of conservation actions should be conducted for Federal candidate plant species and other plant species of concern as for threatened and endangered plant species.

12. The Army should work with off-site land managers/landowners to develop partnerships that would allow for reintroduction of threatened and endangered plant species on their lands.

REINITIATING-CLOSING STATEMENT

This concludes formal consultation on this action. If implementation of conservation actions have not been initiated by the end of calendar year 2005, 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 the action area as described in this biological opinion. 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 population augmentation (determined by the Implementation Team) prior to its being outplanted 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 PTA 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 A. Scientific and Common Nomenclature for Plant and Animal Species Mentioned in the Biological Opinion.	
Acacia koa (end)	koa
Aleurodicus dispersus (nat)	spiraling whitefly
Alyxia oliviformis (end) [1]	maile
Antidesma platyphyllum (end)	hame
Andropogon virginicus (nat)[3]	broomsedge
Asplenium fragile var. *insulare* (end)	fragile fern
Bidens menziesii (end)	kookoolau
Boigus irregularis	brown treesnake
Bos taurus (nat)	cattle
Capra hircus (nat)	goats
Chamaesyce sp. (end)	akoko
Chenopodium oahuense (end)	aheahea
Cynodon dactylon (nat)	Bermuda grass
Dodonaea viscosa (ind) [2]	aalii
Doryopteris sp. (end)	no common name
Dryopteris wallichiana (ind)	io nui
Dubautia linearis (end)	naenae
Dubautia menziesii (end)	naenae
Eragrostis sp. (end, ind, nat)	lovegrass
Gouania hillebrandii (end)	no common name
Grammitis hookeri (ind)	makue lau lii
Haplostachys haplostachya (end)	honohono
Hedyotis coriacea (end)	kioele
Isodendrion hosakae (end)	aupaka

Kalanchoe tubiflora (nat)	chandelier plant
Lantana camara (nat)	lantana
Leptecophylla tameiameiae (ind)	pukiawe
Leucaena leucocephala (nat)	koa haole
Lipochaeta venosa (end)	nehe
Melanthera lavarum (end)	nehe
Melia azedarach (nat)	chinaberry
Melinis minutiflora (nat)	molasses grass
Metrosideros polymorpha (end)	ohia
Myoporum sandwicense (ind)	naio
Myrsine lanaiensis (end)	kolea
Neraudia ovata (end)	spotted nettlebrush
Osteomeles anthyllidifolia (ind)	ulei
Ovis aries (nat)	sheep
Ovis musimon (nat)	mouflon sheep
Pennisetum clandestinum (nat)	kikuyu grass
Pennisetum setaceum(nat)	fountain grass
Physalis peruviana	poha
Portulaca sclerocarpa (end)	poe
Prosopis pallida (nat)	kiawe
Sadleria cyatheoides (end)	amau
Salsola kali (nat)	Russian thistle
Santalum sp. (end)	iliahi
Schiedea menziesii (end)	no common name
Schinus terebinthifolius (nat)	Christmas berry
Senecio mikanioides (nat)	German ivy

Sida fallax (ind)	ilima
Silene hawaiiensis (end)	Hawaiian catchfly
Silene lanceolata (end)	lance-leaf catchfly
Solanum incompletum (end)	popolo ku mai
Sophora chrysophylla (end)	mamane
Spermolepis hawaiiensis (end)	Hawaiian parsley
Stenogyne angustifolia (end)	no common name
Streblus pendulinus (ind)	aiai
Styphelia tameiameiae (ind)=*Leptecophylla tameiameiae*	pukiawe
Sus scrofa (nat)	pigs
Tetramolopium arenarium ssp. *arenarium* (end)	no common name
Vigna o-wahuensis (end)	Oahu vigna
Wikstroemia pulcherrima (end)	akia
Zanthoxylum hawaiiense (end)	ae
[1]endemic, [2] indigenous, [3] naturalized	

Appendix B. External Standing Operating Procedures for Protection of Natural and Cultural Resources at Pohakuloa Training Area (U.S. Army 2003a).

SUBJECT: Appendix 1 (Natural Resources Protection) to Annex T (Protection of Natural and Cultural Resources) to Pohakuloa Training Area (PTA) External Standing Operating Procedures (SOP).

1. Introduction:

a. Pohakuloa Training Area contains several hundred known archaeological sites, including caves, c-shape enclosures, overhang shelters, cairns, excavated pits, stone shrines, prehistoric trails and volcanic glass quarry sites (See photos Appendix 3). Disturbance of archaeological sites such as movement of rocks for hasty fortifications can cause alteration or destruction of those sites. Archaeological sites can be destroyed during a single event, but more often cumulative disturbing actions diminish their integrity. Any damage to cultural resources is to be avoided.

b. PTA can be divided into three cultural impact risk areas:

(1) High Impact Risk Areas where abundance of facilities and military activity occur in areas containing archaeological sites. Also includes areas where there is a potential for occurrence of significant archaeological sites based on historic records documenting native Hawaiian use of the area. Includes training areas 5, 6, 15, 16, 17, 19, 20, 21, 22, and 23.

(2) Moderate Impact Risk Areas where abundance of facilities and military activity occurs in areas containing a limited number of known archaeological sites. Based on landform and isolation from most prehistoric activity, it is expected that some sites would occur in these areas. Includes training areas 1, 2, 3, 4, 7, 10, 11, 13, 14.

(3) Low Impact Risk Areas have not been surveyed, and are covered by aa lava flows where a small number of archaeological sites have been found in the past. However, until surveyed for archaeological sites, the potential for discovery of cultural resources remains. Includes base camp and training areas 8, 9, and 12.

c. Rules to Minimize Potential Threats to Archaeological Sites at PTA:

(1) Vehicles:

(a) Vehicles must be confined to well-traveled road networks. No cross-country off-road driving.

(b) Driving on cinder cones (puu) is restricted to existing roads and trails.

(c) Care will be taken to use previously disturbed areas for tactical parking.

(2) Excavation and Digging:

(a) For ground disturbance (excavation and digging) in Low Impact Areas follow the rules in the Emergency Discovery Procedures outlined below. Fighting positions may be dug using hand tools only and may be placed only in previously disturbed areas that are nearly devoid of vegetation. Fighting positions will not be constructed from rock; use sandbags for built up positions only. Do not disturb, remove rocks from, or walk on rocky outcroppings, as they are the most likely place to contain cultural resources. Hand tools will be used to fill and grade all fighting positions to their original condition when training is completed.

(b) For ground disturbance in Moderate Impact Areas outside of previously disturbed areas, follow the same general rules listed above. For ground disturbance in areas not previously disturbed, the Environmental Office Cultural Resource Specialist must be notified and the planned construction will be reviewed.

(c) Ground disturbance in High Impact Areas will require archaeological survey and testing prior to start of any work. Notify the Environmental Office Cultural Resource Specialist at least a 120 day's prior to the start of work.

(d) Mechanized Excavation. Firing Positions Areas 301, 301, 308, 312, 424, 429, and 438 are the only locations authorized for mechanical excavation with construction equipment. Coordinate with Range Control prior to excavation and clearing.

(e) No digging on fixed ranges.

d. Maneuver/Bivouac:

(1) Lava tubes caves and sinkholes are off-limits as even limited intrusions into such features may damage the resources within them.

(2) Do not use stones to construct rock fortifications, walls, cairns, etc., as surface materials used may in fact be part of an archaeological site.

e. Emergency Discovery Procedures: In the event of inadvertent discovery of archaeological or historic remains at PTA, the following emergency procedures should be followed:

(1) Halt all activities in the area immediately. Protect the resource from further damage.

(2) Inform Range Control of the find and any damage caused.

(3) Range Control will contact the PTA Environmental Office Cultural Resource Specialist, 969-3340 (from the Island of Hawaii) or 523-5196 (from the Island of Oahu).

1. GENERAL.

a. Vehicle restrictions:

(1) Traffic in the training areas is confined to well traveled road networks. No cross-country off-road driving is authorized.

(2) Driving on cinder cones (puu) is restricted to existing roads and trails.

(3) Guides will be used during tactical vehicle parking to insure protection of vegetation. Care will be taken to use previously disturbed areas for tactical parking.

b. Excavation and Digging:

(1) Individual fighting positions (foxholes) are permitted in Training Areas 1 through 16 with the following restrictions. Fighting positions maybe dug using hand tools only. This includes shovels and picks. Fighting positions will be placed in previously disturbed sites that are nearly devoid of vegetation. Do not disturb, remove rocks from, or walk on rocky outcroppings, as they are the areas most likely to harbor endangered plants. Do not cut or remove plants. Hand tools will be used to fill and smooth all fighting positions to their original condition when training is completed.

(2) Mechanized Excavation. Firing Positions Areas 301, 302, 308, 312, 424, 429, and 438 are the only locations authorized for mechanical excavation with construction equipment. Coordinate with Range Control prior to excavation and clearing.

(3) No digging on fixed ranges.

(4) Vegetation will not be cut or removed. This includes grasses, shrubs, bushes and trees.

(5) All fenced and gated areas are off-limits unless specifically noted otherwise by signs.

(6) Lava tubes, caves and sinkholes are off-limits.

(7) Open fires are prohibited in all training areas and base camp, except approved barbecue units located on camp only.

(8) Annex B, Appendix 2, governs the use of pyrotechnics and incendiary munitions.

(9) Fire fighting equipment, to include a 300-gallon pump or tank, will be available prior to firing on range 1, 8, or 10. Range 8 also requires two serviceable spray packs prior to operation.

(10) All fires will be immediately reported to Range Control. If a fire starts outside the impact area or in an environmentally sensitive area, units will suspend training operations and perform fire suppression until the fire is extinguished. Continue fire suppression until relieved by a Range Control or Fire Department representative.

2. AREA SPECIFIC RESTRICTIONS:

a. Redleg Trail. Locate generally along north-south gridline 83:

(1) Digging of fighting positions is authorized only at firing points and pre-approved sites. Fighting positions must be dug with hand tools only; mechanized digging requires a PTA Cdr waiver.

(2) Use existing roads and trails only.

(3) No refueling operations, food preparation or vehicle maintenance.

(4) Do not enter or disturb any cave or lava tube.

b. Puu KeeKee, Alekoi, Maau, Kailua, Hauula, Kahana, Kaneohe, Aiea, Omaokoili, Kaeni, and Koli are available for training. No digging is allowed, but fighting positions may be built up using sandbags. Fill material for sandbags is not to be obtained from Puu areas; contact Range Control for fill source.

c. Training Area 17, Puu Ka Pele, Leilani and Hukilau have special restrictions for access due to high occurrences of rare and endangered species. See the Environmental Office for details.

d. There is no off-road access to Puu Ahi except on the lower elevation foot trail to Range 14. Existing foxholes may be improved with hand tools in previously disturbed areas. Endangered plants exist on higher slopes.

e. Palila Critical Habitat (PCH) includes Training Areas 2 and 10, and parts of Training Areas 1,4, and 11 as indicated by green on the referenced map. This contains Mamane tree forest, which can provide habitat and food for endangered Palila birds. Rules that apply within the PCH are:

(1) LIVE FIRE IS NOT PERMITTED.

(2) A maximum of 24 artillery pieces may be deployed for dry fire exercises only.

(3) No more than 500 troops may bivouac within the PCH.

(4) Aircraft are restricted to an elevation of 2,000 feet AGL and 1500 meters from Mauna Kea State Park.

(5) No maneuver or firing of blanks within 1,500 meters of Mauna Kea State Park.

(6) Use only well-defined roads and trails South of Infantry Trail and Mauna Kea Road.

(7) No fires are allowed.

(8) No refueling operations, food preparation or vehicle maintenance.

(9) A maximum of seven helicopters is allowed in the PCH at a given time.

(10) Do not cut vegetation.

(11) Use of pyrotechnics or simulators is not allowed.

f. Kipuka Kalawamauna Endangered Plant Habitat (KKEPH) is also shown in green on the referencing map and Training Area 22. Rules that apply within the KKEPH are:

(1) No overnight bivouacking within 2,000 meters of the Kona Highway.

(2) No fires or use of any type of pyrotechnic or incendiary munitions.

(3) Foot march is permitted, but stay away from rocky outcroppings and caves.

(4) Vehicles are restricted to established roads and are not permitted in areas protected by gates. Two yellow gates are located on New Bobcat Trail at KB19898232 and KB20728570. Do not pass these gates even if found open.

(5) Firing points 701, and 703 are off limits.

(6) Bivouac is defined as an area where training units conduct vehicle/weapons maintenance, fuel and ammunitions resupply, medical operations, helicopter landings and field cooking/messing operations. Normally a Brigade Support Area or Logistics position with a generally static presence with established living and sleeping areas would be considered a bivouac area.

g. Training Area 23 (Kipuka Alala) and the Puu Ahi Endangered Plant Habitat (EPH) have specific training restrictions. A single strand fence at grid coordinates KB 27688656, KB 28008600, and KB 27528568 encloses the EPH. See the Environmental Office for details.