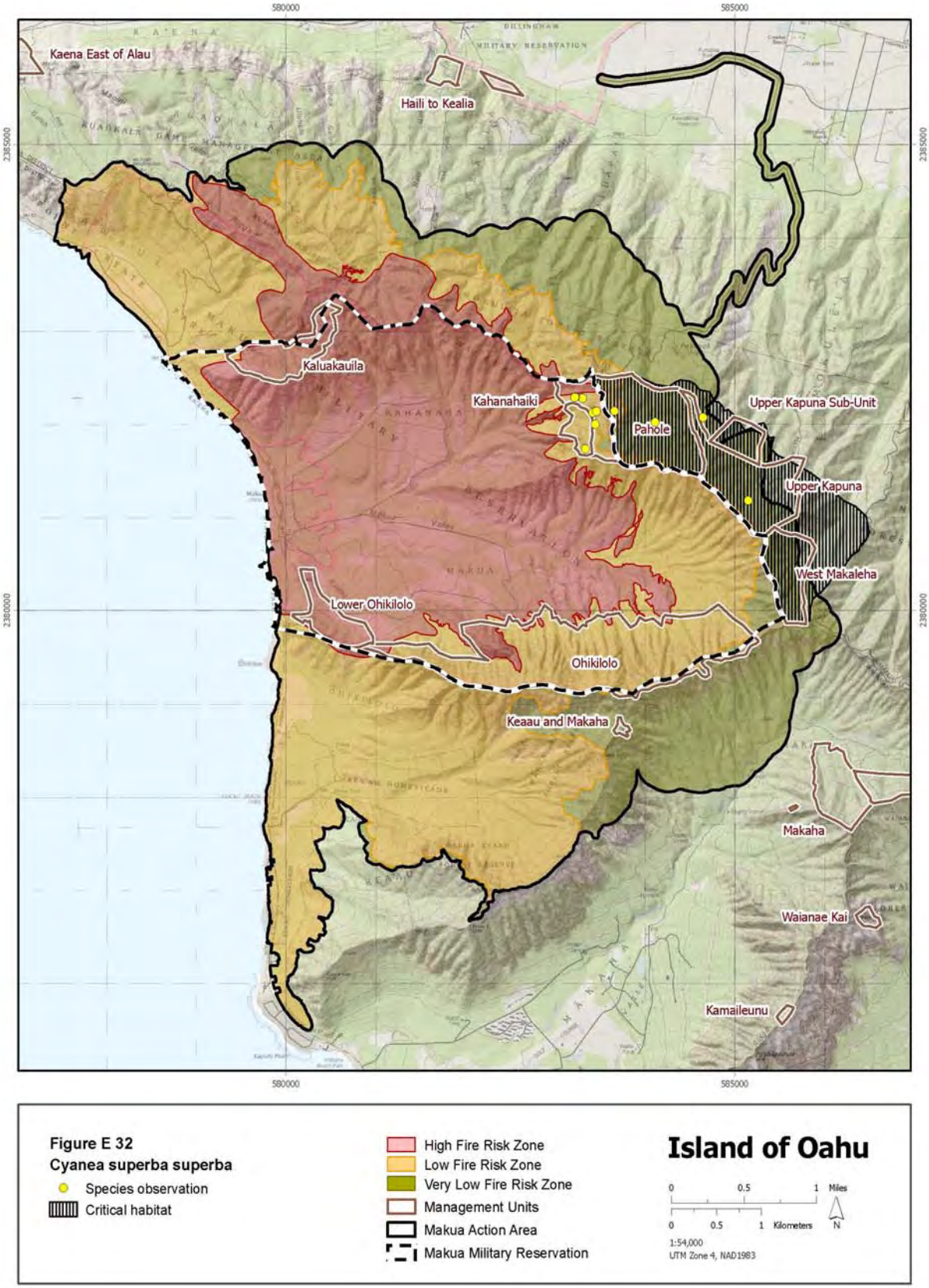
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Lower Ohikilolo
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Makaha
Waianae Kai
Kamaileunu
Figure E 32
Cyanea superba superba
Species observation
Critical habitat
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Low Fire Risk Zone
Very Low Fire Risk Zone
Management Units
Makua Action Area
Makua Military Reservation
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**EFFECTS OF THE ACTION – *Delissea subcordata* (no Common Name)**

*Delissea subcordata*, an Oahu perennial endemic, has an estimated range-wide population of approximately 185 individuals. There are roughly 22 mature *D. subcordata* individuals in the action area (Figure E 33), but threats are not controlled and numbers are maintained primarily through augmentation. Today the action area contains only about 12 percent of all remaining *D. subcordata* individuals; however, in 2006, when the Service and the Army agreed on expedited stabilization for at-risk taxa, the action area contained about 17 percent of all remaining individual. Although these numbers do not fit the general criteria used to identify at-risk taxa, the Army agreed to include *D. subcordata* in expedited stabilization activities due to this species' critically endangered status and its risk of fire from military training at both Makua and Schofield Barracks Military Reservation.

Species Response to the Proposed Action

The majority of the remaining *Delissea subcordata* in the action area are located in the Kahanahaiki to Keawapilau population unit where Army training with long-range, incendiary weapons could result in injury and death of *D. subcordata* individuals. The population most at-risk are the 17 individuals located along the perimeter of the Kahanahaiki Management Unit only 330 m (1083 ft) from the edge of the high fire risk area. The close proximity of these plants to this historically burned area increases the risk that a future fire will spread quickly through the disturbed vegetation and encroach further into the forest edge. To minimize the risk of fires in Kahanahaiki Gulch (west of the occupied management units), the Army will construct either a 20-m (65-ft) wide firebreak, or a 200-m (656-ft) wide shaded fuelbreak in Kahanahaiki Gulch along the Kahanahaiki Management Unit perimeter. In addition, a helispot will be maintained within 500 m (1,640 ft) of the upper reaches of Kahanahaiki Gulch and a safety zone will be established within or adjacent to the management unit. These additional minimization measures will help preserve the extant individuals of *D. subcordata*.

A few individuals of *Delissea subcordata* are located in the Upper Kapuna Management Unit that coincides with the very low fire risk area. We estimate that a misfired live-fire weapon landing in forest and shrub areas will burn approximately 0.1 ha (0.3 ac) of forest prior to fire suppression measures extinguishing the fire. Inadequate detection and suppression response could enable these fires to burn more than 40 ha (100 ac) in a 48-hr period. However, to avoid the risk of an undetected fire, the Army will conduct an aerial survey in a helicopter for 1-hour post-training to check for smoke from a misfired round (see General Effects - Fire Suppression).

Other Risk Reduction Factors

Certain weapons systems and munitions will be restricted until a fire protection system is in place for the Kahanahaiki Management Unit and expedited stabilization thresholds are achieved for at-risk taxa that occur in that management unit (see Table PD 2). Expedited stabilization will involve continued augmentation of *D. subcordata* in the action area and outside the action area (Ekahanui, Kaluaa, and Palawai population units).

A portion of the Kahanahaiki to Keawapilau population unit is within the fenced Kahanahaiki Management Unit and the entire population unit is partially controlled for weeds. *Delissea subcordata* in the action area also will be exposed to the direct and indirect impacts of non-native plants, slugs, and rats. Slug damage is particularly threatening to the survival and recovery of this species and the Army has sponsored further research on this problem. The direct and indirect effects of non-native weeds and invertebrates will reduce the vigor, reproduction, recruitment, and survival of individual plants. However, augmentation conducted by the Army Natural Resources Staff is probably one of the main reasons this plant is still extant in the wild (U.S. Army Garrison, 2006). *Delissea subcordata* is successfully propagated from seed, and as of 2005, survival of outplantings was estimated at 70 percent. Overall, four population units will be managed for stability for this taxon because it occurs in both the Makua and Schofield Barracks action areas. However, full stabilization of this species will be dependent on developing slug control techniques to increase survival and recruitment.

Conclusion

This species is characterized by low numbers and large fluctuations, local declines of naturally occurring individuals, limited recruitment, and predation by slugs and rats and can be characterized by a very high background risk of extinction. However, there is an overall increase in the numbers of *Delissea subcordata* due to reintroduction and augmentation (see Species Status and Baseline). Despite the ongoing exposure of *D. subcordata* to training-related wildland fire impacts, Army conservation and stewardship programs will improve its baseline condition in the action area and range-wide. Weapons restrictions, fuels management, fire suppression, invasive species control, expedited and full stabilization actions over the next 30 years will increase the distribution and abundance of *D. subcordata.* Four population units, including three outside the action area that are not vulnerable to training-related wildland fires, will be stabilized over the long term. Achieving the criteria for expedited stabilization will improve the likelihood that *D. subcordata* will attain full stabilization and enhance this species probability of persistence over the long-term.

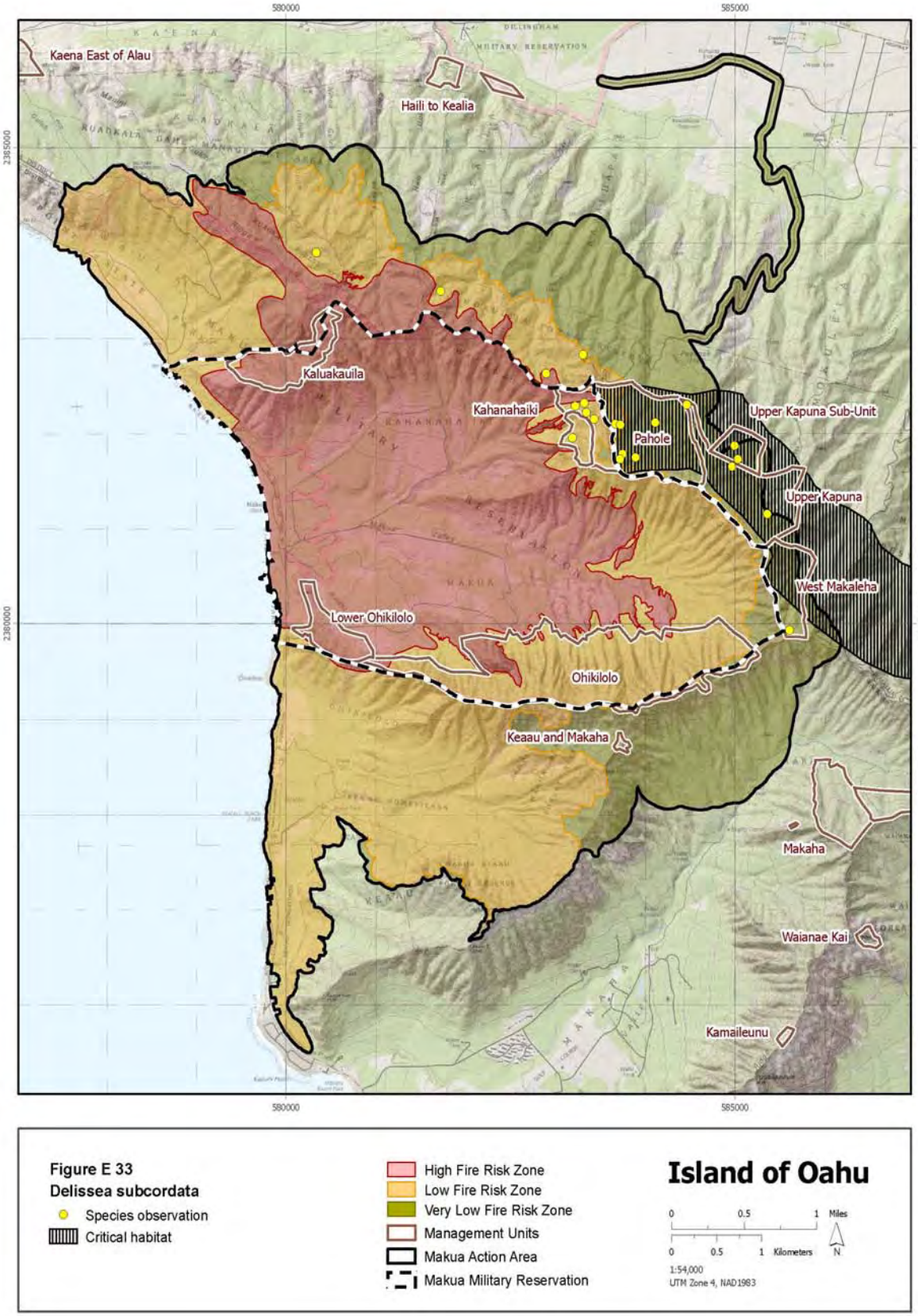
**Effects of the Action on *Delissea subcordata* Critical Habitat**

Twelve percent (187 ha; 462 ac) of the critical habitat for *Delissea subcordata* is located in one unit within the Makua action area. The vast majority of the critical habitat is located in the low fire zones, with 13.03 ha (32.19 ac) in the low fire risk zone and 173.49 ha (428.71 ac) in the very low zone in the northeastern portion of the action area (see Figure E 33). This portion of the critical habitat, together with 577 ha (1,425 ac) outside the action area, was designated to provide habitat for the conservation of four populations, each with a minimum of 300 reproducing individuals of *D. subcordata* (68 FR 35950). The primary constituent elements essential for this species include, but are not limited to, moderate to steep gulch slopes in mixed mesic forest (68 FR 35950). The primary constituent elements that may be affected by a training-related fire include those associated native plant species found within a mixed mesic forest community on Oahu. It is estimated that more than one-half of the critical habitat is located in forest habitat with greater than 50 percent native plant cover, indicating some habitat degradation has occurred (K. Kawelo, pers. comm. 2004).

Approximately 84 percent (156 ha; 385 ac) of the critical habitat in the action area is found within management units (Kahanahaiki, Pahole, Upper Kapuna, Upper Kapuna Sub-Unit, West Makaleha). Due to locations and similarities of potential effects from training, please see the discussion for *Schiedea obovata*. The remaining critical habitat outside the management units (31 ha; approx. 77 ac) is separated from the impact area by low fire risk areas and by the above-mentioned management units themselves.

Conclusion

The critical habitat unit for *Delissea subcordata* in the Makua action area is almost entirely within the low fire risk area. Only 0.24 ha (0.6 ac), or less than one percent, is within the high fire risk area, and this portion is entirely within management units. Implementation of all fire suppression measures incorporated into this action and the Army's standard operating procedures will reduce the likelihood that a fire will ignite and travel outside the firebreak road or that a misfired round will ignite outside of the firebreak road. The risk of fire will be reduced due to the construction of a fuel modification zone between the impact area and the Kahanahaiki Management Unit. In addition, fuel reduction within the management units will further buffer the critical habitat from fire. The critical habitat within Pahole, West, East and Central Makaleha, and Upper Kapuna and Upper Kapuna Sub-Unit management units will be managed to improve its baseline quality, pursuant to the Makua Implementation Plan. Without this management, this critical habitat would eventually lose most of the elements essential to the survival and recovery of the species because of the ongoing threats to this habitat (e.g., ungulates and non-native plant encroachment). We considered this continued degradation of *D. subcordata* critical habitat in the evaluation of the effects of the proposed action. Most importantly, even though there may be a temporal loss of vegetation due to a fire, the restoration of these areas by the Army will provide habitat essential for the conservation of *D. subcordata* and allow for the long-term recovery goals of this species. Therefore, training-related fire events will not result in adverse modification of critical habitat for *D. subcordata*.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Upper Kapuna
West Makaleha
Lower Ohikilolo
Ohikilolo
Keaau and Makaha
Makaha
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Figure E 33
Delissea subcordata
Species observation
Critical habitat
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Management Units
Makua Action Area
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Island of Oahu
0 0.5 1 Miles
0 0.5 1 Kilometers
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1:54,000
UTM Zone 4, NAD1983

**EFFECTS OF THE ACTION – *Gouania vitifolia* (No Common Name)**

The range-wide status of *Gouania vitifolia* is now limited to about 81 total individuals, including 79 individuals on Oahu and only two known individuals on the island of Hawaii. The action area contains 77 individuals, or 95 percent of all remaining *Gouania vitifolia* range-wide (Figure E 34). Plants tend to occur in patches that likely consist of clones of a single or few individuals. Because of these factors, *G. vitifolia* already is in a phase of quasi-extinction with numbers that have declined to the point where demographic or environmental stochasticity alone can result in extirpation from the wild. We infer from these circumstances, conservation biology principles, and examples from other species that *G. vitifolia* has a very high background extinction, and any additional threats associated with training-related wildland fire could eliminate expectation of its long-term persistence. As a short-lived perennial, however, a stable population unit probably requires at least 50 mature, reproducing individuals. The Keaau population unit in the action area thus can be considered numerically stable, but threats are not controlled. *Gouania vitifolia* is an expedited stabilization species due to the low numbers and extreme risk of extinction.

Species Response to the Proposed Action

Over the next 30 years, *Gouania vitifolia* individuals in the Keaau population unit will be exposed to the direct and indirect effects of training-related wildland fire in the low fire risk zone. As a woody vine, all individuals and life stages are vulnerable to the risk of high and low severity wildland fires. The Keaau population unit of *Gouania vitifolia* is located on State-owned lands and currently this area is not fenced nor controlled for weeds. The surrounding dry habitat dominated by alien grasses facilitates the spread of fire. However, no long-range weaponry will be used until expedited stabilization thresholds are achieved for all stabilization population units. Expedited stabilization will involve fencing and maintenance of reduced grass fuel loads in the Keaau population unit inside the action area. Outside the action area, two other population units must be designated for stabilization, including habitat protection and augmentation of the Waianae Kai population unit; and establishment by reintroduction of a third population unit in an area to be identified by the Army and approved by the Service. Stabilization of *G. vitifolia* will depend on developing propagation and outplanting techniques for augmentation and reintroduction.

Despite the ongoing exposure of *Gouania vitifolia* to project wildland fire impacts, Army conservation and stewardship programs will improve its baseline condition in the action area and range-wide. Weapons restrictions, fuels management, fire suppression, invasive species control, and expedited stabilization actions over the next 30 years will benefit the species and increase population numbers of *G. vitifolia*. Full stabilization includes three population units, with two units outside the action area that will not be vulnerable to training-related wildland fire. Thus, the overall effect of the proposed action's stressors and subsidies will result in a net increase in baseline numbers, distribution, and reproduction of *G. vitifolia* in and adjacent to the action area. Reaching expedited stabilization will improve the likelihood that *G. vitifolia* will attain full stabilization and enhance its probability of persistence over the long term.

*Gouania vitifolia* in the action area also will be exposed to the direct and indirect impacts of non-native ungulates and weeds, especially grasses. The direct and indirect effects of non-native

weeds and invertebrates will reduce the vigor, reproduction, recruitment, and survival of individual plants. Habitat management measures such as fencing, weed control, and rat baiting will offset the detrimental effects of these stressors.

Conclusion

Despite the ongoing exposure of *Gouania vitifolia* to project wildland fire impacts, Army conservation and stewardship programs will improve its baseline condition in the action area and range-wide. Weapons restrictions, fuels management, fire suppression, invasive species control, expedited and eventually full stabilization actions over the next 30 years will increase population numbers of *G. vitifolia* in three population units, including two outside the action area that will not be vulnerable to training-related wildland fire. Thus, the overall effect of the proposed action's stressors and subsidies will result in a net increase in baseline numbers, distribution, and reproduction of *G. vitifolia* in and adjacent to the action area. Reaching expedited stabilization will improve the likelihood that *G. vitifolia* will attain full stabilization and enhance its probability of persistence over the long term. Therefore, based on our analysis of the effects of the actions outlined in the Project Description, including training-related fire minimization measures, the Service concludes that the risks associated with the Army's proposed action are outweighed by the long-term benefits of the Army's stabilization actions and ecosystem management.

**Effects of the Action on *Gouania vitifolia* Critical Habitat**

There are four critical habitat units for *Gouania vitifolia* within the Makua action area. These four units represent three percent (84.2 ha; 208 ac) of the total State-wide critical habitat for this species. Three of the four units are located in the high fire risk area and were designated to provide habitat for the conservation of three populations of *G. vitifolia* (see Figure E 34). To meet recovery goals, each population of *G. vitifolia* would be comprised of at least 300 reproducing individuals of (68 FR 35950). The primary constituent elements essential for this species include, but are not limited to, sides of ridges or gulches in dry to mesic forests. The primary constituent elements that may be affected by a training-related fire include those associated native plant species found within dry to mesic forests. It is estimated that close to 90 percent of the critical habitat is located in areas with less than 25 percent native plant vegetation (K. Kawelo pers. comm. 2004; 68 FR 35950). This indicates that these critical habitat units are degraded due to non-native plant encroachment. Critical habitat units A, B, and G are currently unoccupied. Unit H contains a population of this species. Units A and B, together, provide a portion of the habitat necessary for the establishment of an additional population of *G. vitifolia*, while unit G, alone, also provides a portion of habitat for the establishment of one population, in order to meet recovery goals for this species. Critical habitat unit H, in combination with the adjacent 42 ha (104 ac) of designated habitat outside the action area, provides habitat necessary for the expansion of the current population. Critical habitat unit B has been impacted by past fire events that have diminished the conservation value of this habitat. Fire removes the vegetative primary constituent elements. Non-native plant species subsequently outcompete the native plants so that natural recruitment is precluded. In the absence of habitat management, additional fires resulting

from future training actions could add to the degradation of this critical habitat unit by removing the remaining vegetative primary constituent elements.

Critical habitat unit A (20 ha; 49 ac) is north of the Kaluakauila Management Unit (see Figure 25). This critical habitat unit is approximately 1.5 km (1 mi) from the impact area, and the risk of fire in this xeric grassland habitat is high. The surrounding vegetation is dominated by *Panicum maximum*, which is highly flammable and can increase the frequency and size of wildland fires (Beavers et al 1999). The 2003 prescribed burn encroached within 0.4 km (0.25 mi) of the critical habitat (G. Enriques, pers. comm. 2003).

Critical habitat unit B (0.01 ha; 0.02 ac) is within the Kaluakauila Management Unit and is approximately 1.2 km (0.7 mi) from the impact area. As described above, the risk of fire in this xeric grassland habitat is high. The 2003 prescribed burn impacted a portion of this critical habitat unit (G. Enriques, pers. comm. 2003). The consequence of this fire event is the encroachment of non-native grasses that provide flammable fuel and increase the potential for fires in the future. The loss of vegetative primary constituent elements within units A and B would remove their ability to provide a portion of the habitat necessary for one population of *Gouania vitifolia*. The Army will prepare a fire management plan for the Kaluakauila Management Unit and implement several fire abatement measures within and around this management unit (described above). These measures will help reduce the probability that critical habitat units A and B will burn. In addition, this management unit is currently fenced and fuel modification is being conducted to reduce the risk of fire in this area.

Critical habitat unit G (0.03 ha; 0.08 ac) is within the Lower Ohikilolo Management Unit and is approximately 0.3 km (0.2 mi) from the impact area. There is a high risk of fire in this xeric grassland habitat, and, in 2003 a prescribed burn impacted the lower portions of the management unit. Following the fire, the encroachment of non-native grasses provides more flammable fuel and increases the potential for fires in the future. The loss of vegetative primary constituent elements in this critical habitat unit would remove its ability to provide a portion of habitat for one population of *Gouania vitifolia*. Presently fuel modification is being conducted along the ridgeline between the management unit and the installation boundary to reduce the risk of fire in this area. The Army is reducing non-native plants in the Lower Ohikilolo Management Unit and controlling goats and pigs, pursuant to the Makua Implementation Plan. These actions will decrease the risk of fire within the management unit by reducing the fuel load in the area. In addition, a fuel management plan will be prepared and implemented to address fuel modification along the northern portion of this management unit. These actions will further reduce the risk of wildland fire from encroaching into the management unit.

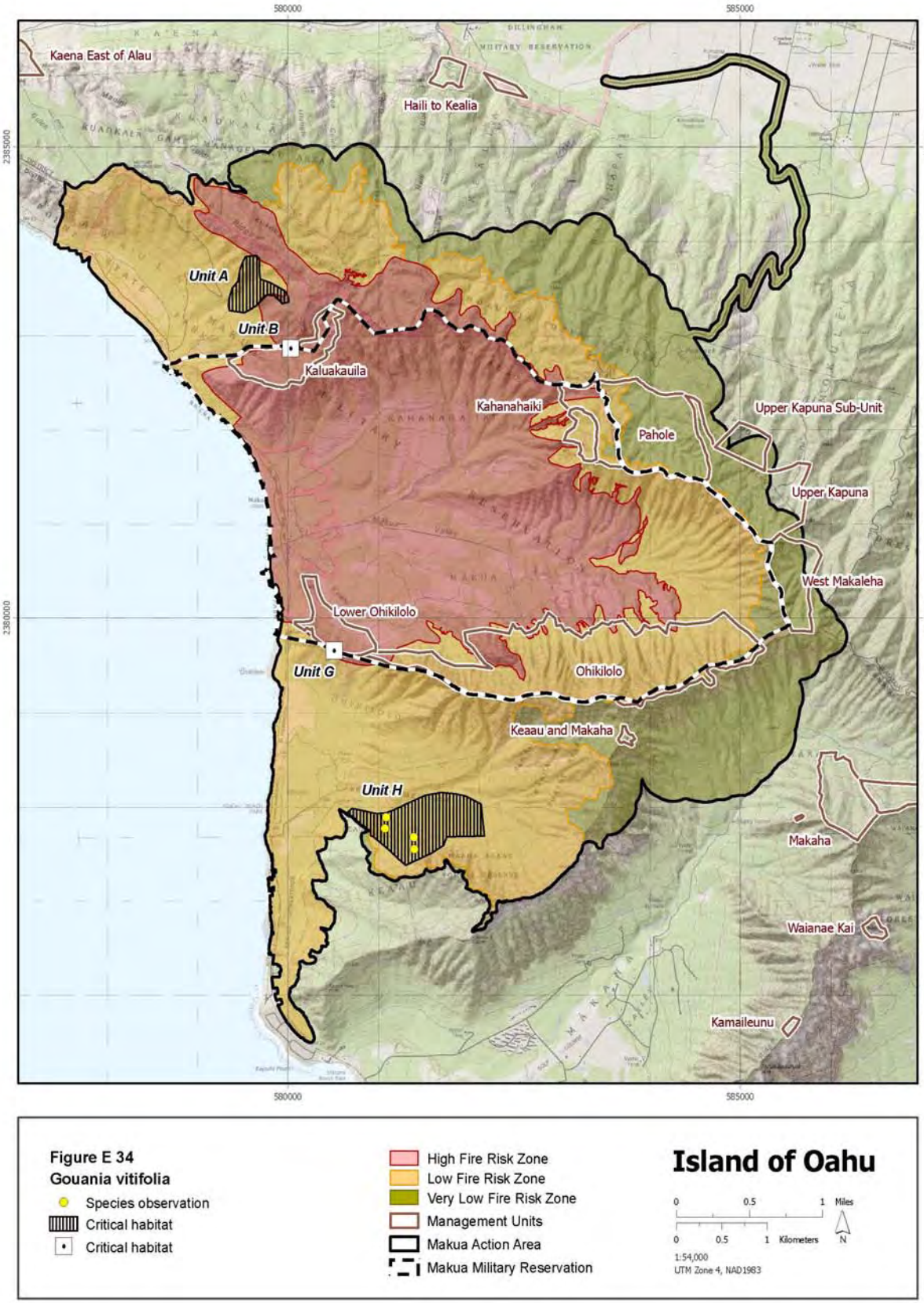
Critical habitat unit H (22 ha; 54 ac) is in the southwestern portion of the Makua action area. This critical habitat is approximately 1.8 km (1 mi) from the impact area and the risk of fire in this xeric grassland habitat is high. The loss of the primary constituent elements of this unit would remove its ability, in combination with the adjacent 42 ha (104 ac) of designated habitat outside the action area, to provide habitat for one population of *Gouania vitifolia*. Critical habitat unit H does not overlap with a management unit. The critical habitat is separated from the impact area by the Lower Ohikilolo and Ohikilolo management units, which buffer it from fires ignited in the impact area. In both of these management units, the Army is working to

reduce the amount of non-native plants, pursuant to the objectives in the Makua Implementation Plan. This action will decrease the risk of fire within the management units by reducing fuel load. In addition, a fuel management plan for the Lower Ohikilolo Management Unit will be prepared and implemented to address fuel modification for this management unit. These actions will further reduce the risk of wildland fire from encroaching into the management unit.

To reduce the negative impacts to critical habitat from any fire that escapes the firebreak road, the Army has committed to revegetate burned areas with native plant species to restore the area to pre-burn conditions. The revegetation plan will address restoration of burned areas by replanting native plant species (primary constituent elements) and controlling non-native, competitive plant species. While there may be a temporal loss of the conservation value of these critical habitat units during the revegetation process, the ability of these units to provide habitat essential for the conservation of three populations of *Gouania vitifolia* will be retained in the long-term.

Conclusion

Three of the four critical habitat units for *Gouania vitifolia* in the Makua action area are located in the high fire risk area. Implementation of all fire suppression measures incorporated into this action and the Army's standard operating procedures will reduce the likelihood that a fire will ignite and travel outside of the firebreak road or that a misfired round will ignite outside of the firebreak road. The risk of fire will be reduced due to the construction of fuel modification zones between the impact area and the Kaluakauila and Lower Ohikilolo management units. In addition, fuel reduction within the management units will further buffer the critical habitat from fire. The critical habitat that is within the Kaluakauila and Lower Ohikilolo management units will be managed to improve its baseline quality pursuant to the Makua Implementation Plan. Without this management, the critical habitat units would eventually lose most of the elements essential to the survival and recovery of the species because of the ongoing threats to this habitat (e.g., ungulates and non-native plant encroachment). We considered this continued degradation of *G. vitifolia* critical habitat in the evaluation of the effects of the proposed action. Most importantly, even though there may be a temporal loss of vegetation due to a fire, the restoration of these areas by the Army will provide habitat essential for the conservation of *G. vitifolia* and allow for the long-term recovery goals of this species. Therefore, training-related fire events will not result in adverse modification of critical habitat for *G. vitifolia*.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**EFFECTS OF THE ACTION – *Hibiscus brackenridgei* ssp. *mokuleianus* (Mao hau hele)**

The range-wide status of *Hibiscus brackenridgei* ssp. *mokuleianus* is now limited to 669 total mature and immature individuals *in situ*. This subspecies is characterized by five *in situ* population units which contain fewer than 20 mature individuals each. Sixteen mature plants (accounting for 33 percent of all *in situ* mature individuals) and four additional immature plants, (accounting for 2 percent of all known *in situ Hibiscus brackenridgei* ssp. *mokuleianus*) grow in the Makua action area (Figure E 35). An experimental outplanting site, containing 35 additional plants, is located in the Kaluakauila Management Unit (U.S. Army Garrison 2006c). Throughout its range, this species grows in dry, low elevation sites, within or adjacent to previously burned areas dominated by invasive exotic grass (Beavers 2007a). Because of its low numbers and high range-wide fire, weed, and ungulate threats, *H. brackenridgei* ssp. *mokuleianus* already is in a phase of quasi-extinction with numbers that have declined to the point where demographic or environmental stochasticity can result in extirpation. We infer from these circumstances, conservation biology principles, and examples from other species that *H. brackenridgei* ssp. *mokuleianus* has a very high background extinction risk in the action area and range-wide, and any additional threats associated with training-related wildland fire could eliminate expectation of its long-term persistence. Because of its limited population status, restricted distribution, high percentage of individuals in the action area, and risk of training-related wildland fire, this species has been identified as an at risk species. *Hibiscus brackenridgei* ssp. *mokuleianus* was identified as an expedited stabilization species as a conservation measure to protect this taxon from extinction while full stabilization measures are being implemented.

Species Response to the Proposed Action

The proposed action of increased Army training with long-range, incendiary weapons could result in injury and death of *Hibiscus brackenridgei* ssp. *mokuleianus* individuals in the Makua (*in situ*) and Kaluakauila (reintroduced experimental) population units. *Hibiscus brackenridgei* ssp. *mokuleianus* in the action area also will be exposed to the direct and indirect impacts of non-native plants, particularly alien grass which spreads as a result of wildland fires (see General Effects). Twenty plants in the Makua population unit, located in the Lower Ohikilolo Management Unit and the 35 experimental plants growing in the Kaluakauila Management Unit occur in the high fire risk zone in the action area without the fire risk minimization measures proposed by the Army. These plants could to be burned by fires resulting from live-fire training and by fires started by the public outside the installation.

Army Natural Resources Staff keep all grass cleared from within 2 m (7 ft) of the 20 *Hibiscus brackenridgei* ssp. *mokuleianus* plants in Lower Ohikilolo Management Unit. No live-fire or blank-fire training will take place at Makua when grass cover in the Ohikilolo Management Unit weed control areas is greater than 20 percent (see Figure PD 6). New weapons restrictions, improved grass mowing around the interior of the south lobe of the firebreak road, and improved fire suppression staffing requirements minimize the risk that fires will escape containment by initial attack fire suppression resources, particularly prior to implementation of Column C weapons restrictions (see Table PD 2). Prior to implementation of Column C weapons restrictions, which permit the use of weapons that are more likely to ignite fires outside the firebreak road, a fuelbreak and firebreak will be established to minimize fire risk to the 35

experimental *H. brackenridgei* ssp. *mokuleianus* plants in the Kaluakauila Management Unit (see Project Description Section 3.1.4.2). In the event that a fire threatens this site, the fuel treatments installed along the edge of the forested areas of the Kaluakauila Management Unit will provide firefighters, including red-carded Army Natural Resources Staff and fire suppression helicopters, a high likelihood of successfully preventing fire from burning additional forest in this area. No 2.75-caliber rockets, or Javelin or TOW missiles will be used until expedited stabilization thresholds are achieved for all four stabilization population units of this species.

The potential damage to or loss of *Hibiscus brackenridgei* ssp. *mokuleianus* individuals due to wildland fires associated with live-fire training will be offset by ongoing efforts by the Army to complete stabilization actions for this species pursuant to the Makua Implementation Plan Addendum. Stabilization actions including outplanting, ungulate control, off-site Army fire suppression assistance, and genetic storage are likely to result in increased probability that this species will persist. Four population units will be managed for stability because of the extreme fire threat to this taxon, and because a large part of the stabilization relies on reintroductions of these species into unoccupied areas. The fourth population unit will be reintroduced in the Keaau portion of the action area. In addition, a replacement population unit may be identified for the Kaimuhole and Palikea Gulch site, which is on private land that is not currently accessible for large scale conservation actions (U.S. Army Garrison 2006c). *Hibiscus brackenridgei* ssp. *mokuleianus* is successfully propagated from cuttings and many plants can be quickly propagated. The high risk of fire to the Haili to Kawaiu, Kaimuhole and Palikea Gulch, and Keaau population units will be minimized by proposed Army wildland fire suppression assistance to the City and County Fire Department, until these populations can be protected with permanent fuels treatments or until the phenotypes are fully represented in replacement sites (Beavers 2007a).

Conclusion

Despite the ongoing exposure of *Hibiscus brackenridgei* ssp. *mokuleianus* to the project's potential wildland fire impacts, Army conservation and stewardship programs will improve its baseline condition in the action area and range-wide. Weapons restrictions, fuels management, fire suppression, invasive species control, and expedited stabilization actions over the next 30 years will increase baseline numbers of *H. brackenridgei* ssp. *mokuleianus* to expedited stabilization thresholds in four population units, including two outside the action area that will not be vulnerable to training-related wildland fire. Thus, the overall effect of the proposed action's stressors and subsidies will result in a net increase in baseline numbers, distribution, and reproduction of *H. brackenridgei* ssp. *mokuleianus* in the action area and range-wide. Reaching expedited stabilization will improve the likelihood that *H. brackenridgei* ssp. *mokuleianus* will attain full stabilization and enhance its probability of persistence over the long term. Based on our analysis of the effects of the actions outlined in the Project Description including fire minimization measures, the Service believes that the risks associated with the Army's proposed action are outweighed by the long-term benefits of the Army's stabilization actions and ecosystem management.

**Effects of the Action on *Hibiscus brackenridgei* var. *mokuleianus* Critical Habitat**

Less than one percent (0 ha; 0.1 ac) of the total critical habitat for *Hibiscus brackenridgei* var. *mokuleianus* is found in one unit within the Makua action area (see Figure E 35). The critical habitat is located entirely within the high fire risk area. The critical habitat unit provides the primary constituent elements that are essential for the conservation of a portion of one population of at least 300 mature, reproducing individuals in order to meet the recovery goals for *H. brackenridgei* var. *mokuleianus*. The primary constituent elements essential for this species include, but are not limited to, dry shrublands (68 FR 35950). The primary constituent elements that may be affected by a training-related fire include those associated native plant species found within a dry shrubland community. It is estimated that all of the critical habitat is located in an area with less than 25 percent native plant cover, indicating that this unit is predominantly characterized by non-native vegetation (K. Kawelo, pers. comm. 2004; 68 FR 35950). Currently unoccupied, this critical habitat unit provides a portion of the habitat necessary for the conservation of one population of *H. brackenridgei*. Portions of this critical habitat may have been impacted by past fire events, which diminishes the conservation value of the habitat by removing the vegetative primary constituent elements. Non-native plant species subsequently outcompete the native plants so that natural recruitment is precluded. In the absence of habitat management, additional fires resulting from future training actions could add to the degradation of this critical habitat unit by removing the remaining vegetative primary constituent elements.

The critical habitat unit is approximately 0.4 km (0.2 mi) from the fire source, and there is a high risk that a fire started in the impact area could move south and impact this unit. The loss of vegetative primary constituent elements within this unit would remove its ability to provide for the conservation of a portion of one population of *Hibiscus brackenridgei* var. *mokuleianus*. Currently, the Army conducts fuel modification in the immediate habitat area of the *H. brackenridgei* var. *mokuleianus* plants, which will enhance the conservation value of the critical habitat and reduce the risk of fire in this critical habitat unit. In addition, the Army is preparing a wildland fire management plan for the Lower Ohikilolo Management Unit. Implementation of this plan may reduce the risk of fire to *H. brackenridgei* var. *mokuleianus* critical habitat due to construction of a fuel modification zone between the impact area and the adjacent Lower Ohikilolo Management Unit.

To reduce the negative impacts to this critical habitat unit from any fire that escapes the firebreak road, the Army has committed to revegetate burned areas with native plant species to restore the area to pre-burn conditions. The revegetation plan will address restoration of burned areas by replanting native plant species (primary constituent elements) and controlling non-native, competitive plant species. While there may be a temporal loss of the conservation value of the critical habitat unit during the revegetation process, the ability of this unit to provide a portion of the habitat essential for the conservation of one population of *Hibiscus brackenridgei* var. *mokuleianus* will be retained in the long term.

<u>Conclusion</u>

Less than one percent of the total State-wide critical habitat for *Hibiscus brackenridgei* var. *mokuleianus* is located within the Makua action area and is entirely within the high fire risk area.

Implementation of all fire suppression measures incorporated into this action and the Army's standard operating procedures will reduce the likelihood that a fire will ignite and travel outside the firebreak road or that a misfired round will ignite outside of the firebreak road. The risk of fire will be reduced due to fuel modification currently being implemented in the immediate habitat area of the *H. brackenridgei* plants themselves. Fuel modification will enhance the conservation value of the critical habitat and reduce the risk of fire in this critical habitat unit. In addition, the Army is preparing a wildland fire management plan for the Lower Ohikilolo Management Unit. Implementation of this plan may reduce the risk of fire to *H. brackenridgei* var. *mokuleianus* critical habitat due to construction of a fuel modification zone between the impact area and the adjacent Lower Ohikilolo Management Unit. Without this management, this critical habitat unit would eventually lose most of the elements essential to the survival and recovery of the species because of the ongoing threats to this habitat (e.g., ungulates and non-native plant encroachment). We considered this continued degradation of *H. brackenridgei* var. *mokuleianus* critical habitat in the evaluation of the affect of the proposed action. Most importantly, even though there may be a temporal loss of vegetation due to a fire, the restoration of this area by the Army will provide habitat essential for the conservation of *H. brackenridgei* var. *mokuleianus* and allow for the long-term recovery goals of this species. Therefore, training-related fire events will not result in adverse modification of critical habitat for *H. brackenridgei* var. *mokuleianus*.

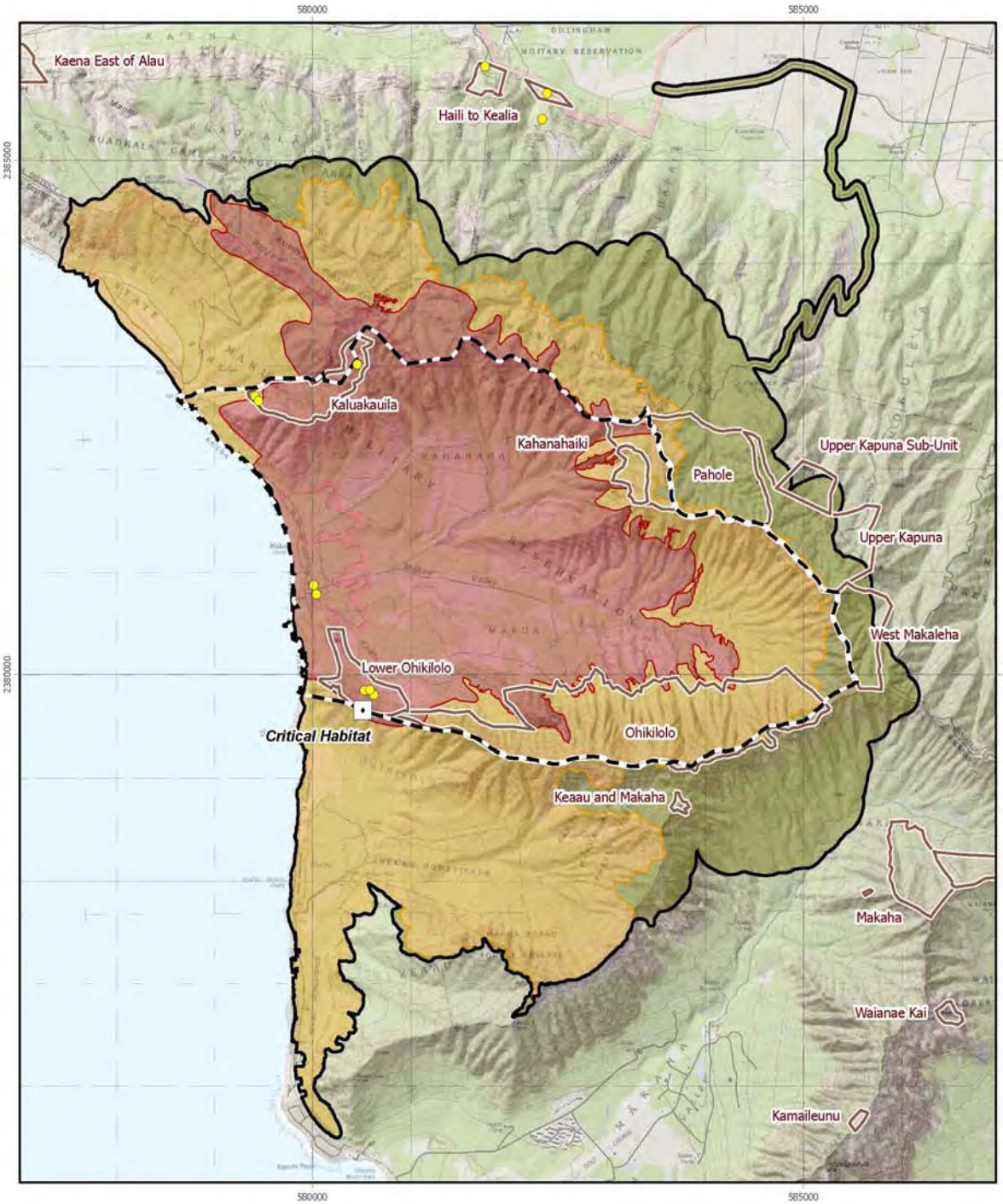



**Figure E 35**
**Hibiscus brackenridgei mokuleianus**

- Species observation
- Critical habitat

- High Fire Risk Zone
- Low Fire Risk Zone
- Very Low Fire Risk Zone
- Management Units
- Makua Action Area
- Makua Military Reservation

**Island of Oahu**

0 0.5 1 Miles
0 0.5 1 Kilometers
N

1:54,000
UTM Zone 4, NAD1983

**EFFECTS OF THE ACTION – *Neraudia angulata* (No Common Name)**

There are approximately 130 individuals of *Neraudia angulata* (Waianae endemic) located in the Makua action area. All individuals area located in the Kaluakauila and Ohikilolo management units in the high fire risk zone (30 individuals), and in the low fire risk zone (100 individuals) (Figure E 36). Stabilization goals established for this species include four populations of 100 mature, reproducing individuals, with all threats abated.

The action area contains about 30 percent of all remaining *Neraudia angulata* individuals and about 33 percent of all mature individuals, which is more than the total number of individuals required to meet the criteria for classification as an at-risk taxa. However, the Army agreed to include this species in its expedited stabilization efforts due to the vulnerability of Kaluakauila to training-related fires. The Army Natural Resources Staff have used this management unit as an augmentation site for this species. *Neraudia angulata* may be in a phase of quasi-extinction because numbers have declined to the point where demographic or environmental stochasticity alone can result in extirpation (see General Effects – Small Population Size). We infer from these circumstances, conservation biology principles, and examples from other species that *N. angulata* has a very high background extinction risk in the action area and range-wide, and any additional threats associated with training-related wildland fire are likely to eliminate expectation of its long-term persistence. Additionally, the apparent increase in abundance of *N. angulata* is due primarily to discovery of new individuals and augmentation (see Status and Baseline).

Species Response to the Proposed Action

Over the next 30 years, *Neraudia angulata* individuals in the Kaluakauila, Makua, and Punapohaku population units may be exposed to the direct and indirect effects of training-related wildland fire in the high and low fire risk zones. As a shrub of forest and open settings, all individuals and life stages are vulnerable to the risk of high and low severity wildland fires. The 30 *N. angulata* plants in the high fire risk zone are very susceptible to training-related wildland fires. The Kaluakauila Management Unit is located in a xeric area surrounded by flammable grasses and shrubs established from historic fires, and therefore, *N. angulata* individuals are at high risk of burning in future training-related wildland fires. The majority of these plants reside is a small 24.3 ha (60 ac) remnant forest that has protected them to date. However, as fires sweep through the area the forest edge is continually impacted and edge habitat is lost as described in the General Effects – Fire Suppression. To minimize the fire risk to this species and the Kaluakauila Management Unit, a 20-m wide (66-ft wide) fuelbreak, with its imbedded firebreak, adjacent to the forested areas will provide firefighters, including red-carded Army Natural Resources Staff and fire suppression helicopters, a high likelihood of successfully preventing fire from burning additional forest in this area.

The 100 or so *Neraudia angulata* located on Ohikilolo Ridge (see Figure E 36) are also at risk from fire spread into Ohikilolo Ridge from the valley floor, or ignition on the ridge from a misfired long-range, live-fire weapon such as the TOW, or from a spot fire resulting from an intense grass fire and high winds in the valley. However, fire detection and suppression response is designed to prevent a fire ignited by misfired weapons landing in forest and shrub areas from burning more than 0.1 ha (0.3 ac). Since the vegetation is on the cliff face of Ohikilolo is sparse

the risk of a large fire is low if fire suppression is quickly deployed (see General Effects - Fire Suppression).

To further reduce the risk to all *Neraudia angulata* individuals, certain weapons systems and munitions will be restricted until fire protection fuelbreaks are in place and expedited stabilization thresholds are achieved. No long-range weaponry will be used until expedited stabilization goals are met for all stabilization population units. In the action area, expedited stabilization actions will involve continued augmentation of *N. angulata* in the Makua population unit and reintroduction in the Kaluakauila population unit. Outside the action area, the Manuwai and Waianae Kai Mauka population units will be protected by future fence exclosures. Four population units will be managed as stabilization population units in order to represent the full, genetic, geographical and morphological complement of this species.

*Neraudia angulata* in the action area also will be exposed to the direct and indirect impacts of non-native ungulates and weeds. The direct and indirect effects of non-native weeds and invertebrates will reduce the vigor, reproduction, recruitment, and survival of individual plants. The Makua and Kaluakauila population units are being managed as stabilization populations within the action area and are located within the fenced Ohikilolo and Kaluakauila management units, respectively, and are partially controlled for weeds.

Conclusion

Despite the ongoing exposure of *Neraudia angulata* to project wildland fire impacts, Army conservation and stewardship programs will increase the baseline number of individuals. Weapons restrictions, fuels management, fire suppression, invasive species control, and expedited stabilization actions over the next 30 years will increase the numbers of *N. angulata* to meet the targets established for expedited stabilization. These goals include two population units outside the action area not vulnerable to training-related wildland fire. Reaching expedited stabilization goals will improve the likelihood that *N. angulata* will meet the criteria of full stabilization and enhance its probability of persistence over the long term. Therefore, based on our analysis of the effects of the actions outlined in the Project Description including fire minimization measures, the Service believes that the risks associated with the Army's proposed action are outweighed by the long-term benefits of the Army's stabilization actions and ecosystem management.

**Effects of the Action on *Neraudia angulata* Critical Habitat**

There are two critical habitat units within the Makua action area, comprising one percent, 6 ha (15 ac), of the total State-wide critical habitat for *Neraudia angulata* (see Figure E 36). All units are located within the high fire risk area. Critical habitat unit A, currently unoccupied, was designated to provide a portion of the habitat necessary for the conservation of one population of *N. angulata* in order to meet recovery goals for this species. Although degraded, unit B still supports individuals of *N. angulata* and provides habitat that is necessary for the expansion of this population. Each population will be comprised of at least 300 mature, reproducing individuals of *N. angulata* (68 FR 35950). The primary constituent elements that are essential for this species include, but are not limited to, slopes, ledges, or gulches in lowland mesic or dry

forest. The primary constituent elements that may be affected by a training-related fire include those associated native plant species found within lowland dry or mesic forest. It is estimated that more than one-half of the critical habitat in the action area is predominantly non-native vegetation (K. Kawelo pers. comm. 2004; 68 FR 35950). This indicates that these critical habitat units are currently degraded due to non-native plant encroachment.

Portions of critical habitat unit A have been impacted by past fire events that diminish the conservation value of this habitat. The loss of the vegetative primary constituent elements from fire and the subsequent invasion by non-native plant species precludes natural recruitment. In the absence of habitat management, fires resulting from future training actions could contribute to the degradation of these critical habitat units.

Critical habitat unit A is 2 hectares (5 ac) and is entirely within the Kaluakauila Management Unit within the high fire risk area (see Figure E 36). Due to the close proximity of this unit to the fire source, there is a risk that if a fire started in the impact area, it could move north and impact this unit. The risk is increased due to the surrounding vegetation that is dominated by *Panicum maximum* (see Figure PD 2), which is highly flammable and can increase the frequency and size of wildland fires (Beavers et al 1999). The prescribed burn in 2003 encroached into the edge of unit A (G. Enriques, pers. comm. 2003). The consequence of this fire event is the subsequent encroachment of non-native grassland that provides more flammable fuel and increases the potential for fires in the future. The loss of vegetative primary constituent elements of this critical habitat unit would remove its ability to provide a portion of the habitat necessary for the conservation of one population of *Neraudia angulata*. To reduce the fire risk, the Army is preparing a fire management plan for the Kaluakauila Management Unit. Implementation of this plan will reduce the risk of fire due to the construction of a fuel modification zone between the impact area and the management unit. Fuel modification will buffer the Kaluakauila Management Unit from fires that spread outside the impact area and in turn help reduce the probability that critical habitat unit A will burn. In addition, this management unit is currently fenced and the Army is working to reduce non-native plants within the exclosure. The removal of ungulates and non-native invasive plant species within this management unit enhances the conservation value of the critical habitat unit A.

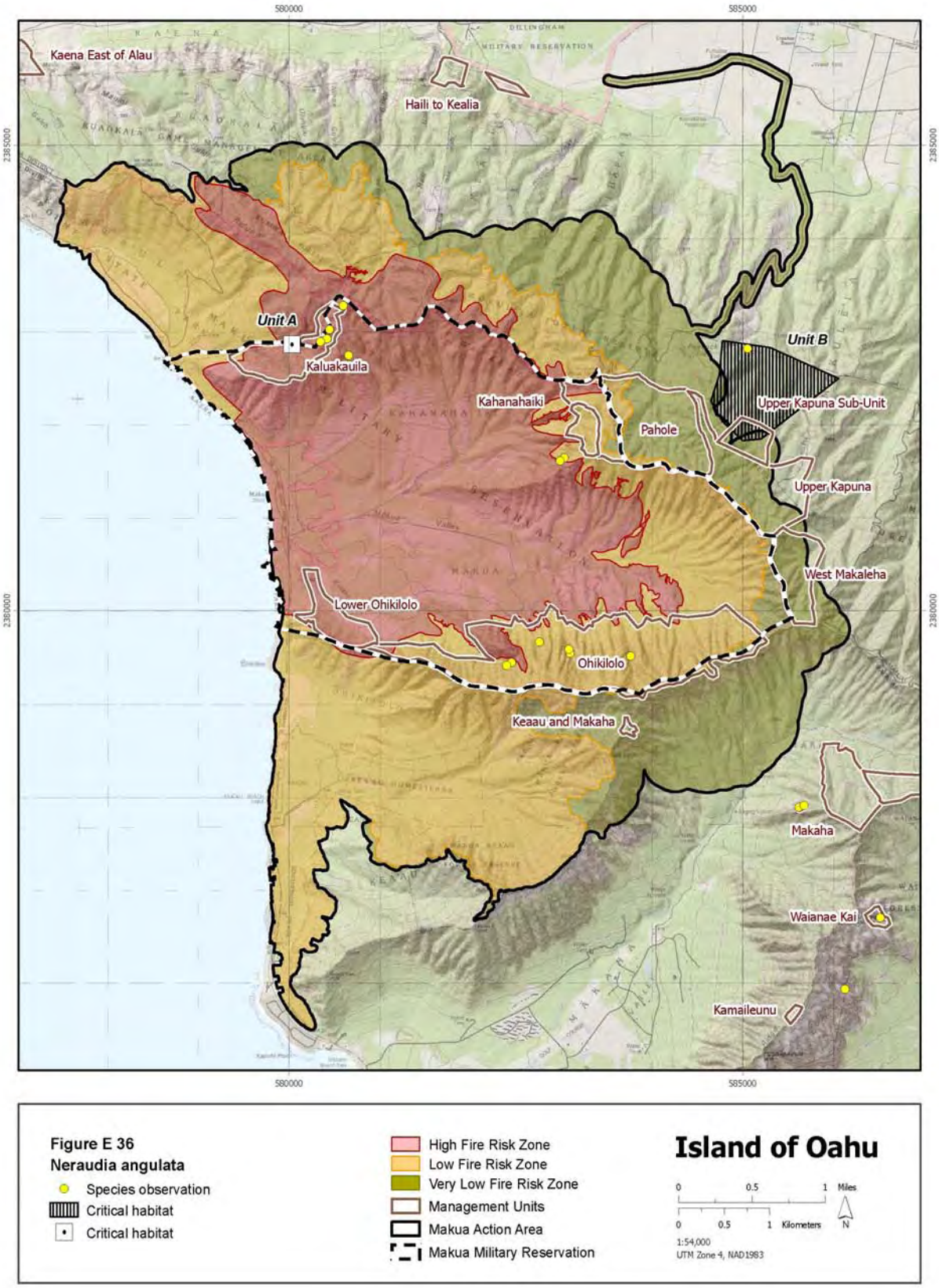
Critical habitat unit B is 90 ha (222 ac) and entirely within a low and very low fire risk area. A small portion of this critical habitat unit extends into the Makua action area. Forty percent, or 36 ha (89 ac), of this unit is located within two management units. Thirty ha (73 ac) are in the Upper Kapuna Sub-unit Management Unit and 6 ha (16 ac) are in the Upper Kapuna Management Unit. The remaining 54 ha (133 ac) of this critical habitat unit is found outside of any management unit. Unit B is approximately 1.3 km (0.8 mi) from the impact area on its eastern end, and there is a risk that a fire started in the impact area could move east and impact this unit. The loss of vegetative primary constituent elements of this unit would remove its ability to provide habitat necessary for the conservation of one population of *Neraudia angulata*. However, the fire risk is decreased due to the surrounding mesic forest vegetation, which is of low flammability and the buffer of surrounding management units, also of low flammability and managed to reduce alien plant species, and, therefore, fuel load (Beavers et al 1999). Pursuant to the Makua Implementation Plan, fuel modification will occur within these management units through the control of alien plant species, some of which are highly flammable. In addition,

these management units will be fenced and the Army will work to reduce non-native plant species within the fenced area. The removal of ungulates and non-native invasive plant species within these management units enhances the conservation value of critical habitat unit B. The remaining critical habitat outside of the management unit is separated from the impact area by the Pahole and the Upper Kapuna, Upper Kapuna Sub-Unit management units. The fuel modification activities, plus other conservation measures implemented by the Army for species stabilization, will further reduce the risk of fire to the portion of the critical habitat outside of the management unit.

To reduce the negative impacts to critical habitat from any fire that escapes the firebreak road, the Army has committed to revegetate burned areas with native plant species to restore the area to pre-burn conditions. The revegetation plan will address restoration of burned areas by replanting native plant species (primary constituent elements) and the control of non-native, competitive plant species. While there may be a temporal loss of the conservation value of these critical habitat units during the revegetation process, their ability to provide habitat essential for the conservation of *Neraudia angulata* will be retained in the long-term.

Conclusion

One hundred percent of the critical habitat units for *Neraudia angulata* in the Makua action area is located in the high fire risk area. Implementation of all fire suppression measures incorporated into this action and the Army's standard operating procedures will reduce the likelihood that a fire will ignite and travel outside of the firebreak road or that a misfired round will ignite outside of the firebreak road. The risk of fire will be reduced for critical habitat unit A due to the construction of a fuel modification zone between the impact area and Kaluakauila Management Unit. In addition, fuel reduction within the management unit will further buffer critical habitat unit A from fire. Fuel reduction within the Upper Kapuna, Upper Kapuna Sub-Unit management units will buffer critical habitat unit B from fire. The critical habitat unit within Kaluakauila Management Unit and the portion of critical habitat unit B that is within Upper Kapuna, Upper Kapuna Sub-Unit management units will be managed to improve their baseline quality, pursuant to the Makua Implementation Plan. Without this management, these critical habitat units would eventually lose most of the elements essential to the survival and recovery of the species because of the ongoing threats to this habitat (e.g., ungulates and non-native plant encroachment). We considered this continued degradation of *N. angulata* critical habitat in the evaluation of the effects of the proposed action. Most importantly, even though there may be a temporal loss of vegetation due to a fire, the restoration of these areas by the Army will provide habitat essential for the conservation of *N. angulata* and allow for the long-term recovery goals of this species. Therefore, training-related fire events will not result in adverse modification of critical habitat.


580000
585000
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Kaena East of Alau
Haili to Kealia
Unit A
Kaluakauila
Unit B
Upper Kapuna Sub-Unit
Kahanahaiki
Pahole
Upper Kapuna
West Makaleha
Lower Ohikilolo
Ohikilolo
Keaau and Makaha
Makaha
Waianae Kai
Kamaileunu
Figure E 36
Neraudia angulata
Species observation
Critical habitat
Critical habitat
High Fire Risk Zone
Low Fire Risk Zone
Very Low Fire Risk Zone
Management Units
Makua Action Area
Makua Military Reservation
Island of Oahu
0 0.5 1 Miles
0 0.5 1 Kilometers
N
1:54,000
UTM Zone 4, NAD1983

**EFFECTS OF THE ACTION – *Phyllostegia kaalaensis* (No Common Name)**

*Phyllostegia kaalaensis* is a short-lived perennial herbaceous plant with no known naturally occurring individuals in existence today. There are only two, reintroduced immature plants, located in the Upper Kapuna Management Unit. The Army Natural Resources Staff reintroduced *P. kaalaensis* at two sites in the Keawapilau to Pahole Population Unit (Figure E 37); however, 45 of the original 47 outplanted individuals perished for unknown reasons. The Army Natural Resources Staff are looking into possible microsite differences and age of greenhouse stock to determine if these factors explain the low success rate for this species (U.S. Army Garrison, 2006c). Eventually there will be four population units for this species defined as 50 mature, reproducing individuals.

*Phyllostegia kaalaensis* is an expedited stabilization species due to the low numbers and extreme risk of extinction; *P. kaalaensis* already is in a phase of quasi-extinction with numbers that have declined to the point where demographic or environmental stochasticity alone can result in extirpation (see General Effects – Small Population Size). We infer from these circumstances, conservation biology principles, and examples from other species that *P. kaalaensis* has a very high background extinction risk in the action area and range-wide, and any additional threats associated with training-related wildland fire are likely to eliminate expectation of its long-term persistence.

Species Response to the Proposed Action

Over the next 30 years, *Phyllostegia kaalaensis* individuals in the Keawapilau to Pahole Population Unit will be exposed to the direct and indirect effects of training-related wildland fire in the very low fire risk zone. However, the risk of extirpation *P. kaalaensis* from a training-related fire is very low due to its location in the mesic forests of Kapuna and distance (2.9 km; 1.8 mi) from the training impact area. We estimate that a misfired weapon landing in forest and shrub areas will burn approximately 0.1 ha (0.3 ac) of forest prior to fire suppression measures extinguishing the fire. Inadequate detection and suppression response could enable these fires to burn more than 40 ha (100 ac) in a 48-hr period. However, to avoid the risk of an undetected fire, the Army will conduct an aerial survey in a helicopter for 1-hour post-training to check for smoke from a misfired round (see General Effects - Fire Suppression).

No long-range weaponry will be used until expedited stabilization thresholds are achieved for all stabilization population units for *Phyllostegia kaalaensis*. Expedited stabilization will involve continued reintroduction and augmentation of all *P. kaalaensis* population units inside and outside of the action area. *Phyllostegia kaalaensis* can be propagated from cuttings, but outplantings have very low survival. Stabilization will depend on developing outplanting techniques and identifying optimum planting site characteristics for this species. The Army will identify a fourth stabilization population unit when successful outplanting techniques have been developed.

Other Risk Reduction Factors

*Phyllostegia kaalaensis* in the action area also will be exposed to the direct and indirect impacts of non-native weeds and pigs. The cause of the extirpation of all naturally occurring individuals of this species is currently unknown; however, the Army Natural Resources Staff are working with the Makua Implementation Team in an attempt to address the problem. Only the Pahole portion of the Keawapilau to Pahole Population Unit is within the fenced Pahole Management Unit; all reintroduction sites are controlled for weeds. Outside the action area, the Makaha and Manuwai population units will be reintroduced in the future after fencing is in place.

Conclusion

Despite the ongoing exposure of *Phyllostegia kaalaensis* to project wildland fire impacts, fire risk to this species is very low, and Army conservation and stewardship programs will improve its baseline condition in the action area and range-wide. In this case, *P. kaalaensis* would be extinct in the wild without all of the stabilization efforts conducted by the Army's Natural Resources Staff. Weapons restrictions, fuels management, fire suppression, invasive species control, and expedited stabilization actions over the next 30 years will increase the number of *P. kaalaensis* in the wild and, therefore, the minimal risk of this species being impacted by a wildland fire is far outweighed by the benefit of its stabilization. Thus, the overall effect of the proposed action's stressors and subsidies will result in a net increase in baseline numbers, distribution, and reproduction of *P. kaalaensis* in and adjacent to the action area. We further believe that this species is unlikely to survive without the Army's expedited and full stabilization efforts.

**Effects of Action on *Phyllostegia kaalaensis* Critical Habitat**

There are two critical habitat units within the Makua action area, representing 13 percent (107 ha; 263 ac) of the total critical habitat for *Phyllostegia kaalaensis*. Critical habitat units A and B are located in the northeastern portion of the action area within the two low fire risk zones with 8.1 ha (20 ac) in the low fire risk area and 98.4 hectares (243 ac) in the very low fire risk area. Critical habitat unit A was designated to provide habitat for the conservation of one population of *P. kaalaensis* (see Figure E 37). The portion of critical habitat unit B inside the action area, together with 348 ha (860 ac) outside the action area, was designated to provide habitat for the conservation of six populations of *P. kaalaensis.* To meet recovery goals, each population should be comprised of at least 300 mature, reproducing individuals for this species (68 FR 35950). The primary constituent elements essential for this species include, but are not limited to, gulch slopes, bottoms, or almost vertical rock faces in mesic forest or *Sapindus oahuensis* forest. The primary constituent elements that may be affected by a training-related fire include those associated native plant species found in mesic forest or *S. oahuensis* forest. It is estimated that almost one-half of the critical habitat is located in areas with predominately non-native vegetation (U.S. Army Garrison 2003b; K. Kawelo, pers. comm. 2004; 68 FR 35950; 68 FR 35950). This indicates that the critical habitat is somewhat degraded due to non-native plant encroachment. In the absence of habitat management, fires from future training actions could add to the degradation of these critical habitat units by removing the remaining vegetative primary constituent elements.

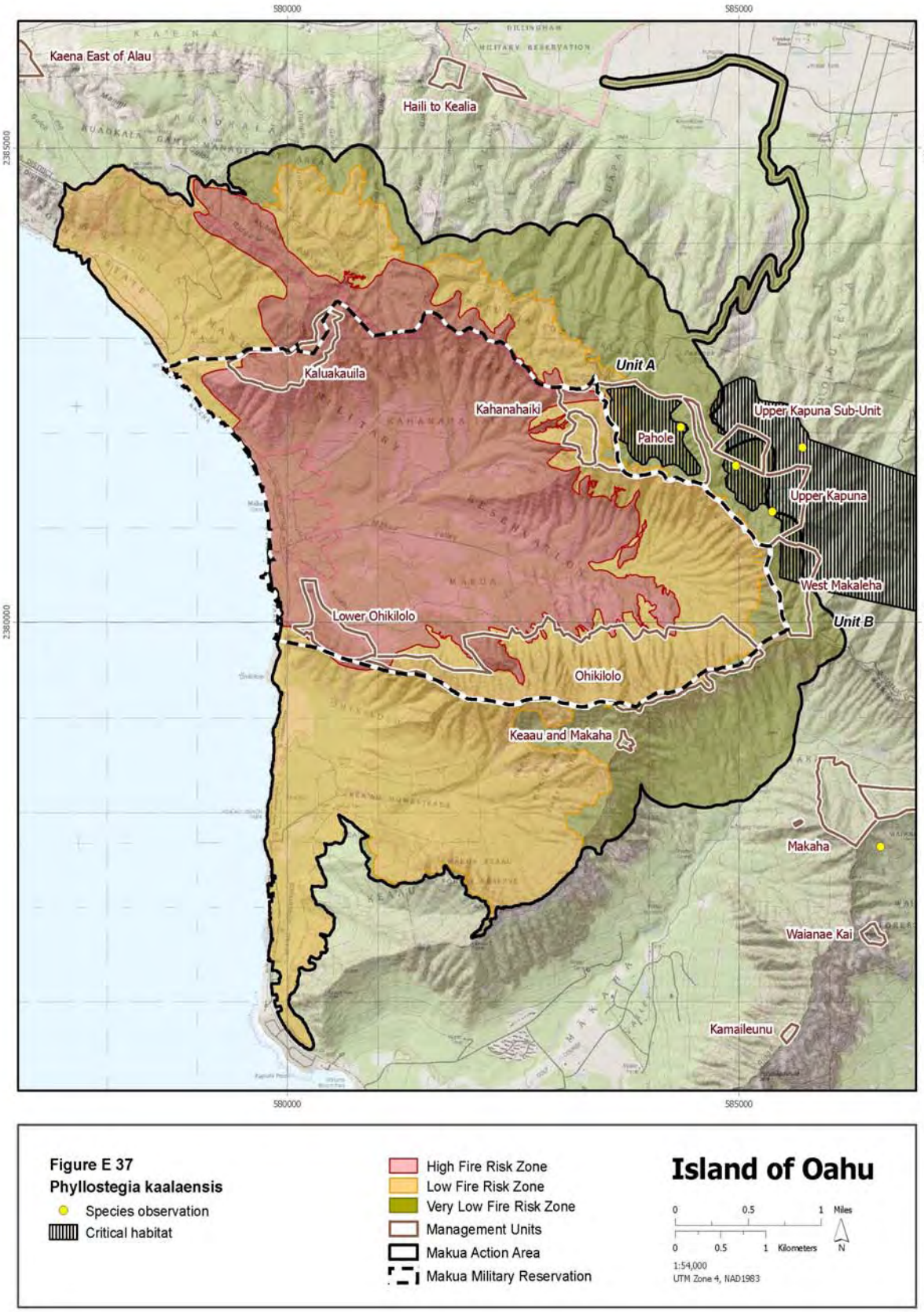
There is a risk that a fire started in the impact area could move east and impact critical habitat units A and B, or that a misfired round could ignite outside of the firebreak road and burn into these units. The loss of vegetative primary constituent elements within these two critical habitat units, together with the 348 ha (860 ac) outside the action area, would remove their ability to provide for the conservation of a total of seven populations of *Phyllostegia kaalaensis*. A prescribed burn in 2003 encroached within 0.3 km (0.2 mi) of critical habitat unit A (G. Enriques, pers. comm. 2003). The consequences of this and other fire events is the subsequent encroachment of non-native vegetation that provides more flammable fuel in nearby areas and increases the potential for future fires. However, the risk of fire is reduced due to the low flammability of the surrounding vegetation (mesic forest), spatial separation from the impact area, and the beneficial resource management actions conducted by the Army in the management units, pursuant to the Makua Implementation Plan. Critical habitat unit A (57 ha; 140 ac) is within the Pahole Management Unit. This management unit is fenced, and the Army is removing non-native plants and ungulates from the fenced areas. The western boundary of critical habitat unit A borders the Kahanahaiki Management Unit. The Army will develop and implement a wildland fire management plan for the Kahanahaiki Management Unit. Implementation of this plan will reduce the risk of fire to *P. kaalaensis* critical habitat due to the construction of a fuel modification zone between the impact area and the Kahanahaiki Management Unit. Fuel modification will buffer the Kahanahaiki Management Unit from fires that spread outside the impact area and therefore buffer the critical habitat.

Thirty-nine percent of critical habitat unit B is located in several management units to include Lower and Upper Kapuna, West Makaleha, Central and East Makaleha management units. The Army has fenced portions of the West Makaleha Management Unit and plans to fence the remainder of this unit, as well as the Upper Kapuna, and Central and East Makaleha management units, pursuant to the Makua Implementation Plan. Ungulates will be removed from all fenced areas. The Army is working to reduce non-native plants in all of these management units. The Army is also conducting rat control in the West Makaleha Management Unit to reduce their impacts on listed and associated native plants. All of these resource management actions in the management units enhance the conservation value of critical habitat. The remaining critical habitat outside of unit B (approximately 50 ha; 133 ac) is buffered from the impact area by the management units themselves. The fuel modification activities and the other threat reduction measures implemented by the Army for species stabilization will further reduce the risk of fire to the critical habitat outside of the management units.

To reduce the negative impacts to critical habitat from any fire that escapes the firebreak road, the Army has committed to revegetate burned areas with native plant species to restore the area to pre-burn conditions. The revegetation plan will address restoration of burned areas by replanting native plant species (primary constituent elements) and the control of non-native, competitive plant species. While there may be a temporal loss of the conservation value of the critical habitat units during the revegetation process, the ability of critical habitat units A and B to provide habitat essential for the conservation of *Phyllostegia kaalaensis* will be retained in the long-term.

Conclusion

The two critical habitat units for *Phyllostegia kaalaensis* in the Makua action area are located in the low and very low fire risk area. Implementation of all fire suppression measures incorporated into this action and the Army's standard operating procedures will reduce the likelihood that a fire will ignite and travel outside of the firebreak road or that a misfired round will ignite outside of the firebreak road. The risk of fire to the critical habitat will be reduced due to the construction of a fuel modification zone between the impact area and the Kahanahaiki Management Unit that is adjacent to critical habitat in the Pahole Management Unit. Fuel reduction within the management units will buffer critical habitat units A and B from fire. The critical habitat that is within Central and East Makaleha, Kahanahaiki, Upper Kapuna Sub-unit, Pahole, Upper Kapuna, and the West Makaleha management units will be managed to improve its baseline quality, pursuant to the Makua Implementation Plan. Without this management, these two critical habitat units could eventually lose most of the elements essential to the survival and recovery of the species because of the ongoing threats to this habitat (e.g., ungulates and non-native plant encroachment). We considered this continued degradation of *P. kaalaensis* critical habitat in the evaluation of the effects of the proposed action. Most importantly, even though there may be a temporal loss of vegetation due to a fire, the restoration of these areas by the Army will provide habitat essential for the conservation of *P. kaalaensis* and allow for the long-term recovery goals of this species. Therefore, training-related fire events will not result in adverse modification of critical habitat for *P. kaalaensis*.


580000
585000
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2380000
Kaena East of Alau
Haili to Kealia
Kaluakauila
Kahanahaiki
Unit A
Pahole
Upper Kapuna Sub-Unit
Upper Kapuna
West Makaleha
Unit B
Lower Ohikilolo
Ohikilolo
Keaau and Makaha
Makaha
Waianae Kai
Kamaileunu
Figure E 37
Phyllostegia kaalaensis
Species observation
Critical habitat
High Fire Risk Zone
Low Fire Risk Zone
Very Low Fire Risk Zone
Management Units
Makua Action Area
Makua Military Reservation
Island of Oahu
0 0.5 1 Miles
0 0.5 1 Kilometers
N
1:54,000
UTM Zone 4, NAD1983

**EFFECTS OF THE ACTION – *Sanicula mariversa* (No Common Name)**

*Sanicula mariversa* is a perennial herbaceous plant with a range-wide status of only 225 individuals. Approximately 80 percent of all remaining *S. mariversa* individuals are found in the action area in the Ohikilolo and Keaau population units. About 52 individuals occur in the low fire risk and 128 in the very low fire risk zone (Figure E 38). *Sanicula mariversa* has been identified as a at risk species based on the limited population status, restricted distribution, high percentage of individuals in the action area, and risk of training-related wildland fire. Therefore, *S. mariversa* was identified as an expedited stabilization species as a conservation measure to protect this taxon from extirpation while full stabilization measures are being implemented. It is likely *S. mariversa* is already is in a phase of quasi-extinction with numbers that have declined to the point where demographic or environmental stochasticity alone can result in extirpation (see General Effects – Small Population Size). We infer from these circumstances, conservation biology principles, and examples from other species that *S. mariversa* has a very high background extinction risk in the action area and range-wide, and any additional threats associated with training-related wildland fire are likely to eliminate expectation of its long-term persistence.

Analysis for Effects of the Proposed Action

Over the next 30 years, the proposed action could result in injury and death of *Sanicula mariversa* individuals as a result of training-related wildland fire. Fifty-two individuals of *S. mariversa* are located on the upper ridgeline of the Ohikilolo Management Unit (see Figure E 38). A training-related wildland fire could spread into Ohikilolo Ridge from the valley floor, or start on the ridge from a misfired long-range, live-fire weapon such as the TOW, or ignite from a spot fire during high winds. However, fire detection and suppression response is designed to prevent a fire ignited by misfired weapons landing in forest and shrub areas from burning more than 0.1 ha (0.3 ac). The risk of a fire spreading from the valley floor (impact area) up the ridge is very low due to sparse vegetation on the cliff face of Ohikilolo Ridge and the fire suppression measures that will be enacted that will impede fire spread prior to impacting the top of Ohikilolo ridgeline (see General Effects - Fire Suppression). Even if the fire did reach the top of the ridgeline the risk of burning all *S. mariversa* plants in one fire is very low due to their distribution.

Approximately 128 *Sanicula mariversa* are located in the very low fire risk zone near the Keaau and Makaha Management Unit. These plants beyond the Ohikilolo Ridge are unlikely to be burned as a result of training-related fires due to their distance (1.6 km; 1 m) from the impact area in conjunction with fire suppression response. At 14 mature individuals, the Keaau population unit in the action area is far from stable (defined as 100 mature, reproducing individuals), and the Ohikilolo population unit contains no mature individuals.

*Sanicula mariversa* is also exposed to the suite of threats as described and analyzed in the General Effects. The direct and indirect effects of non-native grasses, goats, and erosion will reduce the vigor, reproduction, recruitment, and survival of individual plants. The overall response of *S. mariversa* to project impacts will be a measurable reduction in baseline numbers, distribution, and reproduction within the action area population units.

In the action area, the Ohikilolo population unit is fenced and controlled for weeds; the Keaau population unit, located within a State Game Management Area, is not fenced nor weeded. No long-range weaponry will be used until expedited stabilization thresholds are achieved for all stabilization population units. Expedited stabilization will involve continued habitat management for *Sanicula mariversa* within the two action area population units, and in the Kamaileunu population unit outside the action area. Propagation and outplanting techniques have not yet been identified; the dormancy cycle of this species may preclude feasible propagation and reintroduction. Stabilization will require monitoring and study of population demographics over several years to determine dormancy effects on survival, reproduction, and recruitment.

Conclusion

Despite the ongoing exposure of *Sanicula mariversa* to training-related wildland fire impacts, Army conservation and stewardship programs will improve its baseline condition in the action area and range-wide. Weapons restrictions, fuels management, fire suppression, invasive species control, and expedited stabilization actions will increase baseline numbers of *S. mariversa* to stability thresholds in three population units. However, the risk of training-related wildland fire to individuals within the action area is low to very low and one of the action area population units is located in manageable habitat where ungulate and weed threats can be controlled. Thus, the overall effect of the proposed action's stressors and subsidies will result in a net increase in baseline numbers, distribution, and reproduction of *S. mariversa* in and adjacent to the action area over the next 30 years. Reaching expedited stabilization will improve the likelihood that *S. mariversa* will attain full stabilization and enhance its probability of persistence over the long term. Overall, the minimal risk of impact from training-related actions and the beneficial resource management activities to be conducted at Makua outweigh the Army training-related risks to this species.

**Effects of the Action on *Sanicula mariversa* Critical Habitat**

There are two critical habitat units within the Makua action area, comprising approximately 11 percent (10 ha; 25 ac) of the total critical habitat for *Sanicula mariversa*. Critical habitat units A and D, located in the south-central portion of the action area, are entirely within the low fire risk zones, with 0.33 ha (0.82 ac) in the low fire risk area and 6.57 ha (16.23 ac) in the very low fire risk area (see Figure E 38). The two units, combined, provide habitat for the conservation of one population of at least 300 mature, reproducing individuals of *S. mariversa* (68 FR 35950). The primary constituent elements essential for this species include, but are not limited to, dry, well-drained slopes or rock faces in mesic shrublands or open grassy area. The primary constituent elements that may be affected by a training-related fire include those associated native plant species found within mesic shrublands or open grassy areas. It is estimated that slightly more than one-half of the critical habitat within the action area is found in an area with less than 50 percent native plant cover (K. Kawelo, pers. comm. 2004; 68 FR 35950). This indicates that these critical habitat units are currently degraded due to non-native plant encroachment. Portions of these units may have been impacted by past fire events, which further diminishes the conservation value of this habitat. Fire removes the vegetative primary constituent elements, and non-native plant species subsequently outcompete the native plants so that natural recruitment is

precluded. In the absence of habitat management, additional fires resulting from future training actions could add to the degradation of these critical habitat units by removing the remaining vegetative primary constituent elements.

Critical habitat unit A is approximately 10 ha (25 ac) on Ohikilolo Ridge. Approximately one hectare (2 ac) of this critical habitat unit is located in the Ohikilolo Management Unit, straddling the low and high fire risk boundary. The remaining 9 ha (23 ac) of critical habitat are outside of the management unit and in the low and very low fire risk areas. The loss of vegetative primary constituent elements of this unit would remove its ability to provide habitat for the conservation for a portion of one population of *Sanicula mariversa*. See *Dubautia herbstobatae* for a discussion of the effects of fire and management.

Critical habitat unit D is 3 ha (7 ac). Almost 2 ha (4.5 ac) or approximately 18 percent of the critical habitat is in the Keau and Makaha Management Unit. A small portion (0.6 ha; 1.5 ac), or 34 percent, of the critical habitat in the management unit is within the high fire risk area. The remainder of the critical habitat in the management unit is in the low and very low fire risk areas. The remaining 8 ha (19 ac) of critical habitat are outside the management unit and mostly within the low and very low fire risk areas. Critical habitat unit D is approximately 1.6 km (1 mi) from the impact area and the risk of fire in this xeric, lowland grassland habitat is high. The prescribed burn in 2003 encroached within 1 km (0.6 mi) of unit D (see Figure E 38 and Figure E 3) (G. Enriques, pers. comm. 2003). The consequence of this fire is the encroachment of non-native grassland that provides more flammable fuel and increases the potential for fires in the future. The loss of vegetative primary constituent elements of this unit would remove its ability to provide a portion of habitat for the conservation of one population of *Sanicula mariversa*. Presently, fuel modification conducted for critical habitat unit A will also reduce the risk of fire in this area. In the Upper Keaau and Makaleha management units, the Army will fence and remove ungulates and reduce non-native plants, pursuant to the Makua Implementation Plan. In addition, the control of non-native species in the Ohikilolo Management Unit will provide an additional buffer between the Upper Keaau and Makaleha management units and the impact area. These actions will decrease the risk of fire within the management units by reducing the fuel load in the area.

To reduce the negative impacts to critical habitat from any fire that escapes the firebreak road, the Army has committed to revegetate burned areas with native plant species to restore the area to pre-burn conditions. The revegetation plan will address restoration of burned areas by replanting native plant species (primary constituent elements) and controlling non-native, competitive plant species. While there may be a temporal loss of the conservation value of these critical habitat units during the revegetation process, their ability to provide habitat essential for the conservation of two populations of *Sanicula mariversa* will be retained in the long-term.

Conclusion

One hundred percent of the critical habitat unit for *Sanicula mariversa* in the Makua action area is located outside of the high fire risk area. Implementation of all fire suppression measures incorporated into this action and the Army's standard operating procedures will reduce the likelihood that a fire will ignite and travel outside of the firebreak road or that a misfired round

will ignite outside of the firebreak road. The risk of fire will be reduced due to the construction of fuel modification zones between the impact area and their respective management units. In addition, fuel reduction within the Makaleha and Upper Keaau management units will further buffer critical habitat units A and B from fire. The portion of critical habitat in unit A that is within the Ohikilolo Management Unit and the portion within the Upper Keaau and Makaleha management units will be managed to improve their baseline quality pursuant to the Makua Implementation Plan. Without this management, these critical habitat units would eventually lose most of the elements essential to the survival and recovery of the species because of the ongoing threats to this habitat (e.g., ungulates and non-native plant encroachment). We considered this continued degradation of *S. mariversa* critical habitat in the evaluation of the effects of the proposed action. Most importantly, even though there may be a temporal loss of vegetation due to a fire, the restoration of these areas by the Army will provide habitat essential for the conservation of *S. mariversa* and allow for the long-term recovery goals of this species. Therefore, training-related fire events will not result in adverse modification of critical habitat for *S. mariversa.*

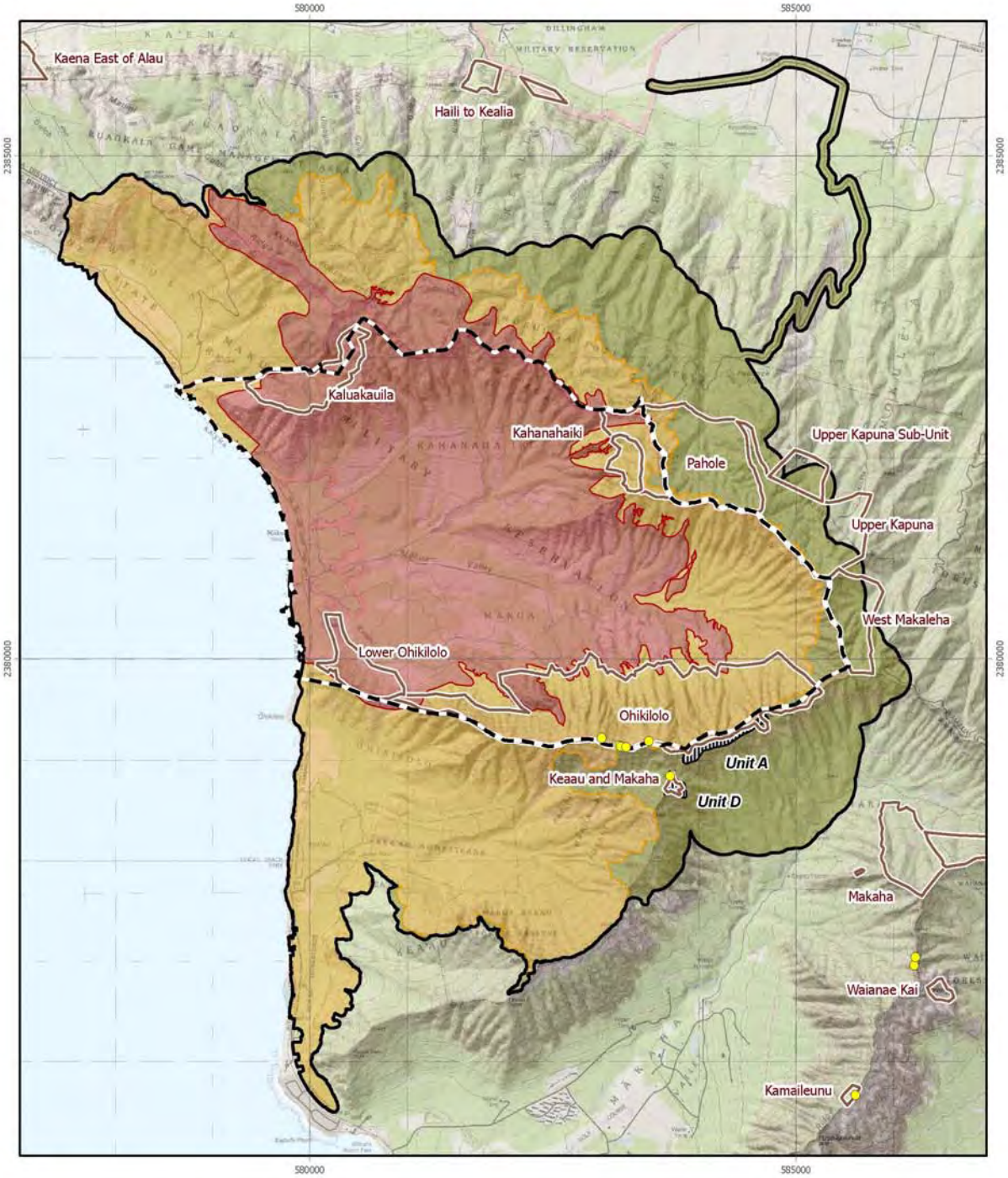



**Figure E 38**
**Sanicula mariversa**

- Species observation
- Critical habitat

- High Fire Risk Zone
- Low Fire Risk Zone
- Very Low Fire Risk Zone
- Management Units
- Makua Action Area
- Makua Military Reservation

**Island of Oahu**

0 0.5 1 Miles
0 0.5 1 Kilometers
N
1:54,000
UTM Zone 4, NAD1983

**EFFECTS OF THE ACTION – *Schiedea nuttallii* (No Common Name)**

The range-wide status of the subshrub *Schiedea nuttallii* is now limited to approximately 100 individuals. With approximately 80 mature individuals, the Kahanahaiki to Pahole population unit is the only stabilization population in the action area with more than 50 mature reproducing individuals, but is not considered fully stabilized because threats are not controlled and numbers are maintained primarily through augmentation (Figure E 39). The Kapuna-Keawapilau Ridge population unit with only three mature individuals is far from reaching the criteria established for stabilization populations. Any loss of action area plants will reduce baseline numbers and available propagule material for augmentation and reintroduction, and prolong the time needed to achieve expedited and full stabilization.

This species is extremely rare with only four extant population site, one consisting of a single plant. Hence, this species is characterized by a precipitous decline in the number of individuals, extremely low genetic variability, and extirpation of the majority of naturally occurring plants. Because of these factors, *Schiedea nuttallii* already is in a phase of quasi-extinction with numbers declined to the point where demographic or environmental stochasticity alone can result in extirpation (see General Effects – Small Population Size). We infer from these circumstances, conservation biology principles, and examples from other species that *S. nuttallii* has a very high background extinction risk, and any additional threats associated with training-related wildland fire are likely to eliminate expectation of its long-term persistence. Therefore, *S. nuttallii* has been identified as an at risk species based on its limited population status, restricted distribution, high percentage of individuals in the action area, and risk of training-related wildland fire. *Schiedea nuttallii* was identified as an expedited stabilization species as a conservation measure to protect these taxa from extirpation while full stabilization measures are being implemented.

Species Response to the Proposed Action

Over the next 30 years, *Schiedea nuttallii* individuals in the Kahanahaiki to Pahole and Kapuna-Keawapilau Ridge population units will be exposed to the direct and indirect effects of training-related wildland fire in the low and very low fire risk zones. For this Biological Opinion, we are relying on the Army's most recent status update (U.S. Army Garrison 2006d), which is based on the action area used to develop the Makua Implementation Plan in 2003. This 2003 action area differs from the 2007 action area under consideration for this opinion (see discussion in the Introduction to Status and Environmental Baseline of the Species and Critical Habitat). For *S. nuttallii*, however, we are confident that the Kapuna to Keawapilau Ridge population unit is outside the currently delineated action area (M. Mansker, U.S. Army Garrison, pers. comm. 2006).

As a small, mostly herbaceous understory subshrub, all individuals and life stages are vulnerable to the risk of high and low severity wildland fires. About 90 individuals occur in the low fire risk zone and five in the very low fire risk zone. Lack of alien grass control in the lower Pahole portion of the population unit, however, increases exposure of nearby native and mixed forest areas to long-term fire encroachment. Certain weapons systems and munitions will be restricted until a fire protection system is in place for the Kahanahaiki Management Unit and expedited stabilization thresholds are achieved for at-risk taxa that occur in that management unit. No

long-range weaponry will be used until expedited stabilization thresholds are achieved in all stabilization population units. Expedited stabilization will involve continued augmentation of *S. nuttallii* in the Kahanahaiki to Pahole population unit inside the action area. Outside the action area, the Kapuna to Keawapilau Ridge population unit will be augmented and the Makaha population unit will be newly established through reintroduction. Although *S. nuttallii* has been successfully propagated from seed and cuttings, stabilization will depend on developing slug and black twig borer control techniques to increase survival and recruitment. After expedited stabilization is complete and long-range incendiary weapons are used at Makua, we estimate that a misfired live-fire weapon landing in forest and shrub areas will burn approximately 0.1 ha (0.3 ac) prior to fire suppression measures extinguishing the fire. Inadequate detection and suppression response could enable these fires to burn more than 40 ha (100 ac) in a 48-hr period. However, to avoid the risk of an undetected fire, the Army will conduct an aerial survey in a helicopter for one hour post-training to check for smoke from a misfired round (see General Effects - Fire Suppression).

*Schiedea nuttallii* in the action area also will be exposed to the direct and indirect impacts of non-native species such as molasses grass, slugs, and perhaps black twig borers. Slug and black twig borer damage is particularly threatening to the survival and recovery of this species because no feasible control methods are available for field situations. The direct and indirect effects of non-native weeds and invertebrates will reduce the vigor, reproduction, recruitment, and survival of individual plants. Pursuant to stabilization actions, both portions of the Kahanahaiki to Pahole population unit are fenced to exclude feral ungulates; the Kapuna to Keawapilau Ridge population unit is not fenced. All *S. nuttallii* occurrences except those in the lower Pahole portion of the Kahanahaiki to Pahole population unit are regularly controlled for weeds, and individuals under mesic forest canopy are protected from the spread of fire.

Conclusion

Because the action area contains nearly 100 percent of all of the remaining individuals, the environmental baseline of *Schiedea nuttallii* in the action area is virtually equivalent to the status of the species as a whole. Despite the ongoing exposure of *S. nuttallii* to project wildland fire impacts, Army conservation and stewardship programs will improve its baseline condition in the action area and range-wide. Weapons restrictions, fuels management, fire suppression, invasive species control, and expedited stabilization actions over the next 30 years will increase baseline numbers of *S. nuttallii* to stability thresholds. Stabilization of three population units, including two outside the action area that will not be vulnerable to training-related wildland fire, will further reduce the risk of plant loss to training-related wildland fire. Thus, the overall effect of the proposed action's stressors and subsidies will result in a net increase in baseline numbers, distribution, and reproduction of *S. nuttallii* in and adjacent to the action area over the next 30 years. Reaching expedited stabilization criteria will improve the likelihood that *S. nuttallii* will reach the thresholds outlined for stabilization and enhance its probability of persistence over the long term.

**Effects of the Action on *Schiedea nuttallii* Critical Habitat**

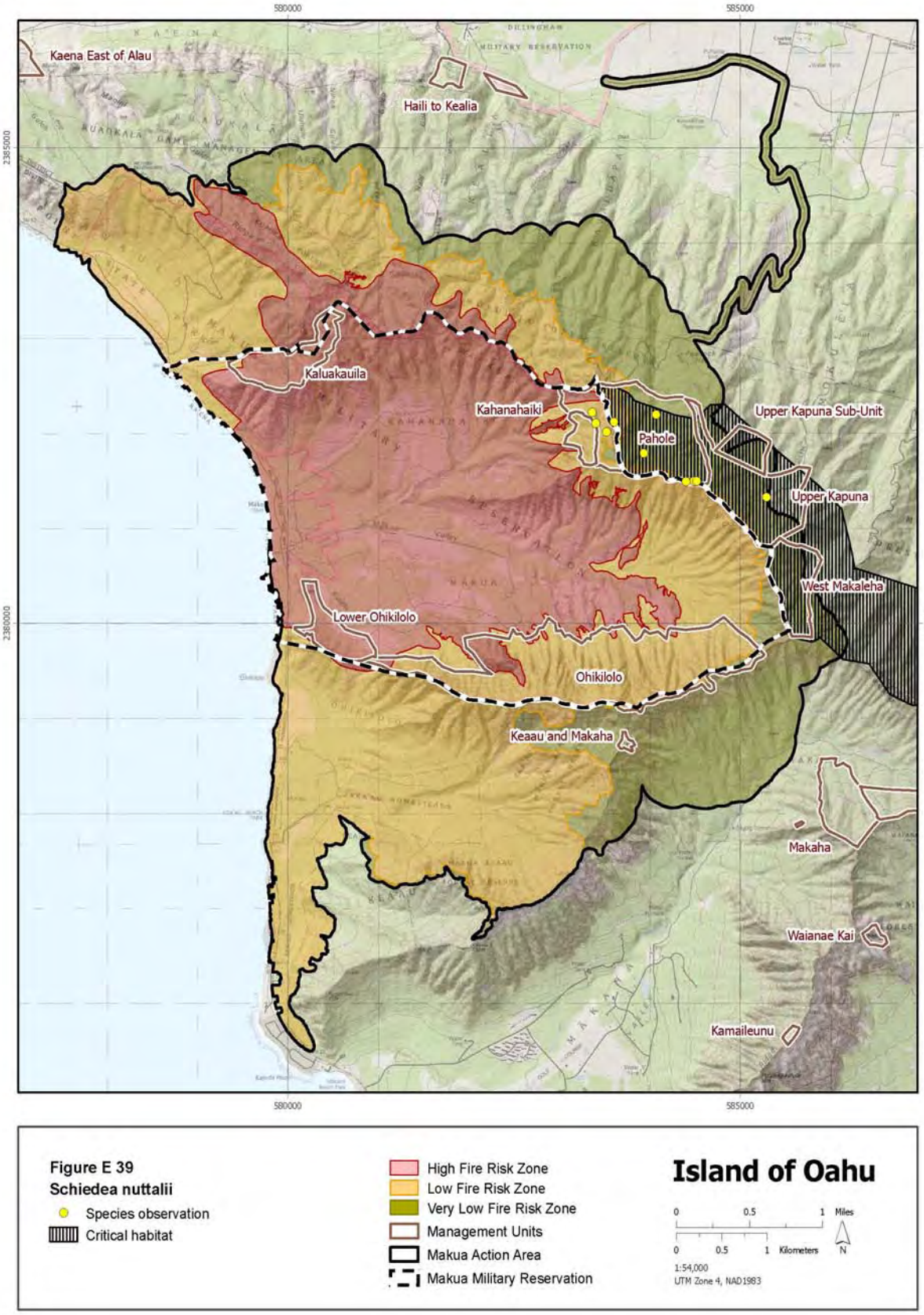
A total of 200 ha (494 ac), or 16 percent, of the total critical habitat for *Schiedea nuttallii* is located in one unit within the Makua action area. This critical habitat is part of a larger 527 ha (1,304 ac) critical habitat unit that extends outside the Makua action area. Located in the northeastern portion of the action area, almost all critical habitat is in the two low fire risk zones, with 17 ha (42.3 ac) in the low fire risk area and 182 ha (450 ac) in the very low fire risk area (see Figure E 39). The entire critical habitat unit was designated to provide habitat for the conservation of four populations, each of at least 300 mature, reproducing individuals of *S. nuttallii* (68 FR 35950). The primary constituent elements essential for this species include, but are not limited to, rock walls, forested slopes, or steep walls in *Acacia koa-Metrosideros polymorpha* (koa-ohia) lowland mesic forest or ohia-*Dodonaea viscosa* (aalii) forest (68 FR 35950). The primary constituent elements that may be affected by a training-related fire include those associated native plant species that are found within koa-ohia lowland mesic forest or ohia-aalii forest on Oahu. It is estimated that nearly one-half of the critical habitat is located in forest habitat comprised of 50 to 75 percent native plant cover, indicating that there is some non-native plant encroachment in this unit (K. Kawelo pers. comm. 2004; 68 FR 35950). Fire diminishes the conservation value of the habitat by removing the vegetative primary constituent elements. Non-native plant species subsequently outcompete the native plants so that natural recruitment is precluded. In the absence of habitat management, additional fires resulting from future training actions could add to the degradation of this critical habitat unit by removing remaining vegetative primary constituent elements.

Approximately 85 percent (170 ha; 421 ac) of the critical habitat for *Schiedea nuttallii* is located within the Pahole, Upper Kapuna and West Makaleha management units (small portion included in East and Central Makaleha Management Unit). Please see *Schiedea obovata* for the effects analysis on the action of training and the proposed activities for the aforementioned management units. The remaining critical habitat outside the management units (30 ha; 72 ac) is separated from the impact area by low and very low fire risk areas and by the above-mentioned management units themselves. Therefore, spatial separation from the impact area, adjacent low and very low fire risk area along the western boundary of the critical habitat unit, fuel modification actions that will be implemented for the Kahanahaiki management unit that is adjacent to the northwestern portion of the critical habitat unit, and the aforementioned activities implemented by the Army for species stabilization in the Pahole, Upper Kapuna, and West Makaleha management units will further reduce the risk of fire to critical habitat inside and outside the management units.

Conclusion

The critical habitat unit for *Schiedea nuttallii* in the Makua action area is almost entirely within the low and very low fire risk area. Implementation of all fire suppression measures incorporated into this action and the Army's standard operating procedures will reduce the likelihood that a fire will ignite and travel outside the firebreak road or that a misfired round will ignite outside of the firebreak road. The risk of fire will be reduced due to the construction of a fuel modification zone between the impact area and the adjacent Kahanahaiki Management Unit. In addition, fuel reduction within the management units will further buffer the critical habitat

unit from fire. The portion of critical habitat within the Pahole, Upper Kapuna, Upper Kapuna Sub-Unit, and West, Central and East Makaleha management units will be managed to improve its baseline quality, pursuant to the Makua Implementation Plan. Without this management, this critical habitat unit would eventually lose most of the elements essential to the survival and recovery of the species because of the ongoing threats to this habitat (e.g., ungulates and non-native plant encroachment). We considered this continued degradation of *S. nuttallii* critical habitat in the evaluation of the effects of the proposed action. Most importantly, even though there may be a temporal loss of vegetation due to a fire, the restoration of these areas by the Army will provide habitat essential for the conservation of *S. nuttallii* and allow for the long-term recovery goals of this species. Therefore, training-related fire events will not result in adverse modification of critical habitat for *S. nuttallii*.


580000
585000
2385000
2380000
Kaena East of Alau
Haili to Kealia
Kaluakauila
Kahanahaiki
Pahole
Upper Kapuna Sub-Unit
Upper Kapuna
West Makaleha
Lower Ohikilolo
Ohikilolo
Keaau and Makaha
Makaha
Waianae Kai
Kamaileunu
Figure E 39
Schiedea nuttalii
Species observation
Critical habitat
High Fire Risk Zone
Low Fire Risk Zone
Very Low Fire Risk Zone
Management Units
Makua Action Area
Makua Military Reservation
Island of Oahu
0 0.5 1 Miles
0 0.5 1 Kilometers
N
1:54,000
UTM Zone 4, NAD1983

**EFFECTS OF THE ACTION – *Schiedea obovata* (No Common Name)**

The range-wide status of *Schiedea obovata* is now limited to approximately 400 total individuals. About 90 percent of all remaining individuals are located in the action area (Figure E 40). With approximately 100 and 55 mature individuals respectively, the Kahanahaiki to Pahole and the Keawapilau to West Makaleha population units are the only stabilization population in the action area. These units are not considered fully stabilized; threats are not controlled and numbers are maintained primarily through augmentation.

Once found in six sites, this species is now characterized by a decline in the number of individuals and population units, and to date only three populations are known to exist. This species is also characterized by large fluctuations in numbers, limited natural recruitment and low numbers that are increasing only through augmentation and discovery of new individuals. Because of these factors, *Schiedea obovata* already is in a phase of quasi-extinction with numbers declined to the point where demographic or environmental stochasticity alone can result in extirpation (see General Effects – Small Population Size). We infer from these circumstances, conservation biology principles, and examples from other species that *S. obovata* has a very high background extinction risk in the action area and range-wide, and any additional threats associated with training-related wildland fire are likely to eliminate expectation of its long-term persistence. Therefore, *S. obovata* has been identified as an at risk species based on its limited population status, restricted distribution, high percentage of individuals in the action area, and risk of training-related wildland fire. *Schiedea obovata* was identified as an expedited stabilization species as a conservation measure to protect these taxa from extirpation while full stabilization measures are being implemented.

Species Response to the Proposed Action

Over the next 30 years, *Schiedea obovata* individuals in the Kahanahaiki to Pahole and Keawapilau to West Makaleha population units will be exposed to the direct and indirect effects of training-related wildland fire in the low and very low fire risk zones. About 140 individuals occur in the low fire risk zone and 210 in the very low fire risk zone. Approximately 20 *S. obovata* are at a greater risk of fire impacts because they are growing in close proximity to the perimeter of the high fire risk zone near the Kahanahaiki Management Unit (180 m; 590 ft) (see Figure E 40). The close proximity of these plants to this historically burned area increases the risk that a future fire will spread quickly through the disturbed vegetation and encroach further into the forest edge. To minimize the risk of fires in Kahanahaiki Gulch (west of the occupied management units), the Army will construct either a 20-m (65-ft) wide firebreak, or a 200-m (656-ft) wide shaded fuelbreak in Kahanahaiki Gulch along the Kahanahaiki Management Unit perimeter. In addition, a helispot will be maintained within 500 m (1,640 ft) of the upper reaches of Kahanahaiki Gulch and a safety zone will be established within or adjacent to the management unit. These additional fire suppression measures will reduce the risk of losing all individuals of *S. obovata* in the Kahanahaiki Management Unit.

Certain weapons systems and munitions will be restricted until a fire protection system is in place for the Kahanahaiki Management Unit and expedited stabilization thresholds are achieved for at-risk taxa that occur in that management unit (see Table PD 2). No long-range weaponry

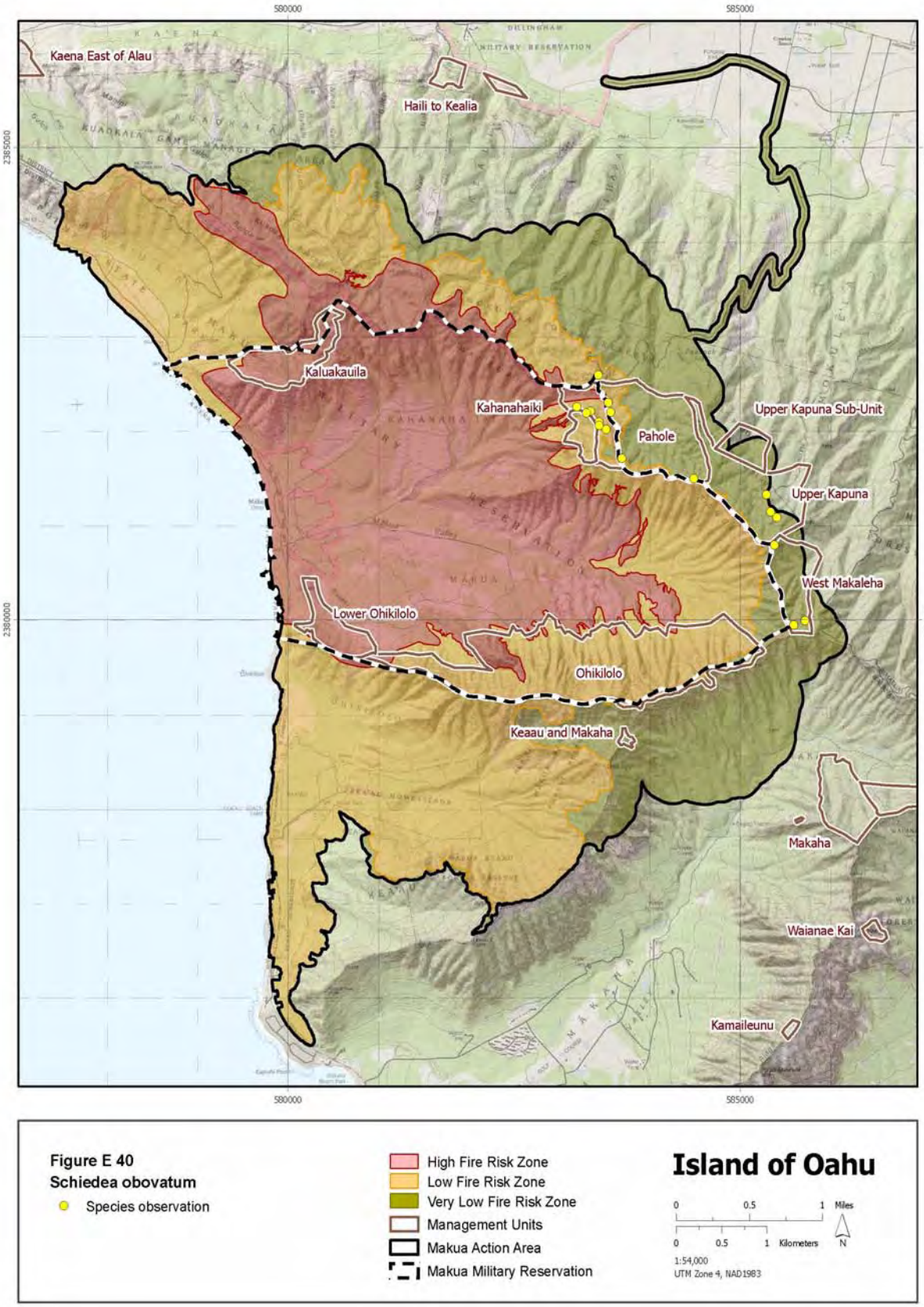
will be used until expedited stabilization thresholds are achieved in all stabilization population units. Inside the action area, expedited stabilization will involve continued augmentation of *Schiedea obovata* in the Kahanahaiki to Pahole population unit, and reintroduction and augmentation in the Keawapilau to West Makaleha population unit. After expedited stabilization is complete when long-range incendiary weapons may be used at Makua, we estimate that a misfired live-fire weapon landing in forest and shrub areas will burn approximately 0.1 ha (0.3 ac) prior to fire suppression measures extinguishing the fire. Inadequate detection and suppression response could enable these fires to burn more than 40 ha (100 ac) in a 48-hr period. However, to avoid the risk of an undetected fire, the Army will conduct an aerial survey in a helicopter for one hour post-training to check for smoke from a misfired round (see General Effects - Fire Suppression).

The *Schiedea obovata* individuals located in and adjacent to the Pahole and Upper Kapuna management units are in the very low fire risk zone. These plants could be susceptible to a misfired long-range, live-fire weapon such as the TOW. However, as with our determination for the risk of fire in the low risk area, fire detection and suppression response is designed to minimize the risk of a fire igniting in mesic forest and shrub areas.

The direct and indirect effects of non-native weeds, slugs, and ungulates will reduce the vigor, reproduction, recruitment, and survival of individual plants. *Schiedea obovata* in the action area also will be exposed to the direct and indirect impacts of non-native plants, slugs, and ungulates. Slug damage is particularly threatening to the survival and recovery of this species and the Natural Resources Staff are conducting research to help solve this widespread pest issue. Both portions of the Kahanahaiki to Pahole population unit are fenced; only the Northwest Makaleha portion of the Keawapilau to West Makaleha population unit is fenced and both population units are controlled at least partially for weeds.

Conclusion

Despite the ongoing exposure of *Schiedea obovata* to project wildland fire impacts, Army conservation and stewardship programs will improve this species baseline number of individuals in the action area and range-wide. Weapons restrictions, fuels management, fire suppression, invasive species control, and expedited stabilization actions over the next 30 years will increase baseline numbers of *S. obovata* to meet expedited stability thresholds in three population units. However, the risk of training-related wildland fire to individuals within the action area is low and the action area population units are located in manageable habitat where ungulate and weed threats can be controlled. Thus, the overall effect of the proposed action's stressors and subsidies will result in a net increase in the baseline number of individuals, distribution, and reproduction of *S. obovata* in and adjacent to the action area over the next 30 years. Reaching the goals outline for expedited stabilization will improve the likelihood that *S. obovata* will attain stabilization criteria and enhance its probability of persistence over the long term.


580000
585000
2385000
2380000
Kaena East of Alau
Haili to Kealia
Kaluakauila
Kahanahaiki
Pahole
Upper Kapuna Sub-Unit
Upper Kapuna
West Makaleha
Lower Ohikilolo
Ohikilolo
Keaau and Makaha
Makaha
Waianae Kai
Kamaileunu
Figure E 40
Schiedea obovatum
Species observation
High Fire Risk Zone
Low Fire Risk Zone
Very Low Fire Risk Zone
Management Units
Makua Action Area
Makua Military Reservation
Island of Oahu
0 0.5 1 Miles
0 0.5 1 Kilometers
N
1:54,000
UTM Zone 4, NAD1983

## EFFECTS OF THE ACTION ON NON-STABILIZATION TAXA

The 11 Makua-action-area taxa listed below are not directly targeted for Army stabilization management, though they will benefit indirectly from stabilization management measures that are being implemented for other taxa. Less than 50 percent of all known individuals of each of these taxa are located within the action area; for some of the taxa, less than 1 percent is located within the action area (Table E 13 and E 14). Location within the action area by definition means these individuals are at risk of training-related wildland fire. However, this risk is reduced for non-stabilization taxa owing to their lower numbers within the action area and their overall higher abundance range-wide. Because of relatively high numbers of mature, reproducing individuals and sufficient population units at numerical thresholds for stability, stabilization was not considered necessary to protect these taxa from jeopardy due to the risk of training-related wildland fire. Taxon-specific details supporting this general analysis is contained in this section.

*Abutilon sandwicense* (shrub)
*Bonamia menziesii* (woody vine)
*Ctenitis squamigera* (fern)
*Diellia falcata* (fern)
*Euphorbia haeleeleana* (tree)
*Lepidium arbuscula* (subshrub)
*Lobelia niihauensis* (shrub)
*Peucedanum sandwicense* (perennial herb)
*Schiedea hookeri* (perennial herb)
*Silene lanceolata* (subshrub)
*Spermolepis hawaiiensis* (annual herb)

Status Summary of Non-stabilization Taxa

When the Makua Implementation Plan was in development, the decision to implement stabilization management measures for specific taxa was based on the likelihood the taxon would be jeopardized by military training activities and the taxon's need for additional mitigative actions to avoid the likelihood of jeopardy (Service 1999c). The following criteria were used to determine if a taxon's continued persistence is likely to be jeopardized by military training activities: (1) the species does not meet two basic conditions required for stabilization populations (i.e., each population of a taxon is naturally reproducing and at least three populations consist of the minimum number of mature, reproducing individuals); or (2) more than 50 percent of all individuals of a species occur within the Makua action area, regardless of meeting stabilization population thresholds for mature reproducing individuals. Conversely, the following criteria were implicitly used to determine if a species is not likely to be jeopardized by military training activities: (1) the species meets the two basic conditions that define stabilization populations (i.e., each population of a taxa not requiring stabilization management is naturally reproducing and at least three populations consist of minimum numbers of mature, reproducing individuals); or (2) more than 50 percent of all individuals of a taxa occur outside the Makua action area, irrespective of the number of mature, reproducing individuals.

The available data on these taxa is not sufficient to draw conclusions regarding trends in the number of individuals, distribution, and recruitment of the 11 non-stabilization taxa, or to predict quantifiable changes in the baseline conditions of these taxa over the next 30 years, with or without the proposed action.

Table E 13. Status of Non-Stabilization Taxa (U.S. Army Garrison 2006c).

| Taxon | Total Number of Individuals | Percent of Total Individuals in the Action Area | Population Units With Fences | Fire Risk† |
|---|---|---|---|---|
| *Abutilon sandwicense* | 425 | 8 | 2 | H, L, V |
| *Bonamia menziesii* | thousands | < 1 | 1 | H, L |
| *Ctenitis squamigera* | 350 | < 1 | 2 | V |
| *Diellia falcata* | thousands | 25 | 1 | L, V |
| *Euphorbia haeleeleana* | 1,500 | 15 | 2 | H, L |
| *Lepidium arbuscula* | 900 | 10 | 4 | L |
| *Lobelia niihauensis* | 2,000 | 25 | 1 | L |
| *Peucedanum sandwicense* | thousands | ≅1 | 0 | -- |
| *Schiedea hookeri* | 400 | 25 | 3 | H, L, V |
| *Silene lanceolata* | 1000 | < 1 | 1 | L |
| *Spermolepis hawaiiensis* | thousands | 5 % | 1 | H |

†Fire Risk: H (high), L (low), V (very low)

Table E 14. Fire Risk Exposure for Non-Stabilization Taxa.

| Taxon | Individuals Occurring In Fire Risk Zones | | |
|---|---|---|---|
| | High | Low | Very Low |
| *Abutilon sandwicense* | 22 (5) † | 1 (<1) | 12 (3) |
| *Bonamia menziesii* | 10 (<1) | 2 (<1) | 0 |
| *Ctenitis squamigera* | 0 | 0 | 5 (<1) |
| *Diellia falcate* | 0 | 1338 (20) | 20 (<1) |
| *Euphorbia haeleeleana* | 199 (25) | 35 (7) | 0 |
| *Lepidium arbuscula* | 0 | 3 (<1) | 0 |
| *Lobelia niihauensis* | 0 | 150 (8) | 0 |
| *Peucedanum sandwicense* | 0 | 0 | 0 |
| *Schiedea hookeri* | 92 (25) | 20 (5) | 6 (1) |
| *Silene lanceolata* | 0 | 17 (2) | 0 |
| *Spermolepis hawaiiensis* | 356 (5) | 0 | 0 |

†Number of individuals occurring in fire risk zone (percent of all individuals occurring in fire risk zone).

Trends in number of individuals and distribution are difficult to discern, owing to inconsistent identification of occurrences and monitoring efforts, and no range-wide surveys have been conducted for these taxa. Seven of the taxa also occur on other islands; only *Abutilon sandwicense*, *Diellia falcata*, *Lepidium arbuscula*, and *Schiedea hookeri* are limited to population units known only on Oahu. The current known number of individuals of these 11 non-stabilization taxa state-wide ranges from a minimum of 350 to thousands of total individuals. Currently the populations of these taxa in the action area account for between 1 and 25 percent of the known individuals. All have a greater number of known, extant individuals outside the action area than inside the action area, on Oahu and/or on other islands. The range-wide population trends in abundance of most of the non-stabilization taxa appear to be stable or increasing. Although threats are not fully controlled and genetic storage is not extensive, these

non-stabilization taxa are currently considered self-sustaining on a range-wide basis with limited protection and management. Because of the adequate number of mature, reproducing individuals and limited abundance in the action area, all 11 non-stabilization taxa are considered to have a moderate background risk of extinction both in the action area and range-wide. Stabilization management measures, other than those discussed in the Project Description, are considered unnecessary to ensure that the proposed Army action does not jeopardize the future existence of these species.

Analyses for Effects of the Action

Individuals of the 11 non-stabilization taxa in the action area will be exposed to training-related wildland fire and the ongoing impacts of non-native species. Effects of human disturbance (trampling) are considered minor. Life forms of these taxa include ferns, annual and perennial herbaceous plants, a woody vine, partially woody subshrubs, woody shrubs, and a small tree.

Individuals of these 11 taxa will be exposed to the direct and indirect effects of training-related wildland fire over the next 30 years, due to their occurrence within the action area in zones at high, low, or very low risk of training-related wildland fire (see Tables E 13 and E 14). All individuals and life stages are vulnerable to high and low severity fires throughout the year, depending on phenology and the time of year fire occurs. Non-stabilization taxa with individuals located in areas at high risk of fire include *Abutilon sandwicense*, *Bonamia menziesii*, *Euphorbia haeleeleana*, *Schiedea hookeri*, and *Spermolepis hawaiiensis*. These plants are likely to burn under certain conditions. Even full staffing of on-site and standby fire suppression helicopter forces will not guarantee containment of all fires. On between zero and 3.8 percent of historical potential training days analyzed, helicopter containment would have failed to contain a fire burning outside the firebreak road, if the fire had not been successfully contained before 1 p.m. A fire escaping initial attack is likely to burn into the native forest (General Effects—Fire Suppression), before additional helicopter support could arrive on-site. In addition, five non-stabilization taxa in the Kaluakauila and Lower Ohikilolo management units are particularly vulnerable to training-related wildland fire because they are located within dry, grassy areas that have burned in the past.

Plants growing outside the high fire risk zone (i.e., within the low and very low fire risk zones) are at some risk of burning as a result of training-related wildland fire ignited by a misfired or malfunctioning long-range weapons systems and munitions (tracers, AT-4 and SMAW anti-tank weapons, 2.75-caliber rockets, Javelin anti-tank missiles, and TOW missiles). These plants also have a relatively low potential to burn from spot fires of various sizes, depending on topography, vegetation cover, weather, and suppression capability. The expected fire size resulting from a misfired long-range weapon or spot fire landing within intact shrub and/or forest vegetation is about 0.1 ha (0.3 ac) with immediate fire suppression response. However, if the fire is not noticed for 48 hours, it could spread to 40.5 ha (100 ac) before containment. In addition, plants within the low fire risk zone, especially those near the high fire risk zone could burn if a fire within the high fire risk zone creeps into the edge of the low risk zone. Only a small area is expected to burn because the fire will slow down when it hits the forest/shrub habitat.

The areas exposed to training-related wildland fire and invasive species in the action area include mixed native and non-native vegetation in mesic forest, dry forest, and dry grassland/shrubland habitats. Population units of several non-stabilization taxa are at high risk of training-related wildland fire within dry, grassy habitats of the Kaluakauila, Lower Ohikilolo, and Kahanahaiki (C-Ridge vicinity) management units. Population units within mesic, forested habitats in the Kahanahaiki, Pahole, Upper Kapuna, and West Makaleha management units are generally at lower risks of fire, except in areas of alien grass encroachment. Population units in the Ohikilolo management unit along the south valley rim and in the Keaau area beyond Ohikilolo Ridge are likewise at an even lower risk of fire. Mesic conditions in upper slope forests do not preclude the incidence of fire, however, especially during prolonged drought conditions in disturbed areas with grassy understories. The spread of wildland fire from the C-Ridge area into the Kahanahaiki management unit, for example, is strongly influenced by alien grass cover. Past fires, including the 1995 and 2003 escaped prescribed burns, increased the exposure of listed plants near this area to future fires by destroying native vegetation and increasing the alien grass cover. Ten of the population units of the 11 non-stabilization taxa are located within fenced management units, but invasive weeds are not regularly controlled over all of them. Individuals under mesic forest canopy in weed control areas are fairly well protected from the spread of catastrophic fire. Other individuals in locations lacking weed control are not well protected from long-term fire encroachment into native and mixed forest.

To reduce the risk of training-related wildland fire to certain at-risk species, the Army will use certain types of weapons systems and munitions for training at Makua only after completion of specific measures to protect listed plants (see Table PD 2). Delaying the use of these weapons systems and munitions will also benefit non-stabilization species by reducing the long-range fire risk. To minimize threats, as part of the proposed action, the Army will implement conservation and stewardship programs to reduce the risk of ignition and spread of training-related wildland fire (Wildland Fire Management Plan, Integrated Natural Resource Management Plan), reintroduce and augment numbers of stabilization and at-risk taxa in the wild (Makua Implementation Plan Addendum), and improve native habitat in population units by excluding feral ungulates and controlling non-native weeds.

The risk of fire to listed species will be minimized by training restrictions, fire management, and expedited stabilization actions summarized in Table PD 2 and the Project Description. Fire minimization measures are based on required levels of helicopter staffing to contain fires before they escape the firebreak road. In addition, to reduce the fire risk to *Chamaesyce celastroides* var. *kaenana* and *Hibiscus brackenridgei* ssp. *mokuleianus* (stabilization and at-risk taxa, respectively) in the Lower Ohikilolo Management Unit, the Army will not begin any live-fire or blank-fire training until alien grass cover is removed and controlled within 3 m (9.8 ft) of these plants and to less than 20 percent cover within 20 m (65.6 ft) of all native plants. These actions also will benefit the non-stabilization taxa in these areas. Additional fuels modification within a 60-m (197-ft) swath along the inside perimeter of the south firebreak road will allow the Army to reduce the level of on-site helicopter staffing required. With these fuel modifications in place, the Army may train using small arms, demolitions, grenades, mines, simulators, and mortars and artillery, with the use of certain of these weapons systems and munitions restricted to NFDRS Green conditions. Within five to 10 years, plants growing within the Kahanahaiki and Kaluakauila management units will be protected by fuels modification and perimeter firebreaks;

these protections will benefit the non-stabilization taxa. With these management units protected from fire, and with completion of expedited stabilization of the at-risk taxa *Cyanea superba* ssp. s*uperba*, *Schiedea nuttalli*, and *Schiedea obovata*, the Army may begin training with more weapons systems and munitions under Yellow conditions instead of only under Green conditions; and begin using grenade launchers and AT-4 and SMAW weapons under Green or Yellow conditions, depending on live herbaceous fuel moisture. Expedited stabilization of 12 at-risk taxa must be complete before the Army may begin training with tracer ammunition, Javelins, and 2.75-caliber rockets. Full stabilization of all 16 stabilization taxa and all 12 at-risk taxa must be complete before the Army may begin training with TOWs. Thus, all listed species in the action area, including the 11 non-stabilization taxa, will benefit from training restrictions required until expedited stabilization is complete for all 12 at-risk species.

In general, the risk to non-stabilization taxa from military training is not high, since a small percentage (less than 1 to 25) of their total state-wide individuals occur within the action area, and an equally small percentage occurs within the high fire risk zone. Stabilization and expedited stabilization actions being implemented for other species will benefit non-stabilization species as well, so that potential impacts associated with military training activities will be minimized.

Species Response to the Proposed Action

The response of individuals of the 11 non-stabilization taxa to training-related wildland fire and invasive species will include the direct and indirect effects of fire injury and death, ungulate grazing and trampling, invertebrate herbivory, and alien plant competition (see General Effects). As a result, the number of mature reproducing individuals of non-stabilization taxa in the action area are not expected to decline over the next 30 years. The overall response to direct and indirect effects will be a measurable reduction in baseline numbers, distribution, and recruitment of individuals and/or entire occurrences in action area population units due to fire injury and death. Reduced fitness in plants that survive will further decrease the viability of population units through a continuing decline in baseline numbers. Without implementation of the Army's conservation and stewardship programs, these effects would lower the fitness of non-stabilization taxa in the action area by decreasing their ability to recover from disturbance and exacerbating their risk of extinction merely due to small population size alone.

We anticipate that implementation of fire management and species stabilization actions will prevent training-related declines in baseline numbers of individuals and population units of the 16 stabilization taxa and 12 at-risk taxa managed for expedited stabilization. These stabilization actions will also benefit non-stabilization taxa wherever they co-occur. Over the next 30 years, numbers of mature, reproducing individuals are expected to remain stable or increase in population units within and outside the action area. In addition, significant progress is expected over the next 30 years toward full threat control in management units. The Army and the Service will closely monitor them and revise management actions as necessary to maintain stability. Overall, the response of non-stabilization taxa to project subsidies is expected to result in measurably stable trends in individual fitness (survival, reproduction, and recruitment), stable or increased baseline numbers of mature and immature individuals within population units, and maintenance of population units within the action area and within management units outside the

action area. Thus, Army conservation and stewardship programs will protect the 11 non-stabilization taxa from jeopardy over the next 30 years, increase their likelihood of maintaining stability over the long term, and enhance their probability of persistence.

The reasoning outlined above is based on information about the proposed action and the environmental baselines of the 11 non-stabilization taxa in the action area. In addition, we make general inferences from this set of circumstances according to conservation biology principles regarding small populations and from previous experience regarding threats to the conservation of native vegetation in Hawaii (see General Effects section). We also make inferences from examples of other species that are closely related or have a similar life history, and have become unstable, endangered, or extinct. For example, the genus *Schiedea* contains the highest proportion of endangered taxa of any species-rich lineage in the Hawaiian Islands (see discussion under Effects of the Action on At-Risk Taxa). The declines of several *Schiedea* species are attributed to habitat degradation by feral pigs and lack of seedling survival due to slug herbivory. Similarly, about 25 percent of lobelioid species have become extinct over the past 100 years from various causes. If not addressed, ongoing threats are likely to further imperil *Schiedea* and *Lobelia* species in the action area. We infer from such examples that non-stabilization taxa in the action area are similarly threatened with extinction, but these taxa are relatively abundant range-wide outside the action area, and thus these taxons vulnerability as a whole to the proposed action are reduced.

Conclusion

Based on the analysis above, the Service anticipates that stressors associated with training-related wildland fire, and the introduction and spread of invasive species, are likely to result in decreases in fitness of individuals and viability of population units of 11 non-stabilization taxa by reducing their number of individuals, distribution, and recruitment in the action area. Action area individuals will be exposed to high, low, and very low risks of burning as a result of training-related wildland fire over the next 30 years. The response of non-stabilization taxa to training-related wildland fire will range from the direct effects of injury and death to the indirect effects of physiological stress, increased mortality, habitat degradation, and competition with non-native species. The overall effect of training-related wildland fire and spread of invasive species will be a further decline in individual fitness, baseline numbers, and viability of population units within the action area. Individuals in action area population units represent a range of less than 1 to 25 percent of all known remaining individuals of each of these 11 non-stabilization taxa. Thus, reduced viability in action area population units will not significantly affect the range-wide status of these 11 taxa.

We develop our opinion using the best available scientific and commercial information, giving benefit of the doubt to the species if significant information gaps preclude determination of quantifiable effects. For example, the proposed action's training-related wildland fire risk could be estimated more accurately with additional modeling to predict long-term fire frequency and encroachment into native forest, and with collection of adequate demographic data for population viability analysis of listed plants. Lacking that information, we infer from maintenance of a relatively stable number of individuals without artificial augmentation, non-stabilization taxa in the action area are self-sustaining and have a moderate background risk of

extinction. We believe any additional threats, including training-related wildland fire and habitat degradation by invasive species, are likely to reduce expectation of their long-term persistence. Accordingly, we consider the existence of population units outside the action area, where they will not be exposed to training-related wildland fire, essential to the persistence of these 11 taxa in the wild. With relative robust populations and widespread distribution outside the action area, reduced viability of action area occurences is unlikely to appreciably reduce the likelihood that these species will be conserved.

Our conclusion is based on our best professional judgment of the likely response of these 11 non-stabilization taxa to both stressors and subsidies of the proposed action. Military training restrictions and conservation management for stabilization in other species will ensure that at least three population units are maintained for each taxon, including population units for each taxon outside the action area that will not be exposed to training-related wildland fire. We anticipate that Army conservation and stewardship programs, including ecosystem-level protection within stabilization management units, will benefit non-stabilization taxa in the action area and protect them from jeopardy over the next 30 years. Therefore, after reviewing the current status of the 11 non-stabilization taxa, the environmental baseline for these taxa in the action area, and the effects of the proposed action and the cumulative effects, it is the Service's biological opinion that the proposed action is not likely to jeopardize the continued existence of the following 11 non-stabilization taxa in the wild by reducing their reproduction, numbers, and distribution: *Abutilon sandwicense*, *Bonamia menziesii*, *Ctenitis squamigera*, *Diellia falcata*, *Euphorbia haeleeleana*, *Lepidium arbuscula*, *Lobelia niihauensis*, *Peucedanum sandwicense*, *Schiedea hookeri*, *Silene lanceolata*, and *Spermolepis hawaiiensis*.

**EFFECTS OF THE ACTION – *Abutilon sandwicense* (No Common Name)**

*Abutilon sandwicense* is endemic to the island of Oahu where there are an estimated 166 mature and 258 immature individuals. Currently there are 35 or eight percent of all known *A. sandwicense* plants (2 mature, 23 immature, and 10 seedlings) in the action area (Figure E 41). These individuals are located in the Kahanahaiki, Keaau and Kaluakauila population units. Virtually all individuals of *A. sandwicense* occurring in the action area are Army reintroductions. This species also occurs at Schofield Barracks Military Reservation and the Army has developed a stabilization plan for this species pursuant to that consultation. The Oahu Implementation Plan outlines the establishment of three stabilization populations of 50 mature, reproducing individuals (U.S. Army Garrison 2005).

Species Response to the Proposed Action

*Abutilon sandwicense* plants in the action area are located in areas at risk of training-related wildland fire and will be exposed to the direct and indirect effects of training related wildland fires that could result in their injury or death. Twenty-two immature *A. sandwicense* plants occur in the Kaluakauila Management Unit. This management unit is surrounded by flammable grasses and shrubs established from historical fires. These *A. sandwicense* individuals are at high risk of burning in future training-related wildland fires. To date, these plants reside in a small 24.3 ha (60 ac) remnant forest that has protected them from past fires. However, as fires sweep through the area the forest edge is continually impacted and edge habitat is lost as

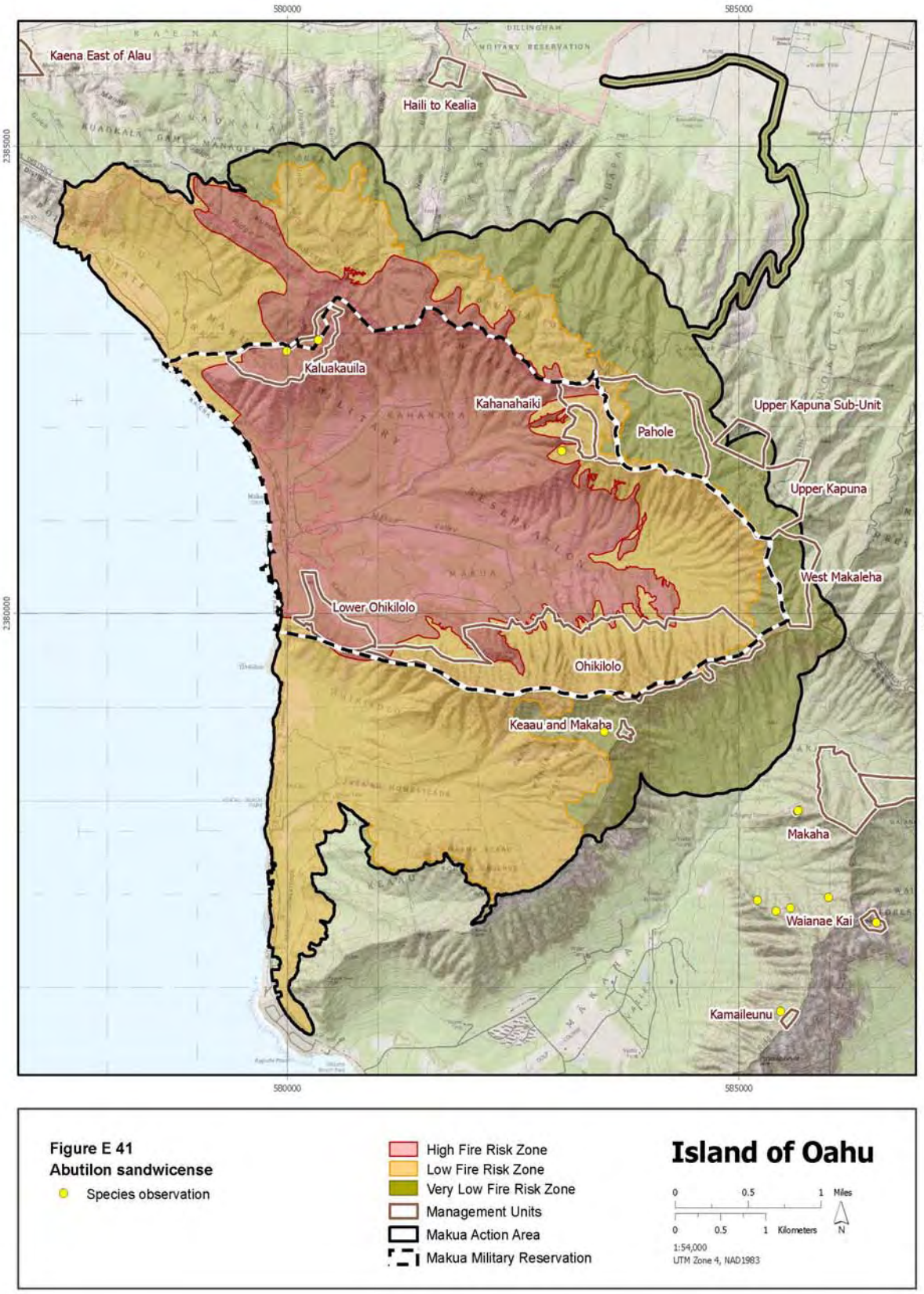
described in General Effects – Fire Suppression. To minimize the risk to this species, the Army will implement weapons restrictions, provide improved grass mowing around the interior of the south lobe of the firebreak road, and increase fire suppression staffing. In the event that a fire threatens this site, the 20-m wide (66-ft wide) fuelbreak, with its imbedded firebreak, adjacent to the forested areas of Kaluakauila Management Unit (see Figure PD 9) will provide firefighters, including red-carded Army Natural Resources Staff and fire suppression helicopters, a high likelihood of successfully preventing fire from burning additional forest in this area.

One mature *Abutilon sandwicense* plant occurs in the low fire risk zone (Kahanahaiki) and 12 individuals occur in the very low fire risk zone (Keaau). These plants beyond the Ohikilolo Ridge in Keaau are unlikely to be burned as a result of training-related fires due to their distance (1.6 km; 1 mi) from the impact area in conjunction with fire suppression response. The probability of plants in the low and very low fire risk zones destroyed by training related fires over the next 30 years is low.

In addition to wildland fire, *Abutilon sandwicense* will also be exposed to the direct and indirect impacts of non-native plants, invertebrate pests, rats, and ungulates. These effects reduce the vigor, reproduction, recruitment, and survival of individual plants. Although this is a non-stabilization species, *A. sandwicense* will benefit from the stabilization actions implemented by the Army Natural Resources Staff such as fencing, weed control, pest management and ungulate removal. Black twig borer and the Chinese rose beetle are a significant threat to *A. sandwicense*. The Army is investigating control methods for these invertebrate pests. Thus, the overall effect of the proposed action's stressors and subsidies will result in maintenance and possibly a net increase in the baseline number of individuals, distribution, and recruitment of *A. sandwicense* in and adjacent to the action area over the next 30 years.

Conclusion

Military training restrictions and stabilization management for other taxa at Makua will benefit *Abutilon sandwicense* in Makua. In addition, as a stabilization species for the training at Schofield Barracks Military Reservation, three population units, including Kaawa to Puulu and Makaha Makai, outside of the action area, will be implemented. At Makua, weapons restrictions, fire suppression helicopter staffing, pre-planning and implementation of suppression actions by skilled NWCG-qualified fireline supervisors, and new fuelbreaks and firebreaks will minimize the risk of a fire destroying *A. sandwicense* in the action area. The potential damage or loss of *A. sandwicense* individuals from fire will be offset by the ongoing efforts of the Army's Natural Resources Staff as they implement stabilization actions for this species pursuant to the Makua and Oahu Implementation Plans. Fencing and ungulate control, weed control, invertebrate pest research, and fire suppression measures are expected to result in increased numbers of *A. sandwicense* at Makua.


580000
585000
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Kaena East of Alau
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Kahanahaiki
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Upper Kapuna
West Makaleha
Lower Ohikilolo
Ohikilolo
Keaau and Makaha
Makaha
Waianae Kai
Kamaileunu
Figure E 41
Abutilon sandwicense
Species observation
High Fire Risk Zone
Low Fire Risk Zone
Very Low Fire Risk Zone
Management Units
Makua Action Area
Makua Military Reservation
Island of Oahu
0 0.5 1 Miles
0 0.5 1 Kilometers
N
1:54,000
UTM Zone 4, NAD1983

**EFFECTS OF THE ACTION – *Bonamia menziesii* (No Common Name)**

There are 12 individuals (all mature) of *Bonamia menziesii* in the action area located in the Makua, Keaau and Kaluakauila population units (Figure E 42). There are several thousand individuals of *B. menziesii* State-wide, however, there are only about 60 individuals on Oahu. Twelve individuals in the Makua action area represent less than one percent of all known *B. menziesii* plants and approximately 20 percent of the individuals on Oahu. This is a non-stabilization species due to its abundance and distribution outside of the Makua action area.

Species Response to the Proposed Action

*Bonamia menziesii* plants in the action area are at risk of injury or death from training-related wildland fire. Approximately 10 mature individuals occur in the Kaluakauila Management Unit located in the high fire-risk area. The Kaluakauila Management Unit is located in a xeric area surrounded by flammable grasses and shrubs established from historical fires, and therefore, *B. menziesii* individuals are at risk of burning in future training-related wildland fires. The majority of these plants reside in a small 24.3 ha (60 ac) remnant forest that has protected them to date. However, as fires sweep through the area the forest edge is continually impacted and edge habitat is lost as described in the General Effects. To minimize the risk to this species, the Army will implement weapons restrictions, provide improved grass mowing around the interior of the south lobe of the firebreak road, and increase fire suppression staffing. These requirements make it unlikely that a fire will escape containment due to initial attack and fire suppression resources, particularly prior to implementation of Column C weapons restrictions (see Table PD 2). In the event that a fire threatens this site, the 20-m (66-ft) wide fuelbreak, with its imbedded firebreak, adjacent to the forested areas of Kaluakauila Management Unit (see Figure PD 9) will provide firefighters, including red-carded Army Natural Resources Staff and fire suppression helicopters, a high likelihood of successfully preventing fire from burning additional forest in this area. Prior to implementation of Column C weapons restrictions, the 10 *B. menziesii* in the Kaluakauila Management Unit will be provided additional protection from fire, either with the completion of additional fuel modification work, or with selected stabilization measures (see General Effects).

One *Bonamia menziesii* in the high risk Lower Ohikilolo Management Unit could be destroyed in a training related fire, however, the Natural Resources Staff control invasive grasses in this unit thus reducing the risk of fire ignition or fire spread in this area. The other individual is located in the low fire risk area on Ohikilolo Ridge and is somewhat protected from wildland fire due to topography and distance from the impact area. Stabilization provides beneficial resource management actions such as ungulate exclusionary fencing, rat baiting, and weed management. For example, recruitment of *Bonamia menziesii* has been observed in the Kaluakauila fence exclosure where in 2005 five new plants were observed (U.S. Army Garrison 2006c).

Conclusion

There are very few naturally occurring individuals of *Bonamia menziesii* within the action area and there are thousands of mature, reproducing individuals range-wide, therefore this species has a low risk of background extinction range-wide. The loss of *B. menziesii* in the action area would reduce the range-wide distribution of this species. However, weapons restrictions, fire

suppression helicopter staffing, implementation of suppression actions, to include the new fuelbreaks and firebreaks at Makua, will minimize the risk of a fire directly impacting *B. menziesii* in the action area. In addition, the potential damage or loss of *B. menziesii* individuals from fire will be offset by the ongoing efforts of the Army's Natural Resources Staff as they implement stabilization actions for other species pursuant to the Makua Implementation Plan and the Makua Implementation Plan Addendum. Based on our analysis of the effects of the actions outlined in the Project Description including fire minimization measures, the Service believes that the risks associated with the Army's proposed action are outweighed by the long-term benefits of the Army's stabilization actions and ecosystem management.

**Effects of the Action on *Bonamia menziesii* Critical Habitat**

There are two critical habitat units within the Makua action area, that, taken together, comprise approximately two percent (28 ha; 69 ac) of the total State-wide critical habitat for *Bonamia menziesii* (see Figure E 42). One hundred percent of unit B is within the high fire risk zone. Three percent of unit A is in the high fire risk zone. Together, these units were designated to provide habitat for the conservation of one population of at least 300 mature, reproducing individuals of *B. menziesii* (68 FR 35950). The primary constituent elements essential for this species include, but are not limited to, steep slopes or level ground in dry or mesic forest in open or closed canopy. The primary constituent elements that may be affected by a training-related fire include those associated native plant species found within dry or mesic forest in open or closed canopy. It is estimated that only one-quarter of the critical habitat within the Makua training action area has a native plant component of more than 75 percent, indicating a high degree of invasive plant encroachment (K. Kawelo, pers. comm. 2004; 68 FR 35950). Although degraded, these units still support individuals of *B. menziesii* and provide habitat that is necessary to meet the recovery goals for this species. Portions of critical habitat unit B burned in 2003, removing approximately 2.4 ha (6 ac) of habitat (G. Enriques, pers. comm. 2003). This loss of native habitat expedites invasion and growth of non-native plant species that can outcompete the native plants. In the absence of habitat management, additional fires from future training activities will add to the degradation of these critical habitat units.

Critical habitat unit A (21 ha; 51 ac) is north of the Kaluakauila Management Unit. This critical habitat unit abuts the high fire risk zone, and, due to the proximity of this critical habitat to the potential fire source, there is a risk that a fire started in the high fire risk zone could escape the firebreak road and move north, impacting this unit. The risk of fire in this xeric grassland habitat is high due to the surrounding *Panicum maximum* grassland which is highly flammable and can increase frequency and size of wildland fires (Beavers et al 1999). A prescribed burn in 2003 encroached within 0.4 km (0.3 mi) of critical habitat unit A (G. Enriques, pers. comm. 2003). The consequence of this burn is the loss of vegetative primary constituent elements and encroachment of non-native grasses and shrubs. This increased fuel load increases the risk of future fires, and each subsequent fire removes additional native habitat, thus setting up a cycle of burn/invasive plant intrusion. The loss of vegetative primary constituent elements within this unit reduces its ability to provide for the conservation of a portion of one population of *B. menziesii* pursuant to recovery goals. To reduce the risk of fire to listed species and sensitive habitats, the Army has prepared a fire management plan for the Kaluakauila Management Unit. Implementation of this plan will reduce the risk of fire due to the construction of a fuel

modification zone between the impact area and the management unit. The fuel modifications in and around the Kaluakauila Management Unit will provide a buffer between the impact area and critical habitat unit A and reduce the probability that fire will reach this critical habitat unit. In addition, this management unit is currently fenced and the Army is working to reduce non-native plants within the exclosure. This action will further reduce the risk of wildland fire from encroaching into and past the management unit.

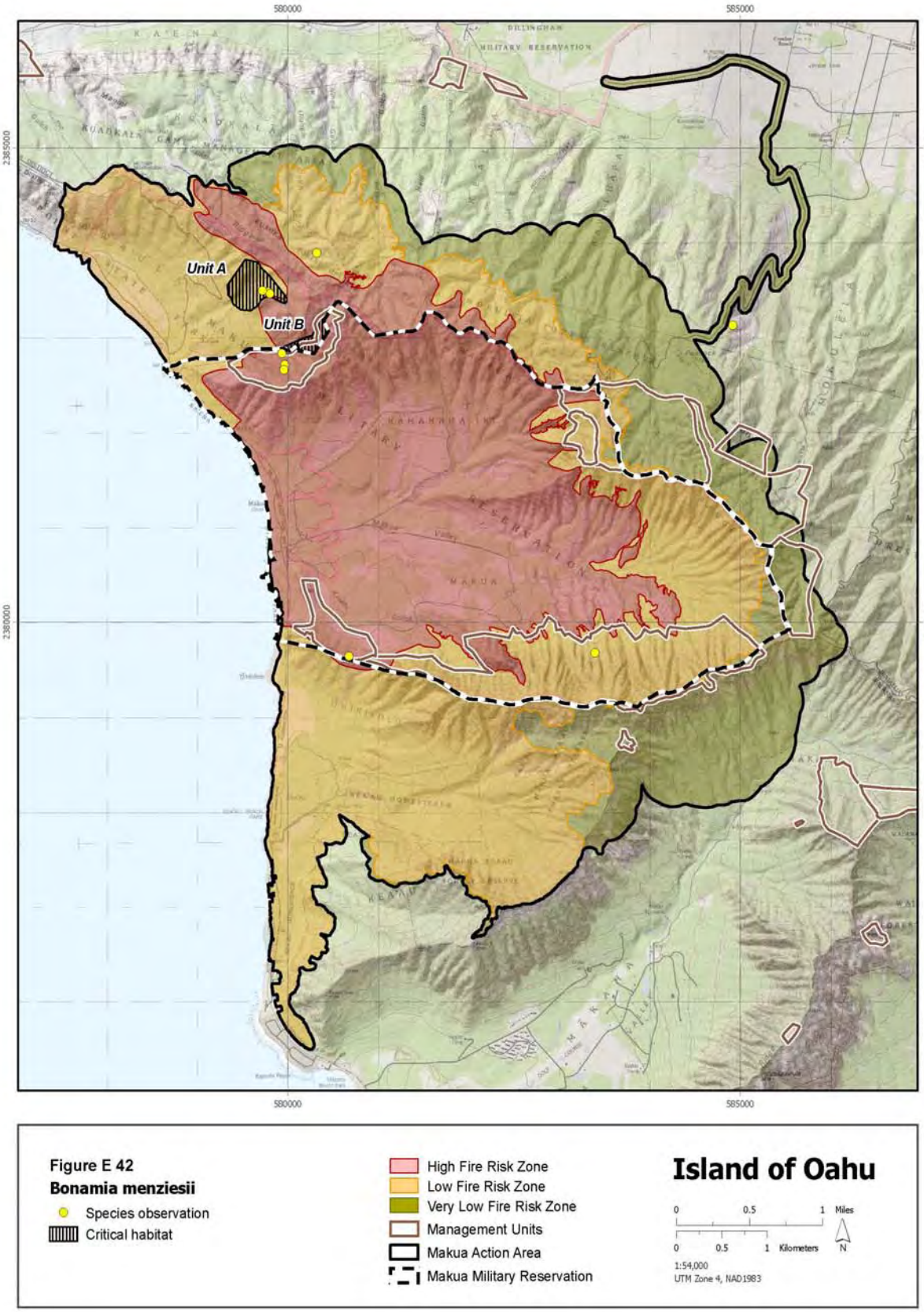
Critical habitat unit B is located within the high fire risk zone as described above; the risk of a fire in this xeric grassland habitat is high. Sixty-five percent (5 ha; 12 ac) of this critical habitat unit is in the Kaluakauila Management Unit. A portion of this critical habitat unit was impacted during the 2003 prescribed burn (G. Enriques, pers. comm. 2003). The loss of primary constituent elements within this critical habitat unit would remove its ability to provide habitat, together with critical habitat unit A, for one population of *Bonamia menziesii*. The fire management plan for the Kaluakauila Management Unit, and the implementation of several fire abatement measures within and around this management unit, will help reduce the probability that critical habitat unit B will burn. In addition to reducing fire threat, the removal of ungulates and non-native invasive plant species within this management unit enhances the conservation value of critical habitat unit B. The remaining critical habitat (2 ha; 6 ac) outside of the management unit is buffered from the impact area by the management unit. The fuel modification activities, plus other conservation measures implemented by the Army for species stabilization, will also reduce the risk of fire to the portion of the critical habitat outside of the management unit.

To reduce the negative impacts to these two critical habitat units from any fire that escapes the firebreak road and burns critical habitat, the Army has committed to revegetate burned areas of critical habitat with native plant species to restore the area to pre-burn conditions. The revegetation plan will address restoration of burned areas by replanting native plant species and by controlling non-native, competitive plant species. While there may be a temporal loss of the conservation value of these critical habitat units during the revegetation process, the ability of these units to provide habitat essential for the conservation of one population of *Bonamia menziesii* will be retained in the long-term.

Conclusion

The two critical habitat units for *Bonamia menziesii* in the Makua action area are located in the high fire risk area. Implementation of all fire suppression measures incorporated into this action and the Army's standard operating procedures will reduce the likelihood that a fire will ignite and travel outside of the firebreak road or that a misfired round will ignite outside of the firebreak road. The risk of fire will be reduced due to the construction of a fuel modification zone between the impact area and the Kaluakauila Management Unit. In addition, fuel reduction within the management unit will further buffer critical habitat units A and B from fire. The portion of critical habitat unit B that is within Kaluakauila Management Unit will be managed to improve its baseline quality pursuant to the Makua Implementation Plan. Without this management, this critical habitat unit would eventually lose most of the elements essential to the survival and recovery of the species because of the ongoing threats to this habitat (e.g., ungulates and non-native plant encroachment). We considered this continued degradation of *B. menziesii*

critical habitat in the evaluation of the effects of the proposed action. Most importantly, even though there may be a temporal loss of vegetation due to a fire, the restoration of these areas by the Army will provide habitat essential for the conservation of *B. menziesii* and will allow for the long-term recovery goals of this species. Therefore, training-related fire events will not result in adverse modification of critical habitat for *B. menziesii*.


580000
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Unit A
Unit B
Figure E 42
Bonamia menziesii
Species observation
Critical habitat
High Fire Risk Zone
Low Fire Risk Zone
Very Low Fire Risk Zone
Management Units
Makua Action Area
Makua Military Reservation
Island of Oahu
0 0.5 1 Miles
0 0.5 1 Kilometers
N
1:54,000
UTM Zone 4, NAD1983

**EFFECTS OF THE ACTION – *Ctenitis squamigera* (**Pauoa**)**

Less than one percent, or three individuals, of *Ctenitis squamigera* are located in Makua in the Ohikilolo Management Unit (U.S. Army Garrison 2005c) (Figure E 43). There are approximately 100 individuals of *C. squamigera* located outside of the Makua action area in the East Makaleha population unit. This is a non-stabilization species due to its abundance and distribution outside of the Makua action area.

Species Response to the Proposed Action

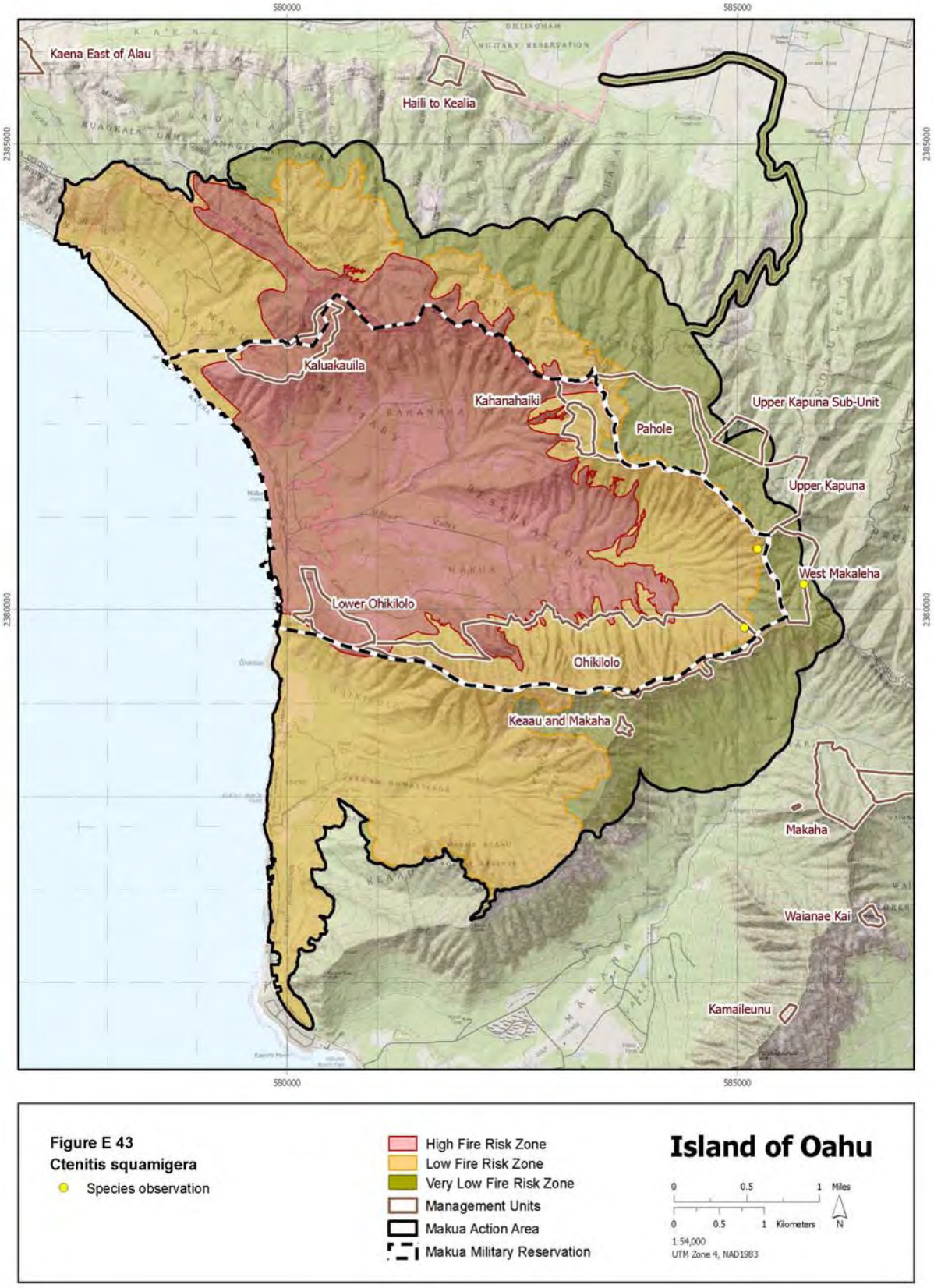
*Ctenitis squamigera* in the action area are at risk of injury or death from training-related wildland fire. Approximately three individuals occur in the Ohikilolo Management Unit located in the low fire risk area. A wildland fire could spread into Ohikilolo Ridge from the valley floor, start on the ridge from a misfired long-range, live-fire weapon such as the TOW, or start from a spot fire resulting from an intense grass fire in the valley. However, fire detection and suppression response is designed to prevent a fire ignited by misfired weapons landing in forest and shrub areas from burning more than 0.1 ha (0.3 ac). Since the vegetation is on the cliff face of Ohikilolo is sparse the risk of a large fire is low if fire suppression is quickly deployed (see General Effects - Fire Suppression). The risk of a wildland fire spreading from the valley floor (impact area) up the ridge is very low due the fire suppression measures that will be enacted that will impede fire spread prior to impacting the top of the Ohikilolo ridgeline. In addition, the spread of a wildland fire would be limited due to the discontinuous fuels on the cliffs.

*Ctenitis squamigera* will benefit from management efforts directed towards stabilization taxa. For instance, the known individuals of *C. squamigera* within the action area occur within a fenced unit benefiting from ungulate exclosure and weed removal. Another beneficial action will be the fencing of the East Makaleha Management Unit in 2008 where 100 individuals of *C. squamigera* reside. Furthermore, this species is represented in an *ex situ* collection of 30 ungerminated spores in micropropagation (Harold L. Lyon Arboretum) (Service 2005b).

Conclusion

There are three individuals of *Ctenitis squamigera* within the action area out of approximately 350 individuals range-wide. Weapon restrictions, fire suppression helicopter staffing, implementation of suppression actions, to include the new fuelbreaks and firebreaks at Makua, will minimize the risk of a fire directly impacting *C. squamigera* in the action area. In addition, the potential damage or loss of *C. squamigera* individuals from fire will be offset by the ongoing efforts of the Army's Natural Resources Staff as they implement stabilization actions for other species pursuant to the Makua Implementation Plan and the Makua Implementation Plan Addendum. Based on our analysis of the effects of the actions outlined in the Project Description including fire minimization measures, the Service believes that the risks associated with the Army's proposed action are outweighed by the long-term benefits of the Army's ecosystem management.

This species has a moderate background risk extinction range-wide, though military training is unlikely to affect the species persistence. However, the fact that there are very few individuals of *Ctenitis squamigera* in the action area suggests there is a significant risk that this species will be extirpated from the action area, though not due to military actions. It should be noted that the Army plans to fence the East Makaleha management unit in 2008. There are currently 100 individuals in this unit. Fencing will remove browsing pressures from alien ungulates and should thus increase this species abundance in the management unit. Weed removal and rat baiting, in management units the Army currently manages, will also increase the abundance of this species. Elsewhere across the species current range there are populations with a moderate number of individuals, making the likelihood this species will be driven to extinction less likely than the probability it will be extirpated from the action area. Overall, the subsidies of the proposed action will outweigh the stressors and may improve its likelihood of persistence over the long term.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Haili to Kealia
Kaluakauila
Kahanahaiki
Pahole
Upper Kapuna Sub-Unit
Upper Kapuna
West Makaleha
Lower Ohikilolo
Ohikilolo
Keaau and Makaha
Makaha
Waianae Kai
Kamaileunu
Figure E 43
Ctenitis squamigera
Species observation
High Fire Risk Zone
Low Fire Risk Zone
Very Low Fire Risk Zone
Management Units
Makua Action Area
Makua Military Reservation
Island of Oahu
0 0.5 1 Miles
0 0.5 1 Kilometers
N
1:54,000
UTM Zone 4, NAD1983

**EFFECTS OF THE ACTION – *Diellia falcata (Puu Pane)***

There are approximately 1,265 *Diellia falcata* in the action area located in the Kaluakauila, Kahanahaiki, Pahole, Upper Kapuna Sub-Unit, West Makaleha, and Ohikilolo management units (U.S. Army Garrison 2005c) (Figure E 44). Approximately 500 additional *D. falcata* grow in the Waianae Mountains, and State-wide there are approximately six-thousand *D. falcata* (U.S. Army Garrison 2006d). *Diellia falcate* is a short-lived perennial fern which grows at mid and upper elevations in the Waianae Mountains. Inside the action area, there are many immature individuals, suggesting natural recruitment is occurring and senescent individuals are being replaced by naturally occurring immature individuals (U.S. Army Garrison 2006d).

Species Response to the Proposed Action

The proposed action of increased Army training with long-range, incendiary weapons could result in injury and death of *Diellia falcata* individuals in the action area. Although the ferns all occur in the low and very low fire risk zones, they may be burned in a fire ignited on the ridge by a misfired long-range, live-fire weapon such as the TOW, or by from a spot fire resulting from an intense grass fire in the valley. Fire detection and suppression response is designed to prevent a fire ignited by misfired weapons landing in forest and shrub areas from burning more than 0.1 ha (0.3 ac). Inadequate detection and suppression response could enable these fires to burn more than 40 ha (100 ac) in a 48 hr period (see General Effects - Fire Suppression).

The 55 *D. falcata* growing on C-Ridge and adjacent to Kaluakauila Management Unit grow within 100 m (328 ft) of the historically burned areas (see General Effects – Fire Suppression). Targeted grass control on C-Ridge will reduce the fire risk to the *D. falcata*, but these plants may be burned in a large fire. There are approximately 1,250 individuals in the Kahanahaiki management unit. This unit is located in the low fire risk zone. However, the dominant overstory vegetation in this area is Kukui trees and fires would spread slowly in this area. To minimize the risk of fires to the 1,250 *D. falcata* and other taxa in Kahanahaiki Gulch, the Army will construct either a 20-m (65-ft) wide firebreak, or a 200-m (656-ft) wide shaded fuelbreak in Kahanahaiki Gulch along the Kahanahaiki Management Unit perimeter. In addition, a helispot will be maintained within 500 m (1,640 ft) of the upper reaches of Kahanahaiki Gulch and a safety zone will be established within or adjacent to the management unit so that skilled NWCG-qualified fireline supervisors and firefighters, including red-carded Army Natural Resources Staff, can safely staff the outplanting site when fire threatens the gulch area. There are approximately 1,200 individuals of *D. falcate* in fenced units in the action area which will benefit from ungulate exclosure and weed removal (Susan Ching, pers. comm. 2007).

Conclusion

Because fewer than 20 percent of the total known *Diellia falcata* plants occur within the action area and thousands occur State-wide, this species has a moderate background risk of extinction. Weapons restrictions, fire suppression helicopter staffing, pre-planning and implementation of suppression actions by skilled NWCG-qualified fireline supervisors, and new fuelbreaks and firebreaks will minimize the risk of a fire burning *D. falcata* in the action area. The potential damage or loss of *D. falcata* individuals from fire will be offset by the ongoing efforts of the

Army's Natural Resources Staff as they implement stabilization actions for this species pursuant to the Makua Implementation Plan Addendum. Fencing and ungulate control, weed control, slug and snail control research, and genetic storage are expected to result in an increase in abundance of *D. falcata*. Based on our analysis of the effects of the actions outlined in the Project Description including fire minimization measures, the Service believes that the risks associated with the Army's proposed action are outweighed by the long-term benefits of the Army's stabilization actions and ecosystem management.

**Effects of the Action on *Diellia falcata* Critical Habitat**

There is one critical habitat unit within the Makua action area, comprising two percent (14 ha; 34 ac) of the designated critical habitat for *Diellia falcata*. It is located in the northeastern portion of the action area, outside of the high fire risk area (see Figure E 44). This critical habitat unit was designated to provide habitat for the conservation of one population of 300 mature, reproducing individuals of *D. falcata* (68FR 35950). The primary constituent elements essential for this species include, but are not limited to, deep shade or open understory on moderate to moderately steep slopes and gulch bottoms in diverse mesic forest. The primary constituent elements that may be affected by a training-related fire include those associated native plant species found within deep shade or open understory in diverse mesic forest. It is estimated that more than 80 percent of the critical habitat is located in forest with greater than 50 percent native plant cover (K. Kawelo, pers. comm. 2004; 68 FR 35950). This indicates that this critical habitat unit is somewhat degraded due to non-native plant encroachment. In the absence of habitat management, fires from future training actions could add to the degradation of this critical habitat unit by removing the remaining vegetative primary constituent elements.

There is a risk that if a fire started in the impact area, it could move east and impact this unit or a misfired round could ignite outside of the firebreak road and burn into this critical habitat. The loss of primary constituent elements within this unit would remove its ability to provide for the conservation of one population of *Diellia falcata*. However, this risk is reduced due to the beneficial resource management actions conducted by the Army, pursuant to the Makua Implementation Plan, in the management units; by the low flammability of the surrounding vegetation (diverse mesic forest); and by spatial separation from the impact area. A total of 11 ha (27 ac), or 77 percent, of critical habitat is in management units. Two ha (5 ac) are in the Upper Kapuna Management Unit and 10 ha (25 ac) are in the West Makaleha Management Unit. The Army plans to complete fencing for the West Makaleha Management Unit and to fence the Upper Kapuna Management Unit. Ungulates will be removed from these fenced areas. The Army is working to reduce non-native plants in both of these management units, thereby reducing their fuel load and the risk of fire. In addition, the Army is conducting rat control in the West Makaleha Management Unit to reduce their impact on listed and associated native plants. The removal of ungulates and non-native plants from within the West Makaleha and Upper Kapuna Management Units enhances the conservation value of this critical habitat unit. The remaining critical habitat (46 ha; 113 ac) outside of the management units is separated from the impact area by both management units. The fuel modification activities, plus other threat reduction measures implemented by the Army for species stabilization, will further reduce the risk of fire to the portion of the critical habitat outside of the management units.

To reduce the negative impacts to critical habitat from any fire that escapes the firebreak road, the Army has committed to revegetate burned areas with native plant species to restore the area to pre-burn conditions. The re-vegetation plan will address restoration of burned areas by replanting native plant species (primary constituent elements) and controlling non-native, competitive plant species. While there may be a temporal loss of the conservation value of these critical habitat units during the re-vegetation process, the ability of these units to provide habitat essential for the conservation of one population of *Diellia falcata* will be retained in the long-term.

Conclusion

The critical habitat unit for *Diellia falcata* in the Makua training action area is located in the low fire risk area. Implementation of all fire suppression measures incorporated into this action and the Army's standard operating procedures will reduce the likelihood that a fire will ignite and travel outside of the firebreak road or that a misfired round will ignite outside of the firebreak road. The risk of fire will be reduced due to fuel reduction within the management units, the low flammability of the surrounding diverse mesic forest, and by spatial separation from the impact area. The portion of critical habitat that is within Upper Kapuna Management Unit and the West Makaleha Management Unit will be managed to improve its baseline quality, pursuant to the Makua Implementation Plan. Without this management, this critical habitat unit could eventually lose most of the elements essential to the survival and recovery of the species because of the ongoing threats to this habitat (e.g., ungulates and non-native plant encroachment). We considered this continued degradation of *D. falcata* critical habitat in the evaluation of the effects of the proposed action. Most importantly, even though there may be a temporal loss of vegetation due to a fire, the restoration of these areas by the Army will provide habitat essential for the conservation of *D. falcata* and allow for the long-term recovery goals of this species. Therefore, training-related fire events will not result in adverse modification of critical habitat.

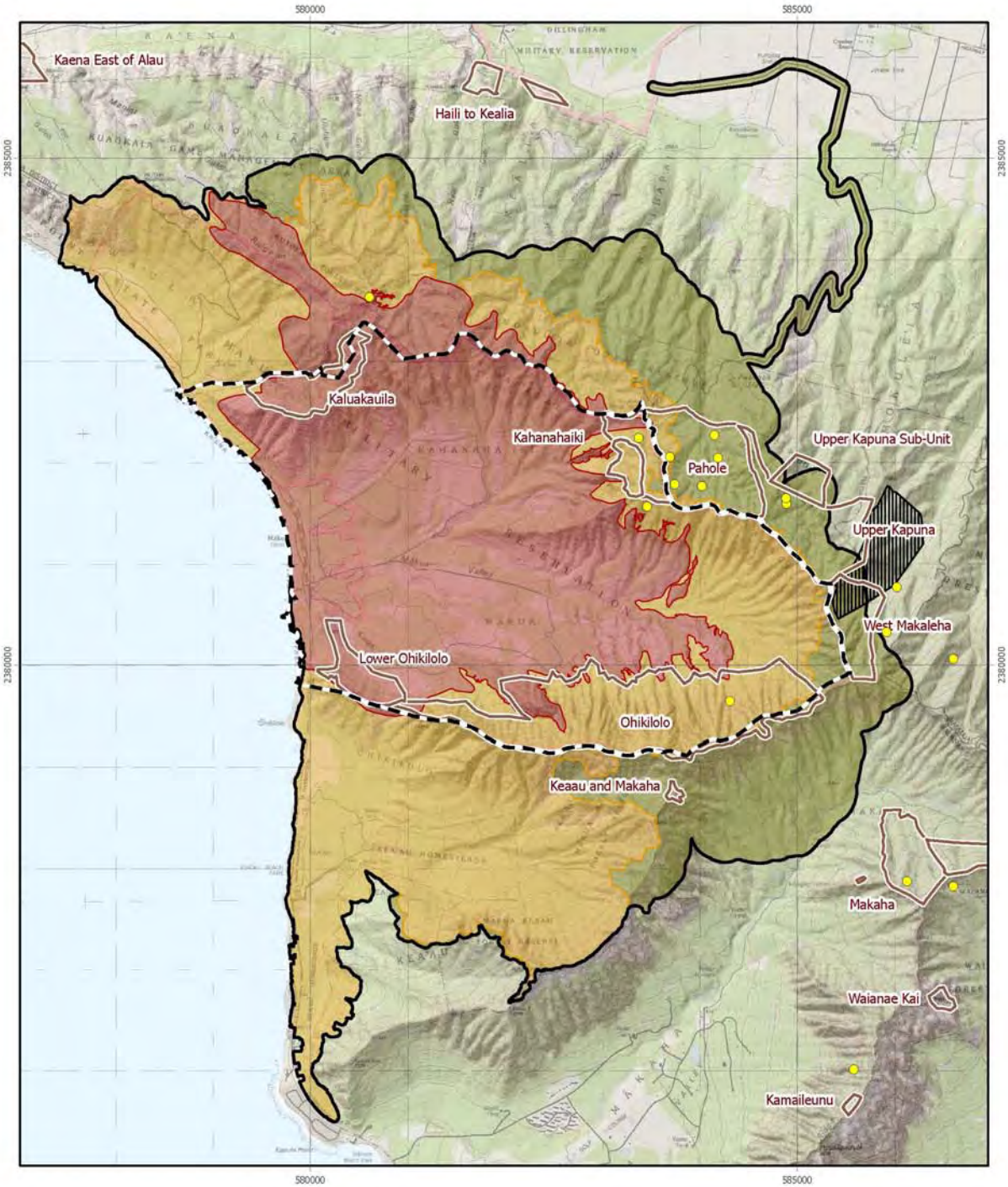



**Figure E 44**
**Diellia falcata**

- Species observation
- Critical habitat

- High Fire Risk Zone
- Low Fire Risk Zone
- Very Low Fire Risk Zone
- Management Units
- Makua Action Area
- Makua Military Reservation

**Island of Oahu**

0 0.5 1 Miles
0 0.5 1 Kilometers
N
1:54,000
UTM Zone 4, NAD1983

**EFFECTS OF THE ACTION – *Euphorbia haeleeleana* (Akoko)**

Of the estimated 934 to 1,094 range-wide individuals of *Euphorbia haeleeleana*, approximately 260 individuals are located in the Makua action area in the Kahanahaiki (34), Kaluakauila (199) and Keawaula (27) population units (Figure E 45). The *E. haeleeleana* trees in Makua represent a substantial portion of the total number of individuals (approximately 28 percent) range-wide. The largest population on Oahu (350 individuals) is located outside the action area within the Palikea Gulch to Kaumokunui population unit.

Species Response to the Proposed Action

The majority of the *Euphorbia haeleeleana* individuals, approximately 199 plants, are located in the Kaluakauila Management Unit in the high fire risk zone where they are at risk of injury or death from a training-related wildfire. The Kaluakauila Management Unit is located in a xeric area surrounded by flammable grasses and shrubs established from historical fires, and therefore, *E. haeleeleana* individuals are at high risk of burning in future training-related wildland fires. The majority of these plants reside is a small 24.3 ha (60 ac) remnant forest that has protected them to date. However, as fires sweep through the area the forest edge is continually impacted and edge habitat is lost as described in the General Effects – Fire Section. To minimize the risk to this species, the Army will implement weapons restrictions, provide improved grass mowing around the interior of the south lobe of the firebreak road, and increase fire suppression staffing. These requirements make it unlikely that a fire will escape containment due to initial attack and fire suppression resources, particularly prior to implementation of Column C weapons restrictions (see Table PD 2). In the event that a fire threatens this site, the 20-m wide (66-ft wide) fuelbreak, with its imbedded firebreak, adjacent to the forested areas of Kaluakauila Management Unit (see Figure PD 9) will provide firefighters, including red-carded Army Natural Resources Staff and fire suppression helicopters, a high likelihood of successfully preventing fire from burning additional forest in this area. Prior to implementation of Column C weapons restrictions, the 199 *E. haeleeleana* in the Kaluakauila Management Unit will be provided additional protection from fire, either with the completion of additional fuel modification work, or with selected stabilization measures.

The other 34 individuals of *Euphorbia haeleeleana*, outplanted in the Kahanakaiki Management Unit, occur in the low fire risk zone. There is a risk that a training related fire could impact some of these individuals due to their proximity to the high fire zone. However, to minimize the risk of fire to the plants growing on the edge and below the Kahanahaiki Management Unit (see Figure E 45), the Army will construct and maintain a new 40-m (131-ft) wide fuelbreak (see Figure PD 7 - section 3.1.4.1 ).

Despite the ongoing exposure of *Euphorbia haeleeleana* to live-fire training impacts, it is our opinion that Army conservation and stewardship programs will benefit this species. Approximately 230 individuals of *E. haeleeleana* are located in management units at Makua. These individuals benefit from the management activities conducted by the Army Natural Resources Staff as discussed in the General Effects.

Conclusion

A majority of the individuals of *Euphorbia haeleeleana* grow in xeric lowland habitat on Makua that make these plants very susceptible to training-related wildfire. If all plants are killed, this would result in a loss of 28 percent of the total range-wide individuals of this species which would have a detrimental impact to the ability of this species to persist for the long-term. To minimize the risk of fire to the plants in the action area, weapons restrictions, fire suppression staffing, and fuel modifications will be completed. Prior to implementation of Column C weapons restrictions, the 199 *E. haeleeleana* in the Kaluakauila Management Unit will be afforded additional protection from fire, either with the completion of additional fuel modification work, or with selected stabilization measures. Stabilization/expedited stabilization management measures for other taxa will benefit all species on an ecosystem wide basis over the long term as fences are constructed and other threats (rats, invertebrate pests and weed management) are abated. Proposed weapons restrictions, fuels management, fire suppression, stabilization actions including invasive species control will maintain or potentially allow for the increase of baseline numbers for *E. haeleeleana*.

**Effects of the Action on *Euphorbia haeleeleana* Critical Habitat**

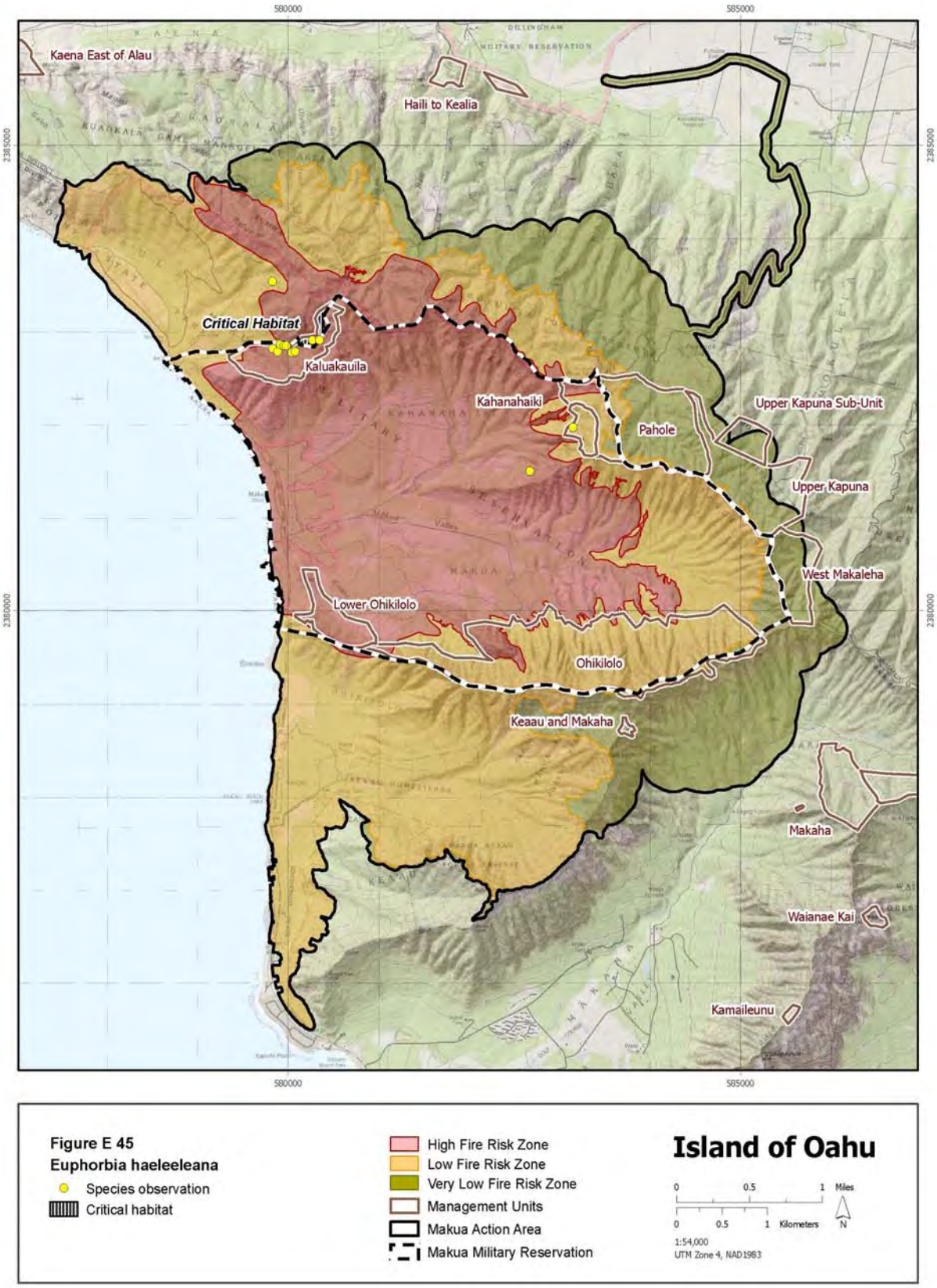
There is one critical habitat unit within the northwestern portion of the Makua action area, comprising one percent (4 ha; 11 ac) of the total critical habitat for *Euphorbia haeleeleana* (see Figure E 45). This unit is found in the high fire risk zone and was designated to provide a portion of the habitat necessary for the conservation of one population of at least 300 mature individuals of *E. haeleeleana* (68FR 35950). The primary constituent elements essential for this species include, but are not limited to, dry forest dominated by *Diospyros* sp. The primary constituent elements that may be affected by a training-related fire include those associated native plant species found within dry forest dominated by *Diospyros* sp. It is estimated that the entire critical habitat is located in an area with greater than 75 percent native plant cover, indicating a slight encroachment of non-native plants within this critical habitat unit (K. Kawelo, pers. comm. 2004; 68 FR 35950). This critical habitat unit provides a portion of the habitat necessary for the expansion of the present population of *E. haeleeleana* in order to meet the recovery goals for this species. It is likely that the 2003 prescribed burn impacted a portion of this unit (G. Enriques, pers. comm. 2003). Fire removes the vegetative primary constituent elements, and non-native plant species subsequently outcompete the native plants so that natural recruitment is precluded. In the absence of habitat management, additional fires from future training actions will add to the degradation of this critical habitat unit.

This critical habitat unit is approximately 1 km (0.6 mi) from the impact area and is almost entirely (95 percent) within the Kalaukauila Management Unit. Due to the proximity of this unit to the fire source, there is a risk that a fire started in the impact area could move north and impact this unit. The risk of fire in this critical habitat unit is high. The surrounding vegetation consists of highly flammable non-native grasses and forest (see Figure E 5). The 2003 prescribed burn impacted a portion of this critical habitat unit (see Figures E 3 and E 23) (G. Enriques, pers. comm. 2003). The consequences of this fire event are the encroachment of non-native grasses in the critical habitat and increased risk of future fires in the unit. The loss of vegetative primary

constituent elements in this unit would remove its ability to provide habitat for the conservation of a portion of one population of *E. haeleeleana*. To reduce the risk of fire to listed species and sensitive habitats, the Army has prepared a fire management plan for the Kaluakauila Management Unit. Implementation of this plan will reduce the risk of fire due to the construction of a fuel modification zone between the impact area and the management unit. Fuel modifications in and around the Kaluakauila Management Unit will provide a buffer between the impact area and critical habitat unit. In addition, this management unit is currently fenced and the Army is working to reduce non-native plants within the enclosure. The removal of ungulates and non-native invasive plant species within this management unit enhances the conservation value of the critical habitat unit.

Conclusion

The critical habitat unit for *Euphorbia haeleeleana* in the Makua action area is located in the high fire risk area. Implementation of all fire suppression measures incorporated into this action and the Army's standard operating procedures will reduce the likelihood that a fire will ignite and travel outside of the firebreak road or that a misfired round will ignite outside of the firebreak road. The risk of fire will be reduced due to the construction of a fuel modification zone between the impact area and the Kaluakauila Management Unit. In addition, fuel reduction within the management unit will further buffer the critical habitat unit from fire. Pursuant to the Makua Implementation Plan, the critical habitat unit will be managed to improve its baseline quality in the Kaluakauila Management Unit. Without this management, this critical habitat unit would eventually lose most of the elements essential to the survival and recovery of the species because of the ongoing threats to this habitat (e.g., ungulates and non-native plant encroachment). We considered this continued degradation of *E. haeleeleana* critical habitat in the evaluation of the effects of the proposed action. Most importantly, even though there may be a temporal loss of vegetation due to a fire, the restoration of these areas by the Army will provide habitat essential for the conservation of *E. haeleeleana* and allow for the long-term recovery goals of this species. Therefore, training-related fire events will not result in adverse modification of critical habitat for *E. haeleeleana.*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Kaena East of Alau
Haili to Kealia
Critical Habitat
Kaluakauila
Kahanahaiki
Pahole
Upper Kapuna Sub-Unit
Upper Kapuna
West Makaleha
Lower Ohikilolo
Ohikilolo
Keaau and Makaha
Makaha
Waianae Kai
Kamaileunu
Figure E 45
Euphorbia haeleeleana
Species observation
Critical habitat
High Fire Risk Zone
Low Fire Risk Zone
Very Low Fire Risk Zone
Management Units
Makua Action Area
Makua Military Reservation
Island of Oahu
0 0.5 1 Miles
0 0.5 1 Kilometers
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1:54,000
UTM Zone 4, NAD1983

**EFFECTS OF THE ACTION – *Lepidium arbuscula* (Pepperwort; Anaunau)**

There are approximately 50 individuals of *Lepidium arbuscula* in the action area (five percent) located in the Ohikilolo, Keeau, Lower Makua and Kuaokala population units (Figure E 46). This species is an Oahu endemic and presently there are an estimated 900 extant individuals island-wide. Due to the abundance and distribution of this species outside of the action area, the Army is not responsible for species stabilization pursuant to criteria as outlined in the Makua Implementation Plan (Makua Implementation Team 2003).

Species Response to the Proposed Action

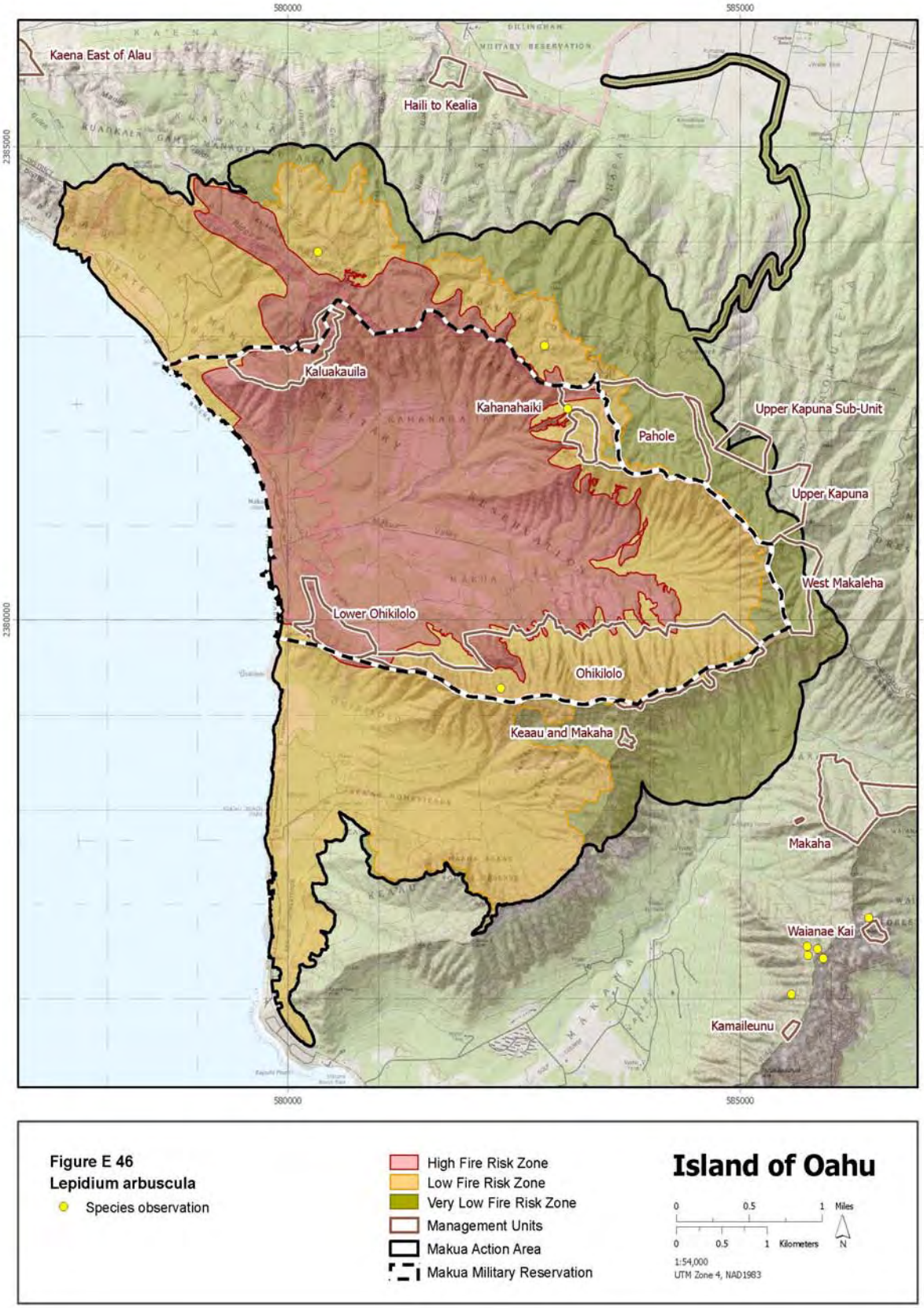
*Lepidium arbuscula* favors the dry to mesic habitat in Makua where all 50 individuals are located in the low fire risk zone. Individuals of *L. arbuscula* will be exposed to the direct and indirect effects of training related wildland fire that could result in their injury or death. The result of a wildland fire could be the direct loss of any plants in the path of the fire. *Lepidium arbuscula* is distributed in four to five population units from the north of Makua (north of Kaluakauila Management Unit), to the east in the Kahanahaiki Management Unit, and to the south in the Ohikilolo Management Unit. A wildland fire could spread into any of these areas from the valley floor, ignite on a ridgeline from a misfired long-range, live-fire weapon such as the TOW, or start from a spot fire resulting from an intense grass fire in the valley. Some individuals of *L. arbuscula* are located near the high fire risk zone (i.e., located closer to the valley floor) and are therefore more susceptible to a training-related fire. However, fire detection and suppression response is designed to prevent a fire ignited by misfired weapons landing in forest and shrub areas from burning more than 0.1 ha (0.3 ac). Inadequate detection and suppression response could enable these fires to burn more than 40 ha (100 ac) in a 48-hr period (see General Effects - Fire Suppression). It is extremely unlikely that all, or even a significant portion, of the 50 *L. arbuscula* plants will be lost in training-related wildland fires. It is our opinion that the risk of fire destroying more than one population of *L. arbuscula* is very low due to their scattered distribution and this loss will not significantly hinder the future existence of this species.

In addition to wildland fire, *Lepidium arbuscula* will also be exposed to the direct and indirect impacts of non-native plants, slugs, rats, and ungulates. These effects reduce the vigor, reproduction, recruitment, and survival of individual plants. Although this is a non-stabilization species, *L. arbuscula* will benefit from the stabilization actions implemented by the Natural Resources Staff such as fencing, weed control, pest management and ungulate removal. Thus, the overall effect of the proposed action's stressors and subsidies will result in maintenance and possibly a net increase in the baseline number of individuals, distribution, and recruitment of *L. arbuscula* in and adjacent to the action area over the next 30 years.

Conclusion

Only five percent of all known *Lepidium arbuscula* individuals occur within the action area. Weapons restrictions, fire suppression helicopter staffing, pre-planning and implementation of suppression actions by skilled NWCG-qualified fireline supervisors, and new fuelbreaks and firebreaks will minimize the risk of a fire impacting *L. arbuscula* in the action area. The potential damage or loss of *L. arbuscula* individuals from fire will be offset by the ongoing

efforts of the Army's Natural Resources Staff as they implement stabilization actions for this species pursuant to the Makua Implementation Plan and the Makua Implementation Plan Addendum. Based on our analysis of the effects of the actions outlined in the Project Description including fire minimization measures, the Service believes that the risks associated with the Army's proposed action are outweighed by the long-term benefits of the Army's stabilization actions and ecosystem management.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Kaluakauila
Kahanahaiki
Pahole
Upper Kapuna Sub-Unit
Upper Kapuna
West Makaleha
Lower Ohikilolo
Ohikilolo
Keaau and Makaha
Makaha
Waianae Kai
Kamaileunu
Figure E 46
Lepidium arbuscula
Species observation
High Fire Risk Zone
Low Fire Risk Zone
Very Low Fire Risk Zone
Management Units
Makua Action Area
Makua Military Reservation
Island of Oahu
0 0.5 1 Miles
0 0.5 1 Kilometers
N
1:54,000
UTM Zone 4, NAD1983

**EFFECTS OF THE ACTION – *Lobelia niihauensis* (No Common Name)**

There are estimated to be between 1,700 and 3,700 individuals of *Lobelia niihauensis* distributed on several islands. Approximately 475 individuals occur in the action area in the Ohikilolo, Kahanahaiki, Eastern Makua and Keaau population units (Figure E 47). This represents between 12 and 30 percent known individuals State-wide. There is a substantial population on Kauai (between 960 and 2,900 individuals in 14 population units). Due to the abundance and distribution of this species, the Army is not responsible for stabilization of *L. niihauensis.* The focus of this species-specific analysis is to assess the risk of loss of individuals from a training related wildland fire.

Species Response to the Proposed Action

Individuals of *Lobelia niihauensis* will be exposed to the direct and indirect effects of training related wildland fire that could result in their injury or death. The result of a wildland fire would be the direct loss of any plants in the path of the fire. Indirect effects of wildland fire include heat, erosion and post-fire recruitment of non-native, competitive plants (see General Effects). The vast majority (over 400; U.S. Army Garrison 2005) of the *L. niihauensis* plants in Makua are located in the low fire risk zone within the Ohikilolo Management Unit.

The risk assessment for this species includes several factors including distribution of *Lobelia niihauensis* within the action area, distance from the high fire zone and impact area. A wildland fire could spread into Ohikilolo Ridge from the valley floor, start on the ridge from a misfired long-range, live-fire weapon such as the TOW, or start from a spot fire resulting from an intense grass fire in the valley. Some individuals of *L. niihauensis* are located near the high fire risk zone (i.e., located closer to the valley floor) and are therefore more susceptible from a training-related fire. However, fire detection and suppression response is designed to prevent a fire ignited by misfired weapons landing in forest and shrub areas from burning more than 0.1 ha (0.3 ac). Inadequate detection and suppression response could enable these fires to burn more than 40 ha (100 ac) in a 48-hr period (see General Effects - Fire Suppression). The risk of a wildland fire spreading from the valley floor (impact area) up the ridge is very low due the fire suppression measures that will be enacted to impede fire spread. In addition, the spread of a wildland fire will be limited due to the discontinuous fuels on the cliffs along Ohikilolo Ridge, and therefore, the risk of affecting all plants in one fire in this area is very low.

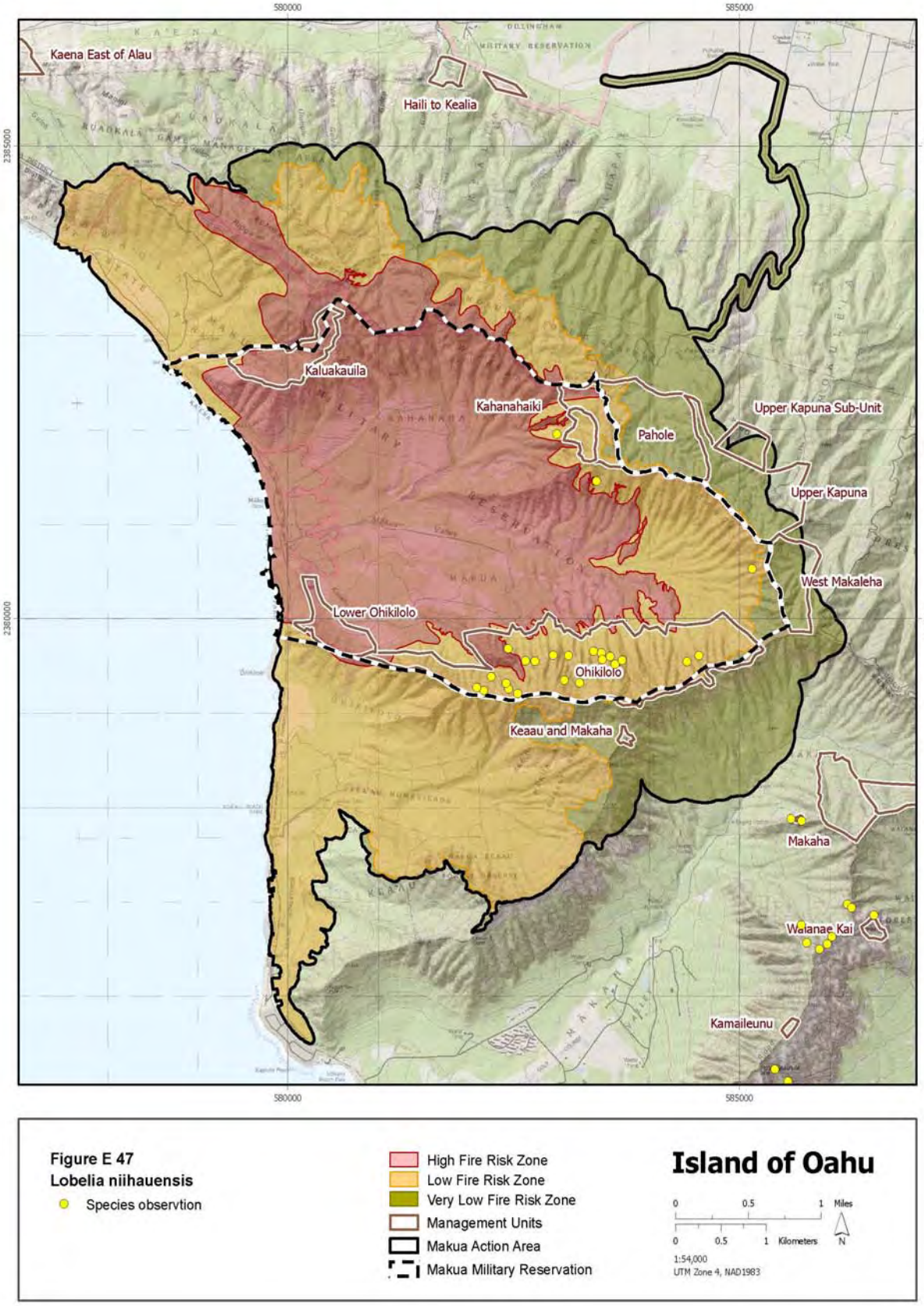
There are approximately 60 individuals in the Keaau Management Unit. This management unit is in the very low fire risk zone. The Keaau Management Unit will be fenced in 2009. Fencing and other ecosystem level management efforts inside the management units will benefit this species. It is extremely unlikely that all, or even a significant portion, of the 475 *Lobelia niihauensis* plants in the action area will be lost in training-related wildland fires, although some plants may be damaged or lost due to fires resulting from Army training activities.

However, based on the available data, numbers of individuals appear to be relatively stable from the time the species range-wide abundance was first estimated in 1991. There is a significant number of naturally occurring seedlings and immature individuals both inside and outside of the

action area, suggesting there is natural recruitment. There are three occurrences of *Lobelia niihauensis* outside the Makua action area that are represented by more than 50 mature reproducing individuals (U.S. Army Garrison 2005). In addition, a boundary ridgeline fence protects a major part of the Ohikilolo Management Unit, and goats have been virtually eradicated from this portion of Makua.

Conclusion

Military training restrictions and stabilization management implemented for other taxa will benefit this species. Weapons restrictions, fire detection, fire suppression helicopter staffing, and implementation of suppression actions by skilled NWCG-qualified fireline supervisors will minimize the risk of a fire burning *Lobelia niihauensis* in the action area. Based on our analysis of the effects of the actions outlined in the Project Description including fire minimization measures, the Service believes that the risks associated with the Army's proposed action are outweighed by the long-term benefits of the Army's fencing, rat control, weed removal and ecosystem management will benefit this species. Overall, the minimal risk of impact from training-related actions and the beneficial resource management activities to be conducted at Makua outweigh the Army training-related risk to this species.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Haili to Kealia
Kaluakauila
Kahanahaiki
Pahole
Upper Kapuna Sub-Unit
Upper Kapuna
West Makaleha
Lower Ohikilolo
Ohikilolo
Keaau and Makaha
Makaha
Waianae Kai
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Figure E 47
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Species observtion
High Fire Risk Zone
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Makua Action Area
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UTM Zone 4, NAD1983

**EFFECTS OF THE ACTION – *Peucedanum sandwicense* (Makou)**

There are approximately 25 individuals of *Peucedanum sandwicense* in the action area (U.S. Army Garrison 2005) out of an estimated population of over 1,150 individuals (Figure E 48). Only about two percent of *P. sandwicense* individuals occur in the action area, thus this species is not a stabilization species. The 25 individuals of *P. sandwicense* are exposed to the suite of threats as described and analyzed in the General Effects section of this Biological Opinion**.**

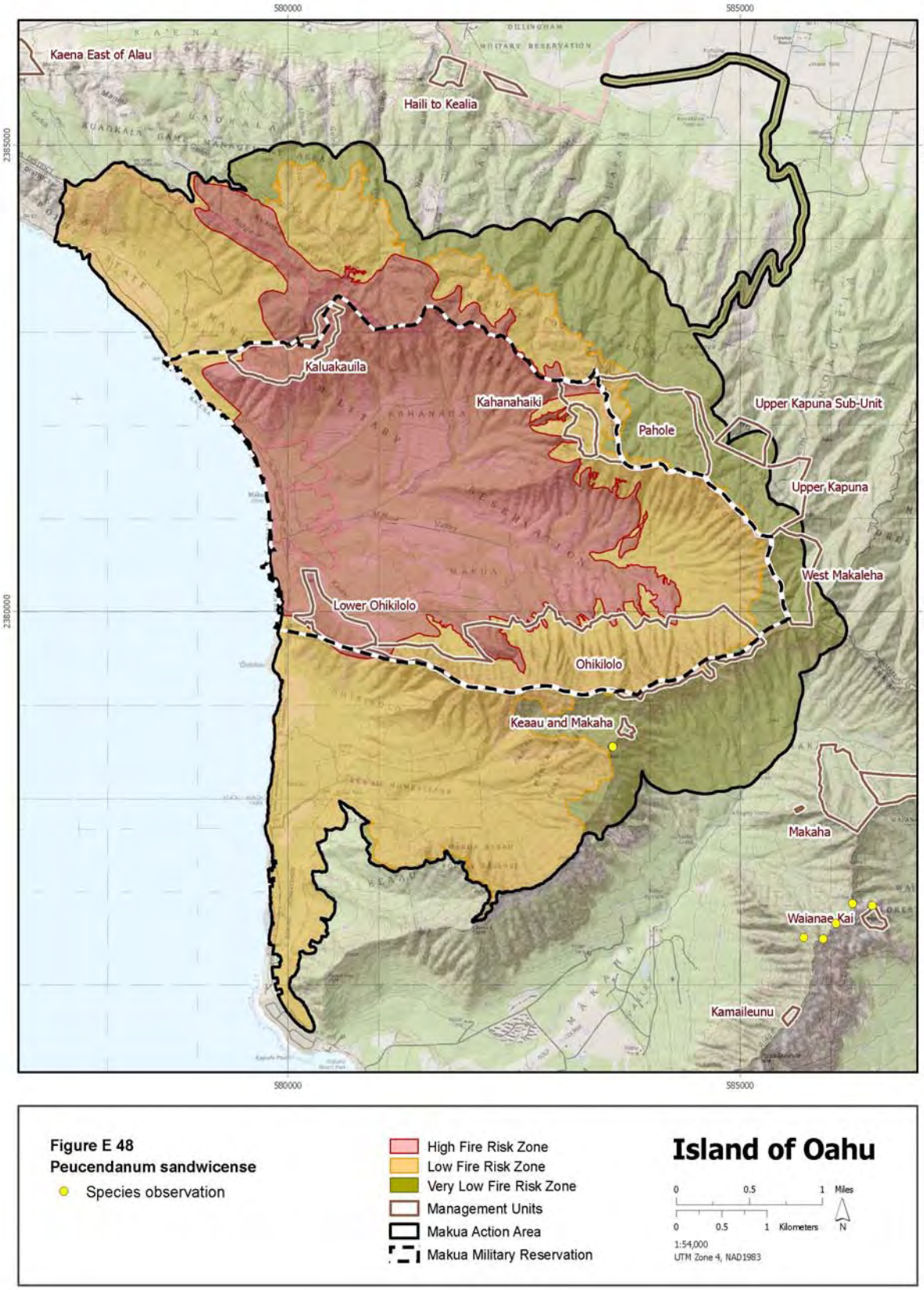
It is difficult to determine accurately the abundance of *Peucedanum sandwicense* since this species is a short-lived perennial herb and fluctuations in numbers are normal depending upon environmental conditions. Variation in rainfall along with other abiotic and biotic factors may account for these fluctuations. However, based on the low number of individuals in the action area the likelihood of this species persisting in Makua over time is low (Brook et al 2006). Then again, seeds of *P. sandwicense* may persist in the soil and there may be increased occurrences of this species if suitable environmental conditions arise. The abundance of *P. sandwicense* on Oahu appears to be relatively stable from the time when the species range-wide abundance was first estimated in 1991. On Kauai there are over 1,000 individuals, suggesting *P. sandwicense* is self-sustaining on that island.

Species Response to the Proposed Action

*Peucedanum sandwicense* will be exposed to the direct and indirect effects of a training-related wildland fire. The risk is very low for this species due to its location in the Keaau Management Unit located on the southern slope of the Ohikilolo Ridgeline. The Keaau Management Unit will be fenced in 2009, which will allow for ecosystem-level management efforts inside the management unit. Fencing and other threat abatement actions conducted by the Army Natural Resources Staff such as rat baiting and non-native plant removal will benefit the remaining *P. sandwicense* plants and residual seedbank and could lead to an increase in baseline numbers, distribution, and reproduction of *P. sandwicense* in and adjacent to the action area over the next 30 years.

Conclusion

There are approximately 25 individuals of *Peucedanum sandwicense* within the action area, and it is estimated that there are several thousand mature, reproducing individuals offsite. Weapons restrictions, fire suppression helicopter staffing, pre-planning and implementation of suppression actions by skilled NWCG-qualified fireline supervisors, and new fuelbreaks and firebreaks will minimize the risk of a fire burning *P. sandwicense* in the action area. Overall, the risk of loss of individuals of this species to training related wildland fires is very low (see General Effects) and the proposed action of fencing in 2009 to preclude grazing pressure will benefit this species over time.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Haili to Kealia
Kaluakauila
Kahanahaiki
Pahole
Upper Kapuna Sub-Unit
Upper Kapuna
West Makaleha
Lower Ohikilolo
Ohikilolo
Keaau and Makaha
Makaha
Waianae Kai
Kamaileunu
Figure E 48
Peucendanum sandwicense
Species observation
High Fire Risk Zone
Low Fire Risk Zone
Very Low Fire Risk Zone
Management Units
Makua Action Area
Makua Military Reservation
Island of Oahu
0 0.5 1 Miles
0 0.5 1 Kilometers
N
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UTM Zone 4, NAD1983

**EFFECTS OF THE ACTION – *Schiedea hookeri* (No Common Name)**

*Schiedea hookeri* is endemic to the Waianae Mountains on Oahu with an estimated range-wide abundance of between 400 and 500 individuals. In the Makua action area, there are approximately 130 individuals (90 mature and 40 seedlings) located in the Kahanahaiki, Kaluakauila, Keaau and Ohikilolo population units (Figure E 49). Therefore, about 25 to 30 percent of all known *S. hookeri* individuals occur within the action area. This species is a non-stabilization species due to overall distribution and abundance.

Species Response to the Proposed Action

*Schiedea hookeri* plants in the action area are at risk of injury or death from training-related wildland fire. Approximately 52 mature individuals occur in the Kaluakauila Management Unit located in the high fire-risk area. The Kaluakauila Management Unit is located in a xeric area surrounded by flammable grasses and shrubs established from historical fires, and therefore, *S. hookeri* individuals are at high risk of burning in future training-related wildland fires. The majority of these plants reside is a small 24.3 ha (60 ac) remnant forest that has protected them to date. However, as fires sweep through the area the forest edge is continually impacted and edge habitat is lost as described in General Effects – Fire Suppression. To minimize the risk to this species, the Army will implement weapons restrictions, provide improved grass mowing around the interior of the south lobe of the firebreak road, and increase fire suppression staffing. These requirements make it unlikely that a fire will escape containment due to initial attack and fire suppression resources, particularly prior to implementation of Column C weapons restrictions (see Table PD 2). In the event that a fire threatens this site, the 20-m (66-ft) wide fuelbreak, with its imbedded firebreak, adjacent to the forested areas of Kaluakauila Management Unit (see Figure PD 9) will provide firefighters, including red-carded Army Natural Resources Staff and fire suppression helicopters, a high likelihood of successfully preventing fire from burning additional forest in this area. Prior to implementation of Column C weapons restrictions, the 50 *S. hookeri* in the Kaluakauila Management Unit will be provided additional protection from fire, either with the completion of additional fuel modification work, or with selected stabilization measures (see General Effects – Fire Suppression).

There are approximately 20 mature individuals just south of the Kahanahaiki Management Unit (see Figure E 49). These individuals are in the low fire risk zone and are located on a ridge top less than 10 m (30 ft) from the high fire risk zone. There is a risk the individuals in this occurrence will be impacted by training related wildland fires especially due to their proximity to more flammable fuels located in the high fire risk zone. To minimize the risk of fire to the plants growing below the Kahanahaiki Management Unit, the Army will construct and maintain a new 40-m (130-ft) wide fuelbreak (see Figure PD 7 - section 3.1.4.1 ).

There are approximately four *Schiedea hookeri* in the Ohikilolo Management Unit and 12 in the Keaau Management Unit in areas of low to very low fire risk. A wildland fire could ignite from a training-related misfired long-range, live-fire weapon such as the TOW, or from a spot fire spread by high winds. However, both of these populations are somewhat protected due to their distance from the impact area or the topography of the Ohikilolo ridgeline. Fire detection and suppression response is designed to prevent a fire ignited by misfired weapons landing in forest

and shrub areas from burning more than 0.1 ha (0.3 ac). Inadequate detection and suppression response could permit these fires to burn more than 40 ha (100 ac) in a 48 hour period (see General Effects - Fire Suppression).

*Schiedea hookeri* is also exposed to the suite of threats as described and analyzed in the General Effects. Although this species is not a stabilization species, many individuals are located in fenced management units (Kaluakauila) or protected by the ridgeline fence on Ohikilolo. These plants benefit from reduced ungulate herbivory and some level of weed management. *Schiedea hookeri* will benefit from the stabilization actions implemented by the Army Natural Resources Staff in the action area. Thus, the overall effect of the proposed action's stressors and subsidies will result in maintenance and possibly a net increase in baseline number of individuals, distribution, and reproduction of *S. hookeri* in and adjacent to the action area over the next 30 years.

Conclusions

There are only between 400 and 500 individuals of *Schiedea hookeri* remaining in the Waianae Mountains; therefore, this species has a high background risk of extinction due to stochastic events. Prior to implementation of Column C weapons restrictions, the 50 *S. hookeri* in the Kaluakauila Management Unit will be afforded additional protection from fire, either with the completion of additional fuel modification work, or with selected stabilization measures. Military training restrictions and stabilization management for other taxa will decrease the likelihood this species will be extirpated from the action area. Weapons restrictions, fire suppression helicopter staffing, pre-planning and implementation of suppression actions by skilled NWCG-qualified fireline supervisors, and new fuelbreaks and firebreaks will minimize the risk of a fire burning *S. hookeri* in the action area. The potential damage or loss of *S. hookeri* individuals from fire will be offset by the ongoing efforts of the Army's Natural Resources Staff as they implement stabilization actions. Therefore, based on our analysis of the effects of the actions outlined in the Project Description including fire minimization measures, the Service believes that the risks associated with the Army's proposed action are outweighed by the long-term benefits of the Army's management actions.

**Effects of the Action on *Schiedea hookeri* Critical Habitat**

There are two critical habitat units within the Makua action area, comprising three percent (30 ha; 75 ac) of the total critical habitat for *Schiedea hookeri* (see Figure E 49). Close to 100 percent (6 ha; 14 ac) of the critical habitat in the action area is in an area of high fire risk. Critical habitat unit A, which is currently occupied, was designated to provide habitat for the conservation of a portion of one population of *S. hookeri*. Critical habitat unit B, which is unoccupied, is part of a larger 717 ha (1,771 ac) unit that extends outside of the action area and was designated to provide habitat for the conservation of two populations of *S. hookeri*. Each population will be comprised of at least 300 mature, reproducing individuals in order to meet the recovery goals for this species (68FR 35950). The primary constituent elements essential to the species include, but are not limited to, slopes, cliffs or cliff bases, rock walls, or ledges in diverse mesic or dry lowland forest often dominated by *Metrosideros polymorpha* (ohia), *Diospyros sandwicensis* (lama), or *Diospyros hillebrandii* (lama). The primary constituent elements that

may be affected by a training-related fire include those associated native plant species found within diverse mesic or dry lowland forest often dominated by ohia or lama. It is estimated that about one-half of the critical habitat is located in an area with 25 to 50 percent native plant cover, and the remainder is located in an area with 50 to 75 percent native plant cover (K. Kawelo, pers. comm. 2004; 68 FR 35950; 68 FR 35950). This indicates that half of the critical habitat is degraded due to non-native plant encroachment.

Portions of critical habitat unit A have been impacted by past fire events, which further diminishes the conservation value of this habitat. Fire removes the vegetative primary constituent elements, and natural recruitment is precluded by aggressive, faster-growing non-native plants species. In the absence of habitat management, additional fires from future training actions could add to the degradation of these critical habitat units by removing the remaining vegetative primary constituent elements.

Critical habitat unit A (5 ha; 12 ac) is in the northwestern portion of the action area and entirely within the Kaluakauila Management Unit. This unit is approximately 1 km (0.6 mi) from the impact area and the risk of fire in this xeric grassland habitat is high. The 2003 prescribed burn impacted a portion of critical habitat unit A (G. Enriques, pers. comm. 2003). Due to the close proximity of this unit to the fire source, there is a risk that a fire started in the impact area could move north and impact this critical habitat unit. The fire risk is increased due to the surrounding vegetation that is dominated by *Panicum maximum* (see Figure E 5), which is highly flammable and can increase frequency and size of wildland fires (Beavers et al 1999). The loss of the vegetative primary constituent elements of this unit would remove its ability to provide a portion of the habitat necessary for the conservation of one population of *Schiedea hookeri*. To reduce the risk of fire to listed species and sensitive habitats, the Army will prepare a fire management plan for the Kaluakauila Management Unit. Implementation of this plan will reduce the risk of fire due to the construction of a fuel modification zone between the impact area and the management unit. Fuel modification will buffer the Kaluakauila Management Unit from fires that spread outside the impact area and in turn help reduce the probability that critical habitat unit A will burn. In addition, this management unit is currently fenced and the Army is working to reduce non-native plants within the exclosure. The removal of ungulates and non-native invasive plant species within this management unit enhances the conservation value of this critical habitat unit.

Critical habitat unit B (20 ha; 49 ac) is in the northeastern portion of the action area, almost entirely in an area of low and very low fire risk. Only 0.8 ha (2 ac) are in a high fire risk area. There is a risk that a fire started in the impact area could move east and impact this unit or that a misfired round could ignite outside of the firebreak road and burn into this critical habitat. The loss of vegetative primary constituent elements within this unit would remove its ability to provide for the conservation of a portion of two populations of *Schiedea hookeri*. However, this risk is reduced due to the beneficial resource management actions conducted by the Army, pursuant to the Makua Implementation Plan, in the management unit; the low flammability of the surrounding vegetation (mesic forest); and spatial separation from the impact area. Approximately 25 ha (approximately 61 ac), or 80 percent, of the critical habitat is in management units. Two tenths of an acre is located in the Upper Kapuna Management Unit and 20 ha (49 ac) are in the West Makaleha Management Unit. Less than one-half of one hectare

(0.47 ha; 1.2 ac) is in the Central and East Makaleha Management Unit. The Army plans to complete the West Makaleha Management Unit fence and to fence the Upper Kapuna Management Unit. Ungulates will be removed from these fenced areas. The removal of ungulates and non-native plants from within the West Makaleha and Upper Kapuna management units enhances the conservation value of both critical habitat units. The Army is working to reduce non-native plants in both of these management units, thereby reducing their fuel load and the risk of fire. In addition, the Army is conducting rat control in the West Makaleha Management Unit to reduce their impact on listed and associated native plants. The remaining critical habitat (6 ha; 14 ac) outside of the management units is separated from the impact area by the management units. The fuel modification activities plus other threat reduction measures implemented by the Army for species stabilization will further reduce the risk of fire to this portion of the critical habitat.

To reduce the negative impacts to critical habitat from any fire that escapes the firebreak road, the Army has committed to revegetate burned areas with native plant species to restore the area to pre-burn conditions. The revegetation plan will address restoration of burned areas by replanting native plant species (primary constituent elements) and controlling non-native, competitive plant species. While there may be a temporal loss of the conservation value of these critical habitat units during the revegetation process, the ability of these units to provide habitat essential for the conservation of *Schiedea hookeri* will be retained in the long-term.

Conclusion

Implementation of all fire suppression measures incorporated into this action and the Army's standard operating procedures will reduce the likelihood that a fire will ignite and travel outside of the firebreak road or that a misfired round will ignite outside of the firebreak road. The risk of fire to the critical habitat in the Kaluakauila Management Unit will be reduced due to the construction of a fuel modification zone between the impact area and this management unit. In addition, fuel reduction within the management units will further buffer both critical habitat units from fire. The critical habitat in unit A and the portions of critical habitat unit B in management units will be managed to improve their baseline quality pursuant to the Makua Implementation Plan. Without this management, these critical habitat units would eventually lose most of the elements essential to the survival and recovery of the species because of the ongoing threats to this habitat (e.g., ungulates and non-native plant encroachment). The Service considered this continued risk of modification to *S. hookeri* critical habitat in the evaluation of the effects of the proposed action. Most importantly, even though there may be a temporal loss of vegetation due to a fire, the restoration of these areas by the Army will provide habitat essential for the conservation of *S. hookeri* and allow for the long-term recovery goals of this species. Therefore, training-related fire events will not result in adverse modification of critical habitat for *S. hookeri.*

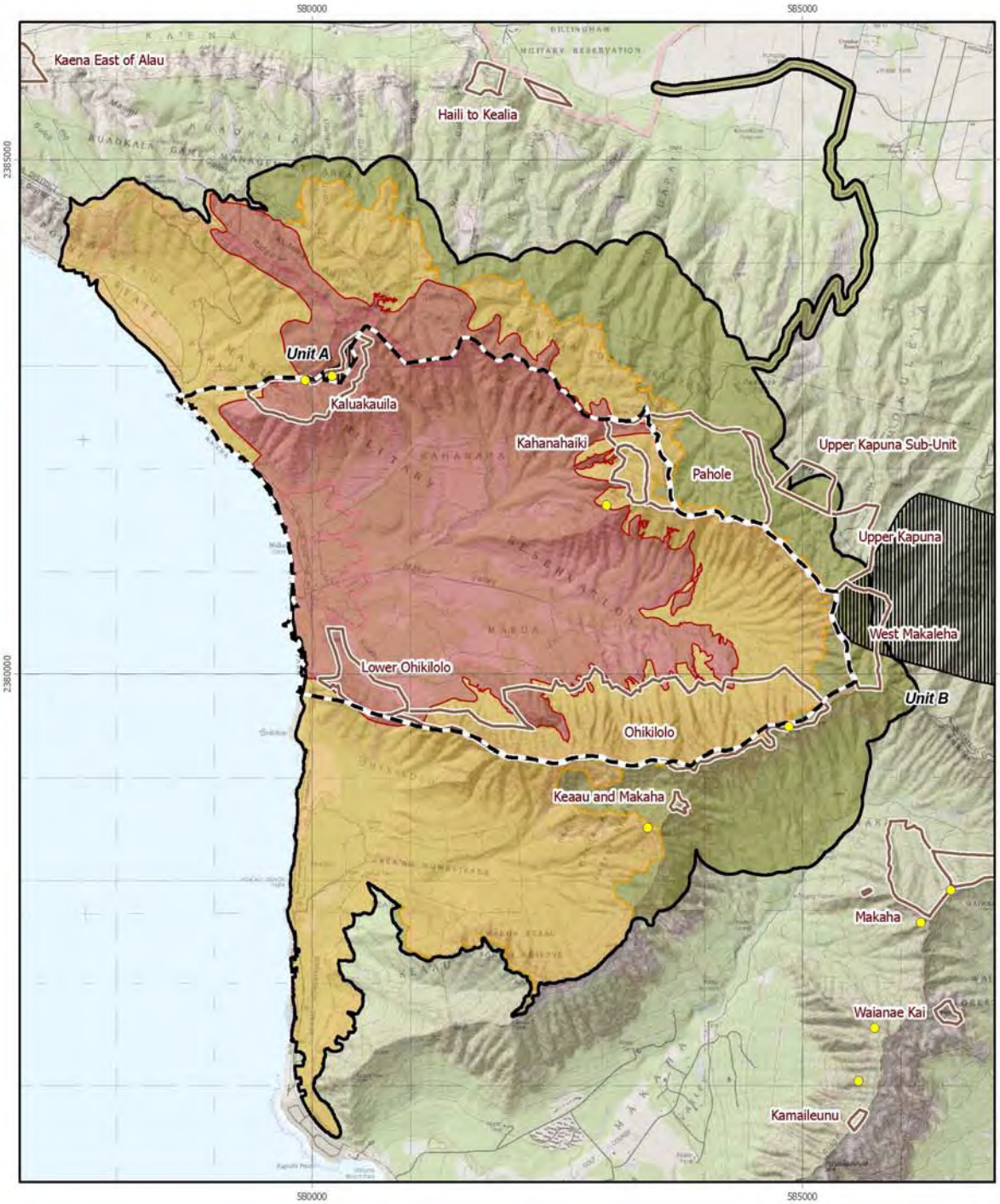


**Figure E 49**
**Schiedea hookeri**

- Species observation
- Critical habitat

- High Fire Risk Zone
- Low Fire Risk Zone
- Very Low Fire Risk Zone
- Management Units
- Makua Action Area
- Makua Military Reservation

**Island of Oahu**

0 0.5 1 Miles
0 0.5 1 Kilometers
N

1:54,000
UTM Zone 4, NAD1983

**EFFECTS OF THE ACTION – *Silene lanceolata* (No Common Name)**

The 24 individuals of *Silene lanceolata* in the action area occur along the ridgeline of the Ohikilolo Management Unit. There are between 600 and 1,000 individuals of *S. lanceolata* on Oahu, Hawaii and Molokai. Roughly 15 percent of *S. lanceolata* individuals on Oahu are found within the action area with approximately 2 percent of the range-wide population located in the action area (Figure E 50). In addition to individuals found in the action area on Oahu, *S. lanceolata* also occurs in the Waianae Kai Population Unit.

The number of *Silene lanceolata* individuals in the action area has declined since the first survey was conducted in 1996. In 1996, there were approximately 40 mature individuals and today there are only 11 mature individuals. It is difficult to assess changes in the abundance *S. lanceolata* outside of the action area, as estimates of total number of individuals has varied greatly since the species range-wide abundance was first estimated in 1991. The focus of this species-specific analysis is to assess the risk of loss of individuals from a training-related wildland fire for this non-stabilization species.

Species Response to the Proposed Action

All of the *Silene lanceolata* individuals are located in the Ohikilolo Management Unit, in the low fire risk zone where they are at risk of injury or death from a training-related wildland fire. A wildland fire could spread into Ohikilolo Ridge from the valley floor, start on the ridge from a misfired long-range, live-fire weapon such as the TOW, or start from a spot fire resulting from an intense grass fire in the valley. However, fire detection and suppression response is designed to prevent a fire ignited by misfired weapons landing in forest and shrub areas from burning more than 0.1 ha (0.3 ac). In addition, the risk of a wildland fire spreading from the valley floor (impact area) up the ridge is very low due the fire suppression measures that will be enacted to impede fire spread (see General Effects – Fire Suppression). The spread of a wildland fire will be limited by the discontinuous fuels on the cliffs, and therefore, the risk of affecting all plants in one fire in this area is very low.

*Silene lanceolata* occur behind a ridgeline fence that precludes grazing by feral ungulates. In addition, this species will benefit from the activities conducted by the Army Natural Resources Staff as they implement stabilization measures for other plant taxa. Therefore, fencing and other ecosystem level management efforts inside the management units will benefit this species. Thus, the overall effect of the proposed action's stressors and subsidies will result in maintenance and possibly a net increase in the baseline number of individuals, distribution, and recruitment of *S. lanceolata* in and adjacent to the action area over the next 30 years.

Conclusion

There are very few individuals of *Silene lanceolata* within the action area and there are between 600 and 1,000 individuals range-wide, therefore, even the worse case scenario of extirpation from the action area would not be a significant loss for this species. Weapons restrictions, fire suppression helicopter staffing, pre-planning and implementation of suppression actions by skilled NWCG-qualified fireline supervisors, and new fuelbreaks and firebreaks will minimize

the risk of a fire burning *S. lanceolata* in the action area. Stabilization/expedited stabilization management measures for other taxa will benefit all species on an ecosystem-wide basis over the long-term as fences are constructed and other threats (rats, invertebrate pests and weed management) are abated. Weapons restrictions, fuels management, fire suppression, stabilization actions including invasive species control will maintain or potentially allow for the increase of baseline numbers for *S. lanceolata*. Based on our analysis of the effects of the actions outlined in the Project Description including fire minimization measures, the Service believes that the risks associated with the Army's proposed action are outweighed by the long-term benefits of the Army's stabilization actions and ecosystem management.

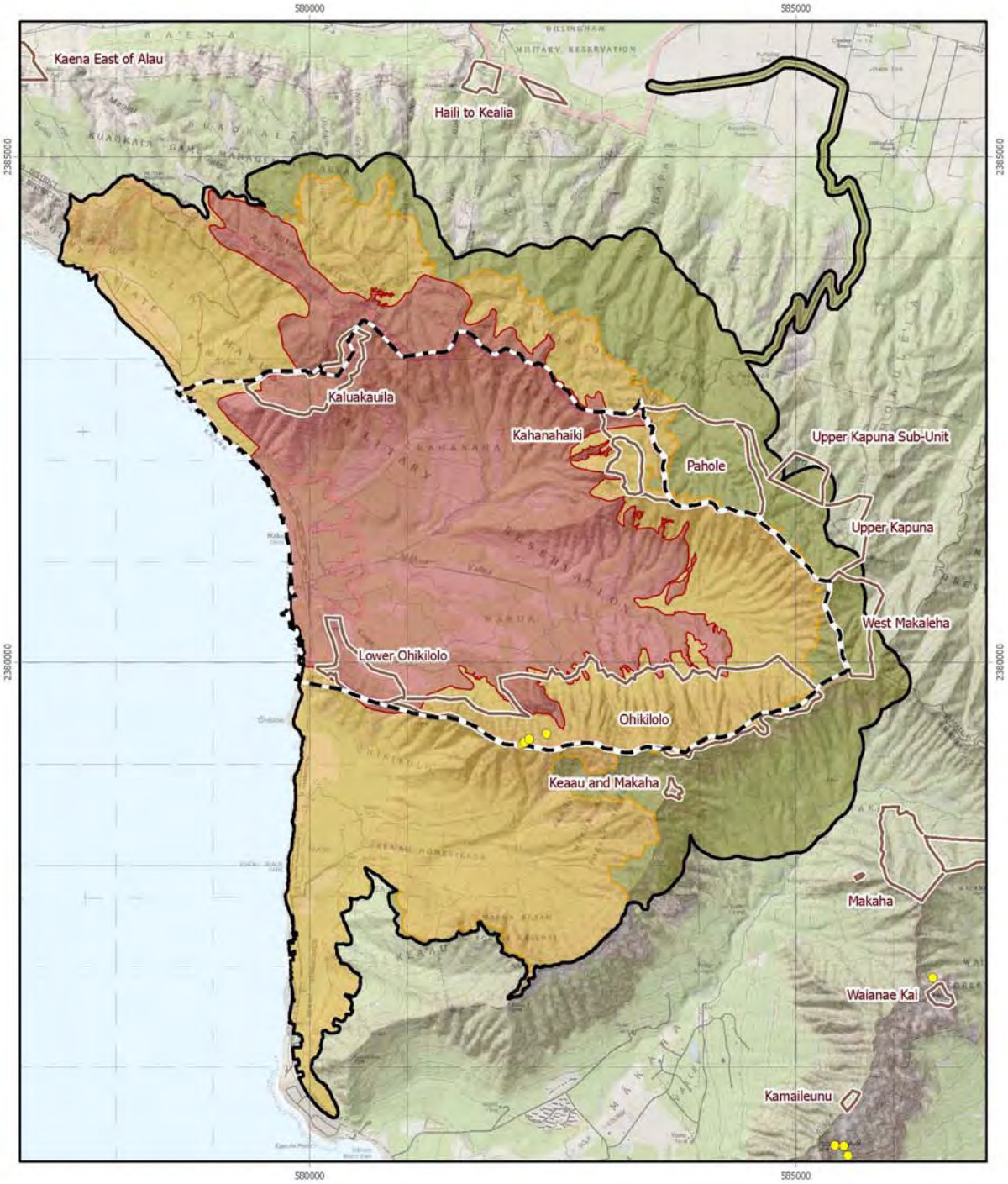


**Figure E 50**
**Silene lanceolata**

Species observation

High Fire Risk Zone
Low Fire Risk Zone
Very Low Fire Risk Zone
Management Units
Makua Action Area
Makua Military Reservation

**Island of Oahu**

0 0.5 1 Miles
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UTM Zone 4, NAD1983

**EFFECTS OF THE ACTION – *Spermolepis hawaiiensis* (No Common Name)**

*Spermolepis hawaiiensis* is an annual and its numbers fluctuate significantly from year to year, depending on climatic conditions and other unknown factors. Most recent survey efforts located 356 *S. hawaiiensis* in the action area in Ohikilolo, Lower Ohikilolo, and Kaluakauila management units (Figure E 51). Depending on environmental conditions, several thousand to over ten thousand *S. hawaiiensis* are found in a given year throughout this species' multi-island range (Service 2003b and U.S. Army Garrison 2005b). Thousands of plants are known to grow on Daimond Head on Oahu, and Army Natural Resources Staff recently discovered 200 *S. hawaiiensis* in the Kamaileunu Management Unit, outside the action area (Susan Ching pers. comm.). *Spermolepis hawaiiensis* is also found on Kauai, Molokai, Lanai, West Maui, and the island of Hawaii. Approximately five percent of all *S. hawaiiensis* individuals occur within the action area.

Species Response to the Proposed Action

*Spermolepis hawaiiensis* plants in the action area are located in the Ohikilolo and Lower Ohikilolo management units (354 individuals) and Punapohaku population unit (2 individuals), in the high fire risk zone. Sites where most of these plants occur are within the perimeters of many historic wildland fires, ignited by the public (along Farrington Highway) and the Army (see General Effects – Fire Suppression). Fire threat to this species is lower than for perennial plants in these areas, because *S. hawaiiensis*' vegetative growth occurs in the winter wet season when fire risk is lower. Intense fires associated with live-fire training may impact this species' soil seed bank in the summer. New weapons restrictions, improved grass mowing around the interior of the south lobe of the firebreak road, and increased fire suppression staffing requirements are likely to reduce the fire risk to these plants. Future long-term management unit-level fire protection systems will reduce fire risk to the individuals in Ohikilolo, Lower Ohikilolo, and Kamaileunu management units. Army wildland fire suppression support to the State and City and County will reduce fire threats to the Kamaileunu population unit, outside the action area. All *S. hawaiiensis* in the action area will benefit from ungulate exclosure and weed removal and the Kamaileunu fence and ungulate removal are scheduled to be completed by the Army in 2008. Thus, the overall effect of the proposed action's stressors and subsidies will result in maintenance and possibly a net increase in baseline numbers, distribution, and reproduction of *S. hawaiiensis* in and adjacent to the action area over the next 30 years.

Conclusion

Only a small percentage of *Spermolepis hawaiiensis* individuals occur within the action area; there are thousands of mature, reproducing individuals in approximately ten occurrences range-wide. Therefore this species has a low background risk extinction. Weapons restrictions, fire suppression helicopter staffing, pre-planning and implementation of suppression actions by skilled NWCG-qualified fireline supervisors, and new fuelbreaks and firebreaks will minimize the risk of a fire burning S. *hawaiiensis* in the action area. The potential damage or loss of S. *hawaiiensis* individuals from fire will be offset by the ongoing efforts of the Army's Natural Resources Staff as they implement ecosystem management actions within the management units. Fencing and ungulate control, weed control, and wildland fire suppression will reduce threats to

this species. Based on our analysis of the effects of the actions outlined in the Project Description including fire minimization measures, the Service believes that the risks associated with the Army's proposed action are outweighed by the long-term benefits of the Army's stabilization actions and ecosystem management.

**Effects of the Action on *Spermolepis hawaiiensis* Critical Habitat**

There is one critical habitat unit within the Makua action area, with 0.7 ha (1.7 ac), of the total State-wide critical habitat for *Spermolepis hawaiiensis* (see Figure E 51). The critical habitat unit is located in the southwestern portion of the action area within the high fire risk area. This unit was designated to provide a portion of the habitat for the conservation of one population with a minimum of 300 mature, reproducing individuals of *S. hawaiiensis* (68 FR 35950). The constituent elements essential for this species include, but are not limited to, steep or vertical cliffs or the base of cliffs or ridges in coastal dry cliff vegetation. The primary constituent elements that may be affected by a training-related fire include those associated native plant species found within coastal dry cliff vegetation. It is estimated that the entire critical habitat is within an area of vegetation that is predominantly non-native (K. Kawelo pers. comm. 2004; 68 FR 35950). This indicates that this critical habitat unit is degraded due to non-native plant encroachment.

Should a fire from future training actions impact this critical habitat unit, the loss of the vegetative primary constituent elements and the subsequent invasion by aggressive non-native plant species will preclude natural recruitment. In the absence of habitat management, fires from future training actions could continue to degrade this critical habitat unit by removing the remaining vegetative primary constituent elements.

The critical habitat unit is approximately 0.3 km (0.2 mi) from the fire source and approximately four percent (0.04 ha; 0.1 ac) of the unit is in the Lower Ohikilolo Management Unit. Due to the proximity of this unit to the fire source, there is a risk that a fire could move south and impact it. The risk of fire in this predominantly non-native habitat is high. The surrounding vegetation is dominated by flammable non-native species such as *Leucana leucocephala* (koa haole) and *Panicum maximum* (guinea grass). The consequences of future fire events in this area are the continued encroachment of non-native grasses and increased risk of future fires reaching the critical habitat. The loss of vegetative primary constituent elements within this unit would remove its ability to provide for a portion of the habitat necessary for the conservation of one population of *Spermolepis hawaiiensis*. Presently fuel modification is being conducted along the ridgeline between the management unit and the installation boundary to reduce the risk of fire in this area (K. Kawelo, pers. comm. 2004; 68 FR 35950). In the Lower Ohikilolo Management Unit, the Army is reducing non-native plants pursuant to the objectives in the Makua Implementation Plan. This action will decrease the risk of fire within the management unit by reducing the fuel load in the area. In addition, a fuel management plan will be prepared and implemented to address fuel modification along the northern portion of this unit. This will further reduce the risk of wildland fire from encroaching into the management unit. The remaining critical habitat (0.0 ha; 0.1 ac) outside the management unit is separated from the impact area by the management unit. The fuel modification activities, plus other conservation

actions implemented by the Army for species stability, will further reduce the risk of fire to the portion of critical habitat outside the management unit.

To reduce the negative impacts to the critical habitat unit from any fire that escapes the firebreak road, the Army has committed to revegetate burned areas with native plant species to restore the area to pre-burn conditions. The revegetation plan will address restoration of burned areas by replanting native plant species (primary constituent elements) and controlling non-native, competitive plant species. While there may be a temporal loss of the conservation value of this critical habitat unit during the revegetation process, the ability of this unit to provide a portion of the habitat essential for the conservation of one population of *Spermolepis hawaiiensis* will be retained in the long-term.

Conclusion

The critical habitat unit for *Spermolepis hawaiiensis* in the Makua action area is located in the high fire risk area. Implementation of all fire suppression measures incorporated into this action and the Army's standard operating procedures will reduce the likelihood that a fire will ignite and travel outside of the firebreak road or that a misfired round will ignite outside of the firebreak road. In addition, fuel reduction within the management unit will further buffer the critical habitat unit from fire. The portion of critical habitat unit that is within Lower Ohikilolo Management Unit will be managed to improve its baseline quality, pursuant to the Makua Implementation Plan. Without this management, this critical habitat unit would eventually lose most of the elements essential to the survival and recovery of the species because of the ongoing threats to this habitat (e.g., ungulates and non-native plant encroachment). We considered this continued degradation of *S. hawaiiensis* critical habitat in the evaluation of the effects of the proposed action. Most importantly, even though there may be a temporal loss of vegetation due to a fire, the restoration of these areas by the Army will provide habitat essential for the conservation of *S. hawaiiensis* and allow for the long-term recovery goals of this species. Therefore, training-related fire events will not result in adverse modification of critical habitat for *S. hawaiiensis.*

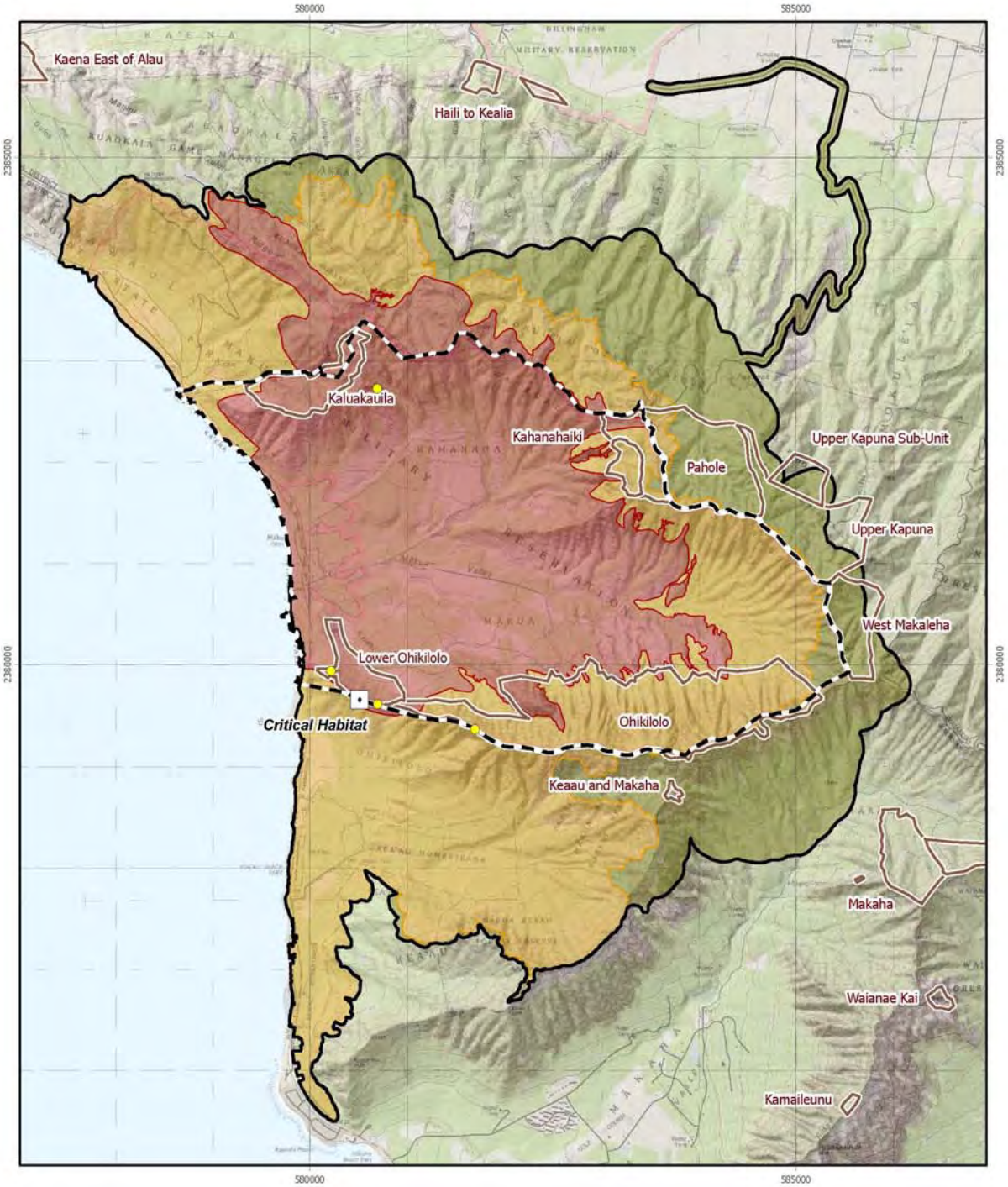



**Figure E 51**
**Spermolepis hawaiiensis**

- Species observation
- Critical habitat

- High Fire Risk Zone
- Low Fire Risk Zone
- Very Low Fire Risk Zone
- Management Units
- Makua Action Area
- Makua Military Reservation

**Island of Oahu**

0 0.5 1 Miles
0 0.5 1 Kilometers
N

1:54,000
UTM Zone 4, NAD1983

## EFFECTS OF THE ACTION ON PLANT CRITICAL HABITAT

Portions of designated critical habitat units for 36 plant taxa occur in the Makua action area. Location within the action area by definition means critical habitat is at risk of training-related wildfire. However, this risk is reduced because there is no critical habitat in Makua military reservation proper. Army-controlled (owned or leased) lands were excluded from plant critical habitat designation because they are covered by Integrated Natural Resource Management Plans (U.S. Army 2002) that adequately address the management and conservation of the listed species within these lands. Seventeen of the 36 taxa have critical habitat units designated on other islands besides Oahu. Individual effects analyses for each plant taxon with designated critical habitat in the action area follow this summary of effects to critical habitat in general.

*Bonamia menziesii*
*Cenchrus agrimonioides* var. *agrimonioides*
*Chamaesyce celastroides* var. *kaenana*
*Chamaesyce herbstii*
*Colubrina oppositifolia*
*Cyanea grimesiana* ssp. *Obatae*
*Cyanea longiflora*
*Cyanea superba* ssp. *Superba*
*Cyrtandra dentate*
*Delissea subcordata*
*Diellia falcate*
*Dubautia herbstobatae*
*Euphorbia haeleeleana*
*Flueggea neowawraea*
*Gouania vitifolia*
*Hedyotis degeneri* var. *degeneri*
*Hedyotis parvula*
*Hesperomannia arbuscula*
*Hibiscus brackenridgei* ssp. *mokuleianus*
*Isodendrion laurifolium*
*Isodendrion longifolium*
*Isodendrion pyrifolium*
*Mariscus pennatiformis*
*Melanthera tenuifolia*
*Melicope pallida*
*Neraudia angulata*
*Nototrichium humile*
*Phyllostegia kaalaensis*
*Plantago princeps* var. *princeps*
*Sanicula mariversa*
*Schiedea hookeri*
*Schiedea kaalae*
*Schiedea nuttallii*
*Schiedea obovata*
*Solanum sandwicense*
*Spermolepis hawaiiensis*

Status Summary of Critical Habitat

The best available scientific and commercial information is insufficient to determine the condition of plant critical habitat in the action area or throughout Oahu, or to predict quantifiable changes in the baseline conditions over the next 30 years, with or without the proposed action. In general, most native Hawaiian ecosystems are threatened by the same suite of factors related to the introduction and spread of non-native invasive species, and degradation and loss of native habitats. Nonetheless, the critical habitat units for these 36 plant taxa have a high existing background conservation value because they are generally designated on open, forested, or otherwise undeveloped lands that are important for the long-term recovery of listed plants. Recovery is dependent upon protection of existing population sites and suitable unoccupied habitat within the known historical range of these 36 taxa. Sites of these critical habitat units within the action area have high existing conservation value based on the quality, quantity, or availability of primary constituent elements. These primary constituent elements include topographic substrates (cliffs, gulches, rock walls, slopes, etc.) at specific elevations, native

vegetation types (e.g., *Acacia koa-Metrosideros polymorpha* lowland mesic forest), and associated native plant species. The plant communities, associated species, and elevations are indicative of important physical and biological features such as soil moisture, nutrient cycling and availability, and microclimate (temperature ranges and light levels) that provide the primary constituent elements of the habitat required for these species' conservation. The primary constituent elements also support the ability of action area critical habitat to provide a portion of the habitat essential for the conservation of one or more populations of listed plants.

The action area encompasses less than 10 percent of the entire designated critical habitat for each of 18 of the 36 plant taxa, and only one percent or less for nine of them. The action area encompasses more than half of the entire designated critical habitat for only two taxa, *Schiedea obovata* (71 percent of entire designated critical habitat within the action area) and *Cyrtandra dentata* (68 percent). Some areas of critical habitat for both of these taxa are located in the high fire risk zone.

Analyses for Effects of the Action

The proposed action is likely to adversely affect portions of designated critical habitat units for 36 plant taxa within the action area, primarily through exposure to the risk of training-related wildfire and the ongoing impacts of non-native species. Effects of human disturbance (such as trampling along trails) are considered minor. The primary constituent elements of critical habitat are vulnerable to high and low severity fires throughout the year, depending on plant phenology and the time of year the fire occurs. Units of critical habitat are located in various fire risk zones within the action area (see Table E 15). Overall, 20 plant taxa have critical habitat areas within the high fire risk zone, including eight at-risk taxa, seven stabilization taxa, and five non-stabilization taxa.

All vegetation cover types within critical habitat units in the action area will be exposed to training-related wildfire and the ongoing impacts of non-native species (see Figures PD 1 and PD 2). These cover types include native, non-native, and mixed vegetation types ranging from grasslands, shrublands, and forest in dry and mesic habitats. All plants at all life stages are vulnerable to high and low severity fires throughout the year, depending on phenology and the time of year fire occurs. As discussed in the "General Effects of Fire on Native Hawaiian Plants" section, non-native grasses in Hawaii are adapted to rapidly regenerating on recently burned or otherwise disturbed sites. Training-related wildfire will further degrade critical habitat units by removing native vegetation, facilitating conversion to alien grasses, and precluding natural regeneration and habitat restoration by native species. Thus, fire effects within the action area will contribute to a loss of habitat function and reduce the conservation role of action area critical habitat units to the entire designated critical habitats for these taxa range-wide.

Primary constituent elements of critical habitat will be exposed to the direct and indirect effects of training-related wildfire over the next 30 years, due to their occurrence within the action area (see Table E 16 below). All plants and life stages, and their substrates and microclimate conditions, are vulnerable to high and low severity fires throughout the year, depending on phenology and the time of year fire occurs. For example, 20 plant taxa have some critical habitat areas within the high fire risk zone, including the at-risk taxa *Chamaesyce herbstii*, *Cyanea*

*grimesiana* ssp. *obatae*, *Cyanea superba* ssp. *superba*, *Delissea subcordata*, *Gouania vitifolia*, *Hibiscus brackenridgei* ssp. *mokuleianus*, *Schiedea nuttallii*, and *Schieda obovata*. Vegetation in all high-risk areas is likely to burn under certain conditions. Even full staffing of on-site and standby fire suppression helicopter forces will not guarantee containment of all fires. On zero to 3.8 percent of historical potential training days analyzed, helicopter containment would have failed to contain a fire burning outside the firebreak road, if the fire had not been successfully contained before 1 pm. A fire escaping initial attack is likely to burn into the native forest (see Figure E 7 in General Effects), before additional helicopter support could arrive on-site. In addition, plants in the Kaluakauila, Kahanahaiki (C-Ridge vicinity), and Lower Ohikilolo management units are particularly vulnerable to training-related wildfire because they are located within dry, grassy areas that have burned in the past.

Plants growing in critical habitat areas outside the high fire risk zone are at a low to very low risk of burning from training-related wildfire. Twenty-four plant taxa have critical habitat areas in the low fire risk zone. These plants are likely to burn in fires that spread from fires that ignite in the high zone but close to the high fire risk boundary, from misfired or malfunctioning long-range weapons systems and munitions (tracers, AT-4 and SMAW anti-tank weapons, 2.75-caliber rockets, Javelin anti-tank missiles, and TOW missiles). Under certain adverse conditions (such as an unreported fire during an extreme drought), fires that start in or spread into the low fire risk zone could burn to the boundary of the very low fire risk zone.

Plants growing outside the low fire risk zone are at a very low risk of burning as a result of training-related wildfire ignited by a misfired or malfunctioning Javelin or TOW projectile under certain dry, windy weather conditions on steep slopes. Thirty of the 36 plant taxa with critical habitat have critical habitat areas located in the very low fire risk zone. These critical habitat units can burn from a “spot” fire, depending on topography, vegetation cover, weather, and suppression capability. The expected fire size from a misfired long-range Javelin or TOW projectile landing within intact shrub and/or forest vegetation is about 0.1 ha (0.3 ac), with immediate fire suppression response. If the fire is not noticed for 48 hours, it could spread over a maximum 40 ha (100 ac) before containment.

The areas exposed to training-related wildfire and invasive species in the action area include mixed native and non-native vegetation in mesic forest, dry forest, and dry grassland/shrubland habitats. Critical habitat units of several plant taxa are in or adjacent to areas at high risk of training-related wildfire within dry, grassy habitats of the Kaluakauila, Lower Ohikilolo, and Kahanahaiki (C-Ridge vicinity) management units. Critical habitat units within mesic, forested habitats in the Kahanahaiki, Pahole, Upper Kapuna, and West Makaleha management units are generally at lower risks of fire, except in areas of alien grass encroachment. Critical habitat units in the Ohikilolo Management Unit along the south valley rim and in the Keaau area beyond Ohikilolo Ridge are likewise at lesser risks of fire. Mesic conditions in upper-slope forests do not preclude the incidence of fire, however, especially during prolonged drought conditions in disturbed areas with grassy understories. The spread of wildfire from the C-Ridge area into the Kahanahaiki Management Unit, for example, is strongly influenced by grass. The 1995 and 2003 escaped prescribed burns increased the exposure of listed plants and primary constituent elements of critical habitat near this area to future fires by destroying native vegetation and increasing the alien grass cover. Much of the total critical habitat acreage in the action area is

located within fenced management units, but not all of them are regularly controlled for invasive weeds. Mesic forest vegetation in weed control areas is probably fairly well protected from the spread of catastrophic fire. Vegetation in locations lacking weed control are not well protected from long-term fire encroachment into native and mixed forest. In general, critical habitat units are at less risk of fire if they are separated from the Makua training impact area by management units that are protected from fire by firebreaks or fuels modification, or by management units that contain greater cover of native forest.

To reduce the risk of training-related wildfire to critical habitat, the Army will use certain types of weapons systems and munitions for training at Makua only after completion of specific measures to protect at-risk taxa and expedite their stabilization (see General Effects - Expedited Stabilization and Table PD 2). In addition, as part of the proposed action, the Army will implement conservation and stewardship programs to reduce the risk of ignition and spread of training-related wildfire (Wildland Fire Management Plan, Installation Natural Resource Management Plan), augment numbers of at-risk taxa in the wild (Makua Final Implementation Plan Addendum), improve native habitat in population units by excluding feral ungulates and controlling non-native weeds (Makua Final Implementation Plan Addendum), and restore any critical habitat that burns to pre-burn conditions (Installation Natural Resource Management Plan).

The risk of fire to critical habitat will be minimized by training restrictions, fire management, and expedited stabilization actions summarized in Table PD 2 (see Project Description). Fire minimization measures are based on required levels of helicopter staffing to contain fires before they escape the firebreak road. In addition, to reduce the fire risk to critical habitat for certain taxa adjacent to the Lower Ohikilolo Management Unit (such as *Gouania vitifolia*, *Hibiscus brackenridgei* ssp. *mokuleianus*, and *Spermolepis hawaiiensis*), the Army will not begin any live-fire or blank-fire training until alien grass cover is removed and controlled within 3 m (9.8 ft) of listed plants and to less than 20 percent cover within 20 m (65.6 ft) of all native plants. Additional fuels modification within a 60-m (197-ft) swath along the inside perimeter of the south firebreak road will allow the Army to somewhat reduce the level of on-site helicopter staffing required. The risk of fire to portions of critical habitat units adjacent to the Kahanahaiki Management Unit will be reduced by fuels modification zones between the impact area and the Kaluakauila, Kahanahaiki, and Lower Ohikilolo management units. Within 5 to 10 years, plants growing within the Kahanahaiki and Kaluakauila management units will be protected by fuels breaks and perimeter firebreaks; these protections will provide a buffer between fire-risk zones and some critical habitat units. With these fuel modifications in place, the Army may train using small arms, demolitions, grenades, mines, simulators, and mortars and artillery, with the use of certain of these weapons systems and munitions restricted to National Fire Danger Rating System Green conditions. With completion of expedited stabilization of the at-risk taxa *Cyanea superba* ssp. s*uperba*, *Schiedea nuttalli*, and *Schiedea obovata*, the Army may begin training with more weapons systems and munitions under Yellow conditions instead of only under green conditions; and begin using grenade launchers and AT-4 and SMAW weapons under green or yellowconditions, depending on live herbaceous fuel moisture. Expedited stabilization of all 12 at-risk taxa must be complete before the Army may begin training with tracer ammunition, Javelins, and 2.75-caliber rockets. Full stabilization of all 16 stabilization taxa and all 12 at-risk taxa must be complete before the Army may begin training with TOWs. All these training

restrictions and conservation measures will also benefit primary constituent elements of critical habitat where they co-occur.

Critical habitat within the management units will be managed to improve baseline quality. Without this management, some critical habitat units would eventually lose most of their constituent elements essential to the conservation of the species, in large part because of ongoing habitat threats associated with non-native invasive species. We considered this continued degradation of critical habitat in the evaluation of the affect of the proposed action. Most importantly, even though there may be a temporal loss of vegetation from fire, the Army's restoration of burned critical habitat areas will maintain or improve baseline conditions by replanting native plants (primary constituent elements) and by the control of non-native, competitive plant species. While there may be a temporary loss of the function of these critical habitat units after a fire and during the revegetation process, the ability of affected critical habitat units to provide a large portion of habitat essential for the conservation of 36 plant taxa will be retained in the long term. Overall, the Army's conservation and stewardship programs will benefit habitat essential for the conservation of 36 plant taxa in designated critical habitat units and contribute to the long-term recovery goals of these species.

Response of Critical Habitat the Proposed Action

The primary constituent elements of critical habitat in the action area are expected to experience changes in quality, quantity, or availability in response to the effects of the proposed action. Constituent elements include physical substrates (cliffs, gulches, etc., at specified elevations) and biological features (native plant associated species) in the action area that are expected to experience changes in quality (erosion, microclimate, species composition), quantity (relative proportion of native and non-native vegetation types), or availability (resulting from conversion to alien grassland) in response to the effects of the proposed action. The response of primary constituent elements to training-related wildfire and invasive species will include the direct and indirect effects of altered regeneration sites and microclimate conditions, plant injury and death by fire, ungulate grazing and trampling, invertebrate herbivory, and alien plant competition (see General Effects). As a result, the primary constituent elements of critical habitat in the action area are expected to decline in quality, quantity, or availability over the next 30 years. However, those changes in the conservation value of critical habitat would not be sufficient to appreciably reduce the conservation value of the entire, range-wide designated critical habitat for these 36 plant taxa. This conclusion implicitly recognizes the importance of spatial constituent elements such as total area in critical habitat units, spatial pattern and connectivity, and occurrence of contiguous areas large enough to potentially support populations of at least 300 individuals of a listed plant taxon.

The Service anticipates that implementation of fire management and species stabilization actions over the next 30 years will minimize training-related declines in quality, quantity, or availability of primary constituent elements of critical habitat of 36 plant taxa. The quality, quantity, and availability of primary constituent elements are expected to remain the same or improve within the action area, especially where they occur in management units for stabilization and at-risk species. The Army also will restore any critical habitat that burns as a result of training-related wildfire to pre-burn conditions. Any losses to primary constituent elements that occur as a result

of fire protection and habitat management will be temporary and will not result in permanent destruction or alteration of the physical and biological features of critical habitat. In addition, significant progress is expected over the next 30 years toward full threat control in the management units. For example, the exclusion and removal of ungulates from the Pahole, Upper Kapuna, and West Makaleha management units, and the control of non-native invasive plants to reduce fuel loads in the Kaluakauila, Kahanahaiki, and Lower Ohikilolo management units, will enhance the conservation value of critical habitat units that are within or adjacent to these management units. Spatial separation from the military training impact area and conservation measures implemented by the Army for species stabilization in the management units will further reduce the risk of fire for much of the critical habitat in the action area. The Army and the Service will closely monitor the condition of critical habitat and revise management actions as necessary to maintain its conservation value to listed plants. Overall, the response of constituent elements to project subsidies is expected to result in retention or improvement of their quality, quantity, and availability over the next 30 years by minimizing adverse impacts of training-related wildfire and non-native species. Any changes in the conservation value of constituent elements are not expected to be sufficient to appreciably reduce the conservation value of the entire, range-wide designated critical habitat.

## CONCLUSION

Based on the analysis above, the Service anticipates that stressors associated with training-related wildfire, and the introduction and spread of invasive species, are likely to result in adverse changes to critical habitat of 36 plant taxa by reducing by reducing the quality, quantity, or availability of primary constituent elements in the action area. Primary constituent elements will be exposed to high, moderate, and low risks of burning as a result of training-related wildfire over the next 30 years. The response of primary constituent elements to training-related wildfire will range from the direct effects of plant injury and death to the indirect effects of physiological stress, delayed mortality, habitat degradation, and competition with non-native species. The overall effect of training-related wildfire and spread of invasive species will be a further decline in conservation value of critical habitat to the 36 plant taxa within the action area. Critical habitat areas in the action area range from a minimum of less than 1 percent to a maximum of 71 percent of the entire designated critical habitats for these 36 plant taxa range-wide. Thus, reduced functionality of critical habitat in action area population units will significantly affect the range-wide status of these 36 plant taxa.

We develop our opinion using the best available scientific and commercial information, giving benefit of the doubt to the species if significant information gaps preclude determination of quantifiable effects. For example, the proposed action's training-related wildfire risk to critical habitat could be estimated more accurately with additional modeling to predict long-term fire frequency and encroachment in native and non-native vegetation types. Lacking that information, we infer from our knowledge and experience of the effects of fire and non-native species in native Hawaiian habitats (see General Effects) that any additional threats are likely to reduce the quality, quantity, or availability of primary constituent elements of critical habitat units in the action area. Our reasoning is based on information about the proposed action and the environmental baselines of primary constituent elements of critical habitat for 36 plant taxa in the action area. In addition, we make general inferences from this set of circumstances

according to conservation biology principles regarding habitat disturbance and from previous experience regarding threats to the conservation of native vegetation in Hawaii (see General Effects section). Accordingly, we consider Army conservation and stewardship programs, including the Wildland Fire Management Plan, indispensable to maintaining the conservation value of designated critical habitat for 36 plant taxa.

Our conclusion is based on our best professional judgment of the likely response of the primary constituent elements of critical habitat for 36 plant taxa to both stressors and subsidies of the proposed action. Military training restrictions and conservation management for stabilization of 28 listed plant taxa will benefit critical habitat units where they co-occur with these actions. We anticipate that Army ecosystem-level protection within management units will benefit critical habitat in the action area over the next 30 years. The Army's multiple actions to minimize and reduce the risk of fire, minimize introduction and spread of non-native species, restore any critical habitat that is burned as a result of training-related wildfire, and maintain or improve the current baseline for primary constituent elements of critical habitat in the action area. Critical habitat would remain functional, or retain the current ability for the primary constituent elements to be functionally established, to serve the intended conservation role for the 36 listed plant taxa. Therefore, after reviewing the current status of the critical habitat for 36 plant taxa, the environmental baseline for critical habitat of these taxa in the action area, and the effects of the proposed action and the cumulative effects, it is the Service's biological opinion that the proposed action is not likely to destroy or adversely modify designated critical habitat by appreciably reducing its value for the conservation of the following 36 listed plant taxa: *Bonamia menziesii*, *Cenchrus agrimonioides* var. *agrimonioides*, *Chamaesyce celastroides* var. *kaenana*, *Chamaesyce herbstii*, *Colubrina oppositifolia*, *Cyanea grimesiana* ssp. *obatae*, *Cyanea longiflora*, *Cyanea superba* ssp. *superba*, *Cyrtandra dentata*, *Delissea subcordata*, *Diellia falcata*, *Dubautia herbstobatae*, *Euphorbia haeleeleana*, *Flueggea neowawraea*, *Gouania vitifolia*, *Hedyotis degeneri* var. *degeneri*, *Hedyotis parvula*, *Hesperomannia arbuscula*, *Hibiscus brackenridgei* ssp. *mokuleianus*, *Isodendrion laurifolium*, *Isodendrion longifolium*, *Isodendrion pyrifolium*, *Mariscus pennatiformis*, *Melanthera tenuifolia*, *Melicope pallida*, *Neraudia angulata*, *Nototrichium humile*, *Phyllostegia kaalaensis*, *Plantago princeps* var. *princeps*, *Sanicula mariversa*, *Schiedea hookeri*, *Schiedea kaalae*, *Schiedea nuttallii*, *Schiedea obovata*, *Solanum sandwicense*, and *Spermolepis hawaiiensis*.

Table E 15. Environmental Baseline of Critical Habitat in the Action Area.

| Species | Critical Habitat in Action Area hectares (acres) | Percent of Total Critical Habitat in Action Area | Fire Risk† |
|---|---|---|---|
| *Bonamia menziesii* | 27.9 ( 69.0) | 2 | H, L |
| *Cenchrus agrimonioides* var. *agrimonioides* | 188.8 (466.6) | 15 | H, L, V |
| *Chamaesyce celastroides* var. *kaenana* | 29.7 ( 73.4) | 6 | H, L |
| *Chamaesyce herbstii* | 204.6 (505.5) | 41 | H, L, V |
| *Colubrina oppositifolia* | 20.7 ( 51.3) | <1 | V |
| *Cyanea grimesiana* ssp. *obatae* | 208.5 (512.2) | 25 | H, L, V |
| *Cyanea longiflora* | 177.0 (437.4) | 24 | L, V |
| *Cyanea superba* ssp. *superba* | 206.6 (510.5) | 23 | H, L, V |
| *Cyrtandra dentata* | 207.9 (513.7) | 68 | H, L, V |
| *Delissea subcordata* | 186.8 (461.6) | 12 | H, L, V |
| *Diellia falcata* | 13.7 ( 33.8) | 2 | V |
| *Dubautia herbstobatae* | 14.4 ( 35.5) | 16 | L, V |
| *Euphorbia haeleeleana* | 4.3 ( 10.5) | 1 | H, L, V |
| *Flueggea neowawraea* | 174.4 (430.8) | 6 | H, L, V |
| *Gouania vitifolia* | 84.2 (208.0) | 3 | H, L, V |
| *Hedyotis degeneri* var. *degeneri* | 212.1 (524.0) | 23 | H |
| *Hedyotis parvula* | 6.7 ( 16.5) | 1 | V |
| *Hesperomannia arbuscula* | 213.4 (527.3) | 12 | H, L, V |
| *Hibiscus brackenridgei* ssp. *mokuleianus* | 0.0 ( 0.1) | <1 | H |
| *Isodendrion laurifolium* | 62.0 (153.3) | 4 | V |
| *Isodendrion longifolium* | 0.5 ( 1.1) | <1 | V |
| *Isodendrion pyrifolium* | 1.3 ( 3.3) | <1 | H, L |
| *Mariscus pennatiformis* | 144.8 (357.8) | 11 | L, V |
| *Melanthera tenuifolia* | 67.4 (166.5) | 32 | L, V |
| *Melicope pallida* | 28.1 ( 69.3) | 2 | V |
| *Neraudia angulata* | 6.1 ( 15.0) | 1 | V |
| *Nototrichium humile* | 6.4 ( 15.9) | 1 | H, V |
| *Phyllostegia kaalaensis* | 106.5 (263.1) | 13 | L, V |
| *Plantago princeps* var. *princeps* | 61.8 (152.7) | 2 | L, V |
| *Sanicula mariversa* | 10.0 ( 24.8) | 11 | L, V |
| *Schiedea hookeri* | 30.3 ( 74.8) | 3 | H V |
| *Schiedea kaalae* | 150.5 (371.9) | 14 | L, V |
| *Schiedea nuttallii* | 199.7 (493.5) | 16 | H, L, V |
| *Schiedea obovata* | 164.5 (406.4) | 71 | H, L, V |
| *Solanum sandwicense* | 104.5 (258.2) | 4 | L, V |
| *Spermolepis hawaiiensis* | 0.7 ( 1.7) | <1 | H |
| *Chasiempis sandwichensis ibidis* | 1106.3 (2733.7) | 4 | H, L, V |

†Fire Risk: H (high), L (low), V (very low)

Table E 16. Fire Risk Exposure for Critical Habitat in the Action Area.

| | Fire Risk | | |
|---|---|---|---|
| | High | Low | Very Low |
| *Bonamia menziesii* | 8.1 (20.1)† | 19.8 ( 48.9) | -- |
| *Cenchrus agrimonioides* var. *agrimonioides* | 0.0 ( 0.1) | 14.8 ( 36.7) | 174.0 (429.9) |
| *Chamaesyce celastroides* var. *kaenana* | 4.1 (10.1) | 25.6 ( 63.3) | -- |
| *Chamaesyce herbstii* | 0.0 ( 0.1) | 19.7 ( 48.8) | 184.8 (456.6) |
| *Colubrina oppositifolia* | -- | -- | 20.8 ( 51.3) |
| *Cyanea grimesiana* ssp. *obatae* | 0.1 ( 0.3) | 15.7 ( 38.7) | 192.7 (476.2) |
| *Cyanea longiflora* | -- | 9.2 ( 22.6) | 167.9 (414.8) |
| *Cyanea superba* ssp. *superba* | 0.2 ( 0.5) | 17.1 ( 42.3) | 189.3 (467.7) |
| *Cyrtandra dentata* | 0.2 ( 0.6) | 17.6 ( 43.6) | 189.9 (469.2) |
| *Delissea subcordata* | 0.2 ( 0.6) | 13.0 ( 32.2) | 173.5 (428.7) |
| *Diellia falcata* | -- | -- | 13.7 ( 33.8) |
| *Dubautia herbstobatae* | -- | 1.7 ( 4.2) | 12.7 ( 31.4) |
| *Euphorbia haeleeleana* | 4.3 (10.6) | -- | -- |
| *Flueggea neowawraea* | 0.2 ( 0.6) | 16.8 ( 41.6) | 157.2 (388.5) |
| *Gouania vitifolia* | 1.7 ( 4.2) | 82.3 (203.3) | 0.2 ( 0.5) |
| *Hedyotis degeneri* var. *degeneri* | 0.2 ( 0.6) | 16.7 ( 41.3) | 195.0 (481.8) |
| *Hedyotis parvula* | -- | -- | 6.7 ( 16.5) |
| *Hesperomannia arbuscula* | 0.2 ( 0.6) | 17.8 ( 44.0) | 195.2 (482.3) |
| *Hibiscus brackenridgei* ssp. *mokuleianus* | 0.0 ( 0.1) | -- | -- |
| *Isodendrion laurifolium* | -- | -- | 62.0 (153.3) |
| *Isodendrion longifolium* | -- | -- | 0.4 ( 1.1) |
| *Isodendrion pyrifolium* | 0.8 ( 2.1) | 0.5 ( 1.2) | -- |
| *Mariscus pennatiformis* | -- | 13.4 ( 33.1) | 131.3 (324.4) |
| *Melanthera tenuifolia* | -- | 7.7 ( 19.0) | 59.6 (147.4) |
| *Melicope pallida* | -- | -- | 28.1 ( 69.3) |
| *Neraudia angulata* | 0.0 ( 0.0) | -- | 6.1 ( 15.0) |
| *Nototrichium humile* | 5.1 (12.6) | -- | 1.3 ( 3.3) |
| *Phyllostegia kaalaensis* | -- | 8.1 ( 19.9) | 98.4 (243.1) |
| *Plantago princeps* var. *princeps* | -- | 3.4 ( 8.3) | 58.3 (144.2) |
| *Sanicula mariversa* | -- | 0.3 ( 0.8) | 9.7 ( 24.0) |
| *Schiedea hookeri* | 5.8 (14.2) | 0.0 ( 0.0) | 24.5 ( 60.6) |
| *Schiedea kaalae* | 0.0 ( 0.0) | 7.4 ( 18.2) | 143.1 (353.6) |
| *Schiedea nuttallii* | 0.2 ( 0.6) | 17.1 ( 42.3) | 182.2 (450.2) |
| *Schiedea obovata* | 0.0 ( 0.1) | 14.5 ( 35.9) | 149.9 (370.4) |
| *Solanum sandwicense* | -- | 5.3 ( 13.2) | 99.1 (245.0) |
| *Spermolepis hawaiiensis* | 0.7 ( 1.7) | 0.0 ( 0.1) | -- |
| *Chasiempis sandwichensis ibidis* | 178.3 (440.6) | 388.4 (959.8) | 539.6 (1333.3) |

0.0 = trace (<0.1)

† = hectares (acres)

-- = no critical habitat present within exposure zone

## EFFECTS OF THE ACTION ON PLANT SPECIES WITH ONLY CRITICAL HABITAT IN THE ACTION AREA

### EFFECTS OF THE ACTION – *Colubrina oppositifolia* Critical Habitat

Approximately 21 ha (51 ac), or less than one percent of the total designated critical habitat for *Colubrina oppositifolia,* is located in the Makua action area (Figure E 52). The critical habitat is in the northeastern portion of the action area and outside of the high risk fire area within only the very low fire zone 20.75 ha (51.27 ac). The critical habitat unit is part of a larger 782 ha (1,935 ac), unit that extends outside of the action area and was designated to provide habitat for the conservation of three populations of *C. oppositifolia*. Each population will include at least 100 mature, reproducing individuals in order to meet the recovery goals for this species (68 FR 35950). The primary constituent elements essential for this species include, but are not limited to, lowland dry or mesic forests dominated by *Diospyros sandwicensis* (68 FR 35950). The primary constituent elements that may be affected by a training-related fire include those associated native plant species found within dry or mesic forests dominated by *D. sandwicensis*. It is estimated that 74 percent of the critical habitat is located in an area of no more than 50 percent native plant cover, indicating that the unit is somewhat degraded due to non-native plant encroachment (K. Kawelo, pers. comm. 2004; 68 FR 35950). Although somewhat degraded, the critical habitat unit still supports individuals of *C. oppositifolia* and provides habitat that is necessary for the expansion of this population. An increase of non-native vegetation creates a denser fuel load, thus increasing the risk of fire in this critical habitat unit. Resource management is necessary to reverse the trend of habitat degradation.

There is a very minimal risk that a fire could travel from the impact area or ignite outside of the impact area and burn into this unit. This is due to the beneficial actions conducted by the Army in the management units, the low flammability of the surrounding vegetation (mesic forest), and the spatial separation of the critical habitat from the impact area. Seventy-seven percent of the critical habitat unit is in management units (Upper Kapuna, Upper Kapuna Sub-Unit, West Makaleha management units). This critical habitat unit is located along the northern edge of the Upper Kapuna and West Makaleha management units, creating even a larger native forest buffer against a training-related fire (see Figure E 52).

The Army has fenced portions of the West Makaleha Management Unit and, in addition to fencing the remainder of this management unit, plans to fence the Upper Kapuna and Central and East Makaleha management units, pursuant to the Makua Implementation Plan. Ungulates will be removed from these fenced areas. The removal of ungulates and non-native plants from within management units enhances the conservation value of the critical habitat. The remaining critical habitat (5 ha; 12 ac) outside of the management units is separated from the impact area by the management units. The fuel modification activities plus other conservation measures implemented by the Army for species stabilization within the management units provides an additional buffer that will further reduce the risk of fire to the portion of the critical habitat outside of the management units.

Conclusion

The critical habitat unit for *Colubrina oppositifolia* in the Makua action area is located in the low fire risk area. Implementation of all fire suppression measures incorporated into this action and the Army's standard operating procedures will reduce the likelihood that a fire will ignite and travel outside of the firebreak road or that a misfired round will ignite outside of the firebreak road. The risk of fire will be reduced due to the beneficial resource management actions conducted by the Army in the management units such as fencing, removal of ungulates and non-native plants, the low flammability of the surrounding mesic forest vegetation, and the spatial separation between the impact area and the critical habitat unit. Without the fuel modification activities and other conservation measures, this critical habitat unit could eventually lose most of the elements essential to the survival and recovery of the species because of the ongoing threats to this habitat (e.g., ungulates and non-native plant encroachment). We considered this continued degradation of *C. oppositifolia* critical habitat in the evaluation of the effects of the proposed action. Most importantly, even though there may be a temporal loss of vegetation due to a fire, the restoration of these areas by the Army will provide habitat essential for the conservation of *C. oppositifolia* and allow for the long-term recovery goals of this species. Therefore, training-related fire events will not result in adverse modification of critical habitat for *C. oppositifolia.*

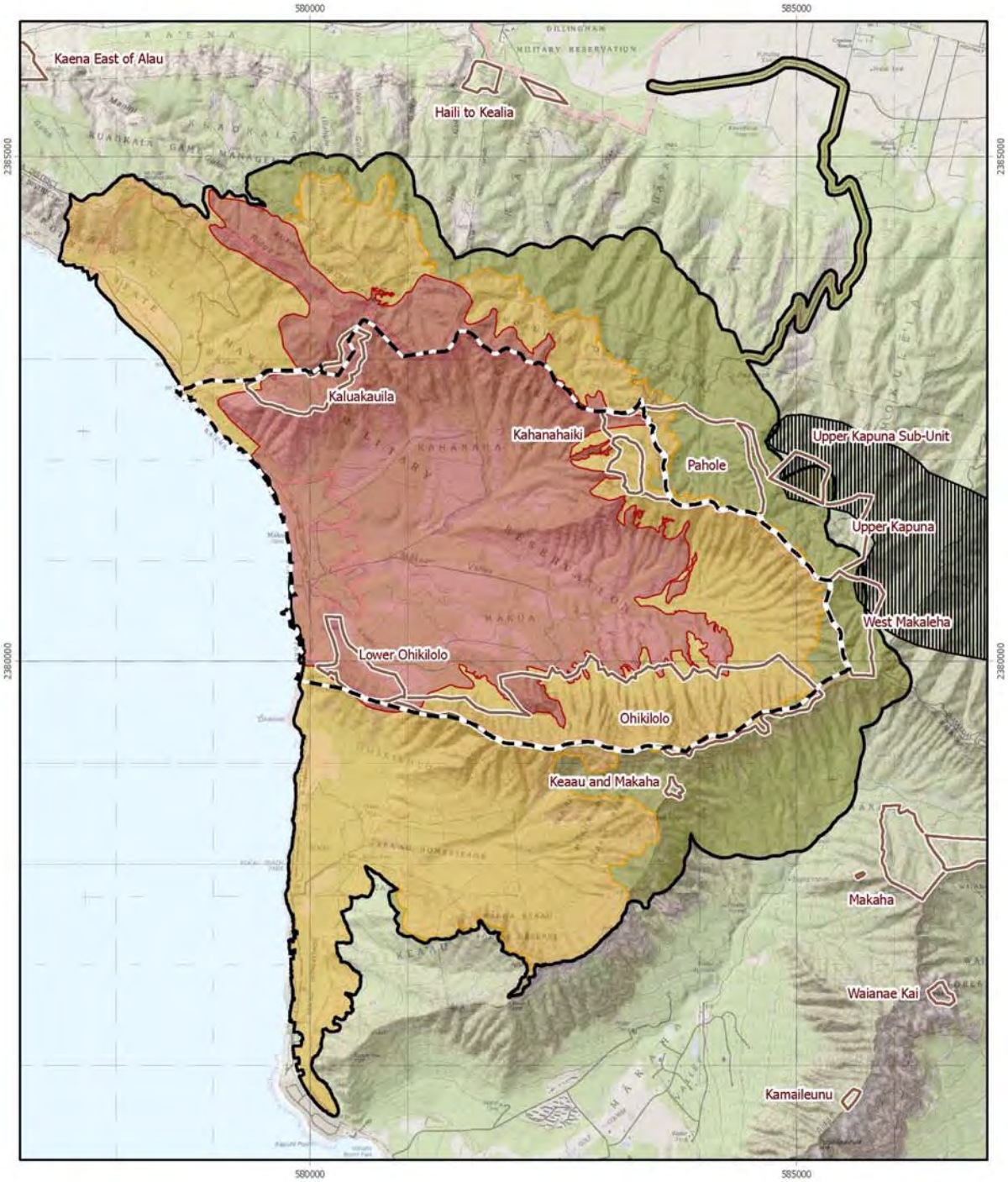



**Figure E 52**
**Colubrina oppositifolia**
Critical habitat

High Fire Risk Zone
Low Fire Risk Zone
Very Low Fire Risk Zone
Management Units
Makua Action Area
Makua Military Reservation

**Island of Oahu**

0 0.5 1 Miles
0 0.5 1 Kilometers
N
1:54,000
UTM Zone 4, NAD1983

**Effects of the Action on *Isodendrion laurifolium* Critical Habitat**

The critical habitat for *Isodendrion laurifolium* in the Makua action area represents approximately four percent (62 ha; 153 ac) of the total critical habitat designated for this species (Figure E 53). The unit, located in the northeastern portion of the action area, is in the very low fire risk zone. This portion of the critical habitat, together with 554 ha (1,371 ac) outside the Makua action area, was designated to provide habitat for the conservation of four populations, each with at least 300 reproducing individuals of *I. laurifolium* (68 FR 35950). The primary constituent elements essential for this species include, but are not limited to, gulch slopes, ravines, or ridges in diverse mesic or dry forest dominated by *Metrosideros polymorpha* (ohia), *Acacia koa* (koa), *Eugenia reinwardtiana* (nioi), or *Diospyros sandwicensis* (lama). The primary constituent elements that may be affected by a training-related fire include those associated native plant species found within diverse mesic or dry forest. It is estimated that more than one-half of the critical habitat is in an area with 50 to 75 percent native plant cover (K. Kawelo pers. comm. 2004; 68 FR 35950). This indicates that there is some encroachment of non-native plants in this critical habitat unit, and without management, the habitat could continue to degrade with removal of remaining vegetative primary constituent elements.

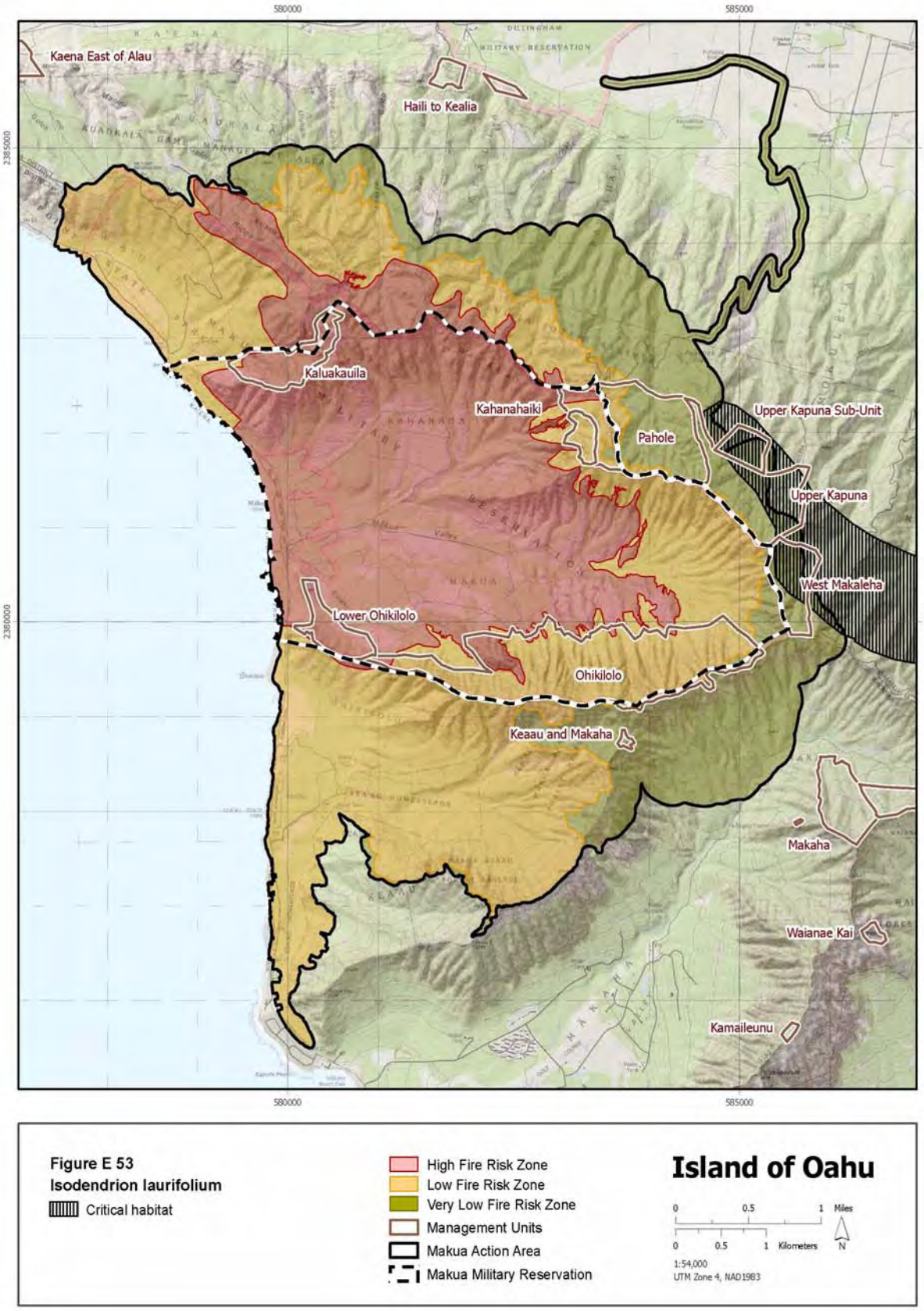
There is a risk that if a fire could move east and impact this unit. Seventy-one percent of the critical habitat unit is in management units (Upper Kapuna, Upper Kapuna Sub-Unit, West Makaleha). The Army has fenced portions of the West Makaleha Management Unit and plans to fence the remainder of this management unit, as well as the Upper Kapuna, and Central and East Makaleha management units, pursuant to the Makua Implementation Plan. Ungulates will be removed from all fenced areas. The Army is reducing non-native plants in all of these management units. In addition, the Army is conducting rat control in the West Makaleha Management Unit to reduce their impacts on listed and associated native plants. All of these threat abatement actions in the management units enhance the conservation value of the critical habitat. The remaining critical habitat (43 ha; 105 ac) outside of the management units is separated from the impact area by the management units themselves. The fuel modification activities plus other conservation measures implemented by the Army for species stabilization will further reduce the risk of fire to this critical habitat.

To reduce the negative impacts to critical habitat from any fire that escapes the firebreak road, the Army has committed to revegetate burned areas with native plant species to restore the area to pre-burn conditions. The revegetation plan will address restoration of burned areas by replanting native plant species (primary constituent elements) and by the control of non-native, competitive plant species. While there may be a temporal loss of the conservation value of this critical habitat unit during the revegetation process, the ability of this unit to provide habitat essential for the conservation of *Isodendrion laurifolium* will be retained in the long term.

Conclusion

The critical habitat unit for *Isodendrion laurifolium* in the Makua action area is located in the low and very low fire risk area. Implementation of all fire suppression measures incorporated into this action and the Army's standard operating procedures will reduce the likelihood that a fire will ignite and travel outside of the firebreak road or that a misfired round will ignite outside

of the firebreak road. The risk of fire will be reduced due to fuel reduction within the management units that buffer the critical habitat unit from fire. The portion of the critical habitat unit that is within the Upper Kapuna, Upper Kapuna Sub-Unit and West Makaleha management units will be managed to improve its baseline quality, pursuant to the Makua Implementation Plan. Without this management, this critical habitat unit would eventually lose most of the elements essential to the survival and recovery of the species because of the ongoing threats to this habitat (e.g., ungulates and non-native plant encroachment). We considered the continued degradation of *I. laurifolium* critical habitat in the evaluation of the effects of the proposed action. Most importantly, even though there may be a temporal loss of vegetation due to a fire, the restoration of this area by the Army will provide habitat essential for the conservation of *I. laurifolium* and allow for the long-term recovery goals of this species. Therefore, training-related fire events will not result in adverse modification of critical habitat for *I. laurifolium*.


580000
585000
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2380000
Kaena East of Alau
Haili to Kealia
Kaluakauila
Kahanahaiki
Pahole
Upper Kapuna Sub-Unit
Upper Kapuna
West Makaleha
Lower Ohikilolo
Ohikilolo
Keaau and Makaha
Makaha
Waianae Kai
Kamaileunu
Figure E 53
Isodendrion laurifolium
Critical habitat
High Fire Risk Zone
Low Fire Risk Zone
Very Low Fire Risk Zone
Management Units
Makua Action Area
Makua Military Reservation
Island of Oahu
0 0.5 1 Miles
0 0.5 1 Kilometers
N
1:54,000
UTM Zone 4, NAD1983

**EFFECTS OF THE ACTION – *Isodendrion longifolium* Critical Habitat**

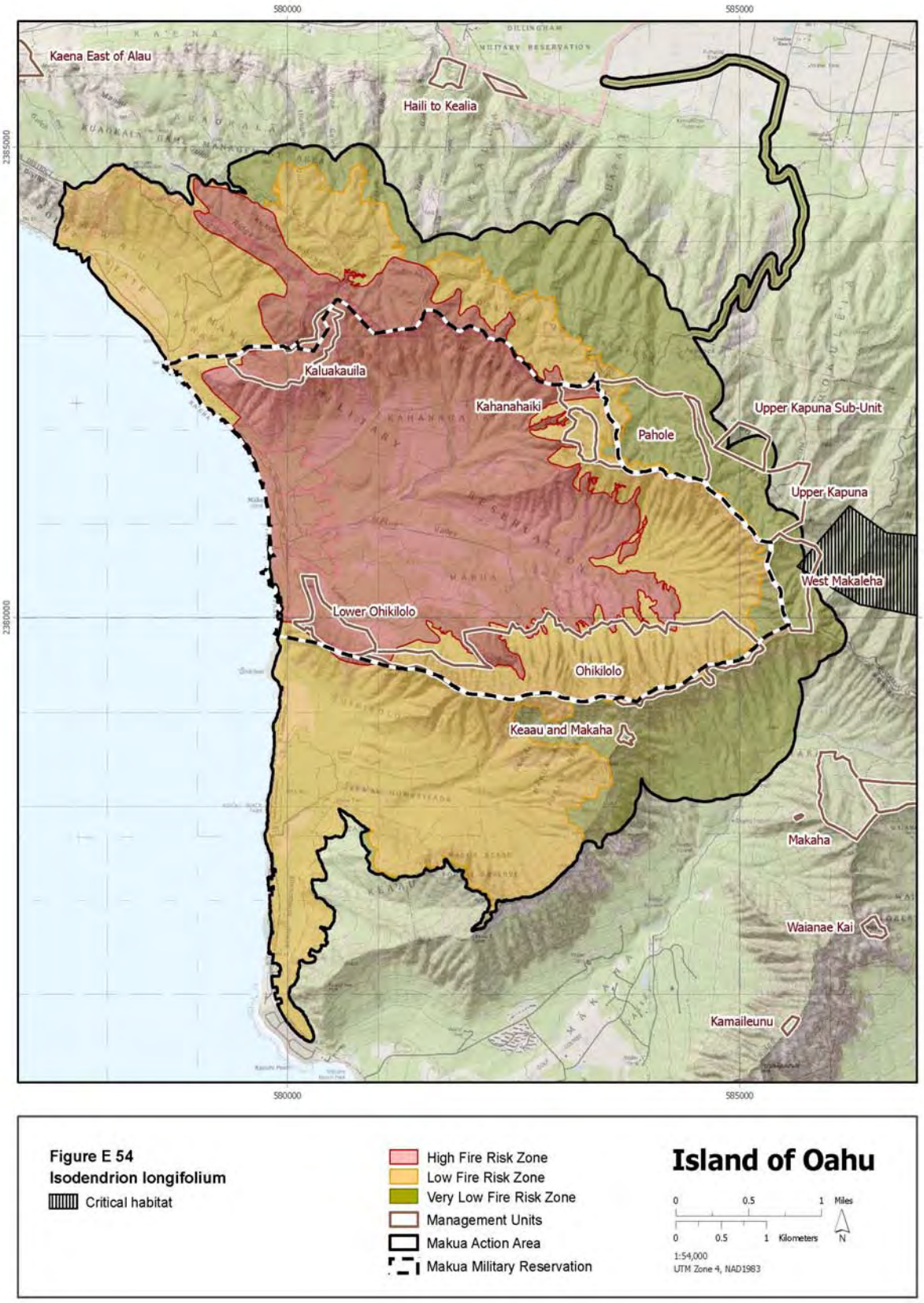
Critical habitat for *Isodendrion longifolium* in the Makua action area is comprised of close to zero percent (0.5 ha; 1 ac) of the total critical habitat for this species (Figure E 54). The unit is located in very low fire risk area with 0.45 ha (1.12 ac).The critical habitat in the action area, together with 551 ha (1,362 ac) outside the action area, was designated to provide habitat for the conservation of three populations of *I. longifolium*. Each population will include at least 300 mature, reproducing individuals in order to reach recovery goals for this species (68 FR 35950). The primary constituent elements essential for this species include, but are not limited to, steep slopes or stream banks in mixed mesic or lowland wet *Metrosideros polymorpha* (ohia)-*Dicranopteris linearis* (uluhe) forest. The primary constituent elements that may be affected by a training-related fire include those associated native plant species found within a mixed mesic or lowland wet forest. It is estimated that more than 90 percent of the critical habitat is in an area with less than 50 percent native plant cover (K. Kawelo pers. comm. 2004; 68 FR 35950). This indicates that this critical habitat unit is very degraded by non-native plant encroachment and other impacts such as foraging by ungulates. In the absence of habitat management, ongoing degradation and fires from future training actions could add to the degradation of this critical habitat unit by removing the remaining vegetative primary constituent elements.

There is a risk that if a fire started in the impact area, it could move east and impact this unit or that a misfired round could ignite outside of the firebreak road and burn into this unit. The loss of primary constituent elements within this critical habitat unit would preclude the conservation of *Isodendrion longifolium*. However, this risk is reduced due to the beneficial resource management actions conducted by the Army in the management units, the low flammability of the surrounding vegetation (mesic or wet forest), and spatial separation (3 km; 2 mi) from the impact area. One hundred percent, 0.5 ha (1 ac), of the critical habitat is located within the West Makaleha Management Unit. To reduce the risk of fire to listed species and sensitive habitats, the Army will reduce fuels in the West Makaleha unit. It will do this through the removal of non-native plant species, some of which are highly flammable. The Army has fenced portions of the West Makaleha Management Unit, pursuant to the Makua Implementation Plan. Ungulates will be removed from all fenced areas. All of these threat abatement actions in the management units enhance the conservation value of the critical habitat. In addition, the Army is conducting rat control in the West Makaleha Management Unit to reduce their impacts on listed and associated native plants.

To reduce the negative impacts to critical habitat from any fire that escapes the firebreak road, the Army has committed to revegetate burned areas with native plant species to restore the area to pre-burn conditions. The revegetation plan will address restoration of burned areas by replanting native plant species (primary constituent elements) and by controlling non-native, competitive plant species. While there may be a temporal loss of the conservation value of this critical habitat unit during the revegetation process, the ability of this unit to provide habitat essential for the conservation of *Isodendrion longifolium* will be retained in the long-term.

Conclusion

The critical habitat unit for *Isodendrion longifolium* in the Makua action area is located in the low and very low fire risk area. Implementation of all fire suppression measures incorporated into this action and the Army's standard operating procedures will reduce the likelihood that a fire will ignite and travel outside of the firebreak road or that a misfired round will ignite outside of the firebreak road. The risk of fire will be reduced due to fuel reduction within the management units, and this action will further buffer the critical habitat unit from fire. The portion of the critical habitat unit that is within West Makaleha Management Unit will be managed to improve its baseline quality, pursuant to the Makua Implementation Plan. Without this management, this critical habitat unit would eventually lose most of the elements essential to the survival and recovery of the species because of the ongoing threats to this habitat (e.g., ungulates and non-native plant encroachment). We considered the continued degradation of *I. longifolium* critical habitat in the evaluation of the effects of the proposed action. Most importantly, even though there may be a temporal loss of vegetation due to a fire, the restoration of this area by the Army will provide habitat essential for the conservation of *I. longifolium* and allow for the long-term recovery goals of this species. Therefore, training-related fire events will not result in adverse modification of critical habitat for *I. longifolium*.


580000
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Kaena East of Alau
Haili to Kealia
Kaluakauila
Kahanahaiki
Pahole
Upper Kapuna Sub-Unit
Upper Kapuna
West Makaleha
Lower Ohikilolo
Ohikilolo
Keaau and Makaha
Makaha
Waianae Kai
Kamaileunu
Figure E 54
Isodendrion longifolium
Critical habitat
High Fire Risk Zone
Low Fire Risk Zone
Very Low Fire Risk Zone
Management Units
Makua Action Area
Makua Military Reservation
Island of Oahu
0 0.5 1 Miles
0 0.5 1 Kilometers
N
1:54,000
UTM Zone 4, NAD1983

**EFFECTS OF THE ACTION – *Isodendrion pyrifolium* Critical Habitat**

There is one critical habitat unit within the Makua action area, comprising less than one percent, or one hectare (3 ac), of the total critical habitat for *Isodendrion pyrifolium*. The unit is located in the southwestern portion of the action area, in two fire risk zones with 0.48 ha (1.19 ac) in the low and only 0.84 hectares (2.07 ac) in the high fire risk area (Figure E 55). This unit is currently unoccupied and provides a portion of the critical habitat necessary for the establishment of one population of at least 300 mature *I. pyrifolium* in order to meet the recovery goals for this species (68 FR 35950). The primary constituent elements essential for this species include, but are not limited to, bare rocky hills or wooded ravines in dry shrublands. The primary constituent elements that may be affected by a training-related fire include those associated native plant species found within a dry shrubland community. The critical habitat unit is in an area that is dominated by non-native plant species, indicating that it is degraded due to non-native plant encroachment (K. Kawelo pers. comm. 2004; 68 FR 35950). Portions of this critical habitat may have been impacted by past fires that diminished the conservation value of the habitat by removing the vegetative primary constituent elements. Subsequent invasion of burned areas by aggressive non-native plants precludes natural recruitment. In the absence of habitat management, fires from future training actions could add to the degradation of this critical habitat unit by removing the remaining vegetative primary constituent elements.

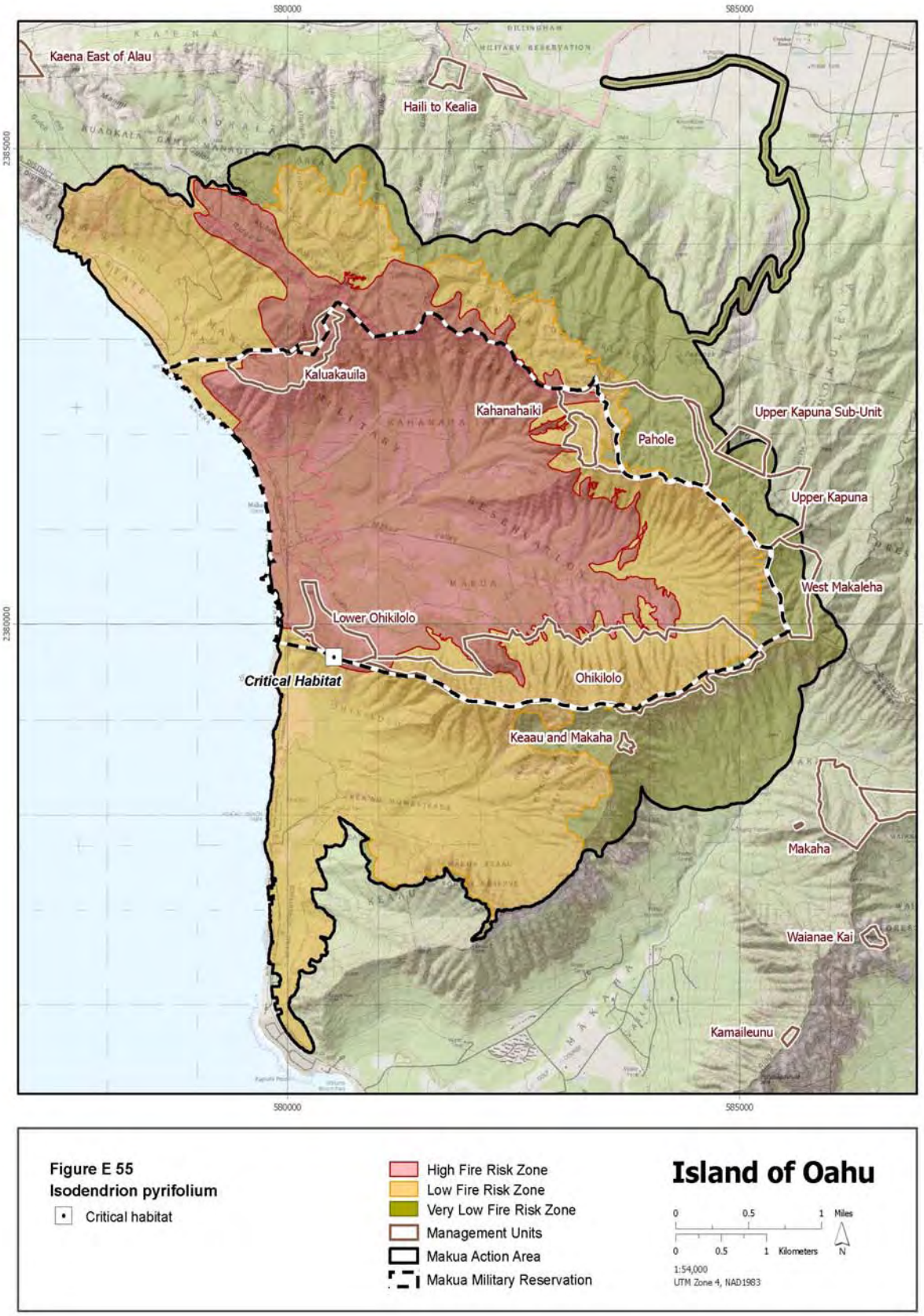
The critical habitat unit is approximately 0.4 km (0.2 mi) from the fire source and there is a high risk that a fire started in the impact area could move south and impact this unit. The risk is increased due to the surrounding vegetation that is dominated by *Panicum maximum* (see Figure PD 2), which is highly flammable and can increase the frequency and size of wildland fires (Beavers et al 1999). The prescribed burn in 2003 encroached within 0.4 km (0.2 mi) of this critical habitat unit. The consequence of this fire event is the encroachment of non-native grasses that provide more flammable fuel and increase the potential for fires in the future. The loss of vegetative primary constituent elements within this critical habitat unit would remove its ability to provide a portion of habitat necessary for the conservation of one population of *Isodendrion pyrifolium*. However, the majority of the critical habitat is outside of Lower Ohikilolo Management Unit and will benefit from the management actions that occur within the adjacent management unit. The Army has prepared a fire management plan for the Lower Ohikilolo Management Unit. Implementation of this plan will reduce the risk of fire due to the construction of a fuel modification zone between the impact area and the management unit. Fuel modification will buffer the Lower Ohikilolo Management Unit from fires that spread outside the impact area and reduce the probability that the critical habitat unit will burn. In addition, the Army has fenced the Lower Ohikilolo Management Unit and is working to reduce non-native plants within the exclosure. The removal of ungulates (goats) and non-native invasive plant species from within this management unit enhances the conservation value of the critical habitat unit. The fuel modification activities, plus other conservation measures implemented by the Army for species stabilization, will further reduce the risk of fire to this critical habitat unit.

To reduce the negative impacts to critical habitat from any fire that escapes the firebreak road, the Army has committed to revegetate burned areas with native plant species to restore the area to pre-burn conditions. The revegetation plan will address restoration of burned areas by replanting native plant species (primary constituent elements) and controlling non-native,

competitive plant species. While there may be a temporal loss of the conservation value of this critical habitat unit during the revegetation process, the ability of this unit to provide habitat essential for the conservation of one population of *Isodendrion pyrifolium* will be retained in the long-term.

Conclusion

Less than one percent (1 ha; 3 ac) of the total State-wide critical habitat for *Isodendrion pyrifolium* is located in one unit in the high fire risk area of the Makua training action area. Implementation of all fire suppression measures incorporated into this action and the Army's standard operating procedures will reduce the likelihood that a fire will ignite and travel outside of the firebreak road or that a misfired round will ignite outside of the firebreak road. The risk of fire will be reduced due to construction of a fuel modification zone between the impact area and Lower Ohikilolo Management Unit. In addition, fuel reduction within the management unit will further buffer the critical habitat unit from fire. The portion of critical habitat that is within the Lower Ohikilolo Management Unit will be managed to improve its baseline quality, pursuant to the Makua Implementation Plan. Without this management, this critical habitat unit would eventually lose most of the elements essential to the survival and recovery of the species because of the ongoing threats to this habitat (e.g., ungulates and non-native plant encroachment). We considered the continued degradation of *I. pyrifolium* critical habitat in the evaluation of the effects of the proposed action. Most importantly, even though there may be a temporal loss of vegetation due to a fire, the restoration of this area by the Army will provide habitat essential for the conservation of *I. pyrifolium* and allow for the long-term recovery goals of this species. Therefore, training-related fire events will not result in adverse modification of critical habitat for *I. pyrifolium*.


580000
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Kaena East of Alau
Haili to Kealia
Kaluakauila
Kahanahaiki
Pahole
Upper Kapuna Sub-Unit
Upper Kapuna
West Makaleha
Lower Ohikilolo
Critical Habitat
Ohikilolo
Keaau and Makaha
Makaha
Waianae Kai
Kamaileunu
Figure E 55
Isodendrion pyrifolium
Critical habitat
High Fire Risk Zone
Low Fire Risk Zone
Very Low Fire Risk Zone
Management Units
Makua Action Area
Makua Military Reservation
Island of Oahu
0 0.5 1 Miles
0 0.5 1 Kilometers
N
1:54,000
UTM Zone 4, NAD1983

**Effects of the Action on *Mariscus pennatiformis* Critical Habitat**

The critical habitat unit within the Makua action area represents 11 percent (145 ha; 358 ac) of the total critical habitat designated for *Mariscus pennatiformis* (Figure E 56). The unit is located in the northeastern portion of Makua and is almost entirely within the two low fire risk zones, with 13.40 ha (33.12 ac) in the low fire risk area and only 131.26 hectares (324.36 ac) in the very low fire risk area. The unit was designated to provide habitat for the conservation of two populations, each with at least 300 mature, reproducing individuals of *M. pennatiformis* (68 FR 35950). The primary constituent elements essential for this species include, but are not limited to, mesic and wet *Metrosideros polymorpha* (ohia) forest and ohia-*Acacia koa* (koa) forest. The primary constituent elements that may be affected by a training-related fire include those associated native plant species found within mesic and wet ohia forest and ohia-koa forest. It is estimated that close to 90 percent of the critical habitat is located in areas that have greater than 50 percent native plant cover (K. Kawelo pers. comm. 2004; 68 FR 35950). This indicates that this critical habitat unit still supports a relatively healthy native forest although invasive plant encroachment has occurred. Hawaiian forests will continue to decline in health and native vegetation without resource management. Fires increase this rate of habitat degradation and vegetative primary constituent elements would be lost in a single burn with little or no natural regeneration. In the absence of fire, native habitat quality from invasive animals and plants continues to decline incrementally, eroding the health and vigor of the remaining vegetative primary constituent elements.

There is a risk that a fire ignited in the impact area could burn into this unit, or a misfired round could start a fire that could impact this unit. Ninety-six percent of the critical habitat unit is in management units including Kahanahaiki, Pahole, Upper Kapuna, Upper Kapuna Sub-Unit and West Makaleha management units. The remaining critical habitat (5 ha; 13 ac) outside of the management units is spatially separated from the impact area by areas of low and very low fire risk and several management units. The critical habitat unit for *Mariscus pennatiformis* is very similar to *Schiedea obovata* due to its location and the Army actions that will occur in and adjacent to this unit. Please see *Schieda obovata* for the detailed discussion regarding management units and reduced risk of fire in this area.

Conclusion

The critical habitat unit for *Mariscus pennatiformis* in the Makua action area is located almost entirely in the low and very low fire risk area. Implementation of all fire suppression measures incorporated into this action and the Army's Standard Operating Procedures will reduce the likelihood that a fire will ignite and travel outside of the firebreak road or that a misfired round will ignite outside of the firebreak road. The risk of fire will be reduced due to the construction of a fuel modification zone between the impact area and the Kahanahaiki Management Unit. In addition, fuel reduction within the management units will further buffer the critical habitat unit from fire. The portion of critical habitat that is within the Pahole, Upper Kapuna, and West Makaleha management units will be managed to improve its baseline quality, pursuant to the Makua Implementation Plan. Without this management, this critical habitat unit would eventually lose most of the elements essential to the survival and recovery of the species because of the ongoing threats to this habitat (e.g., ungulates and non-native plant encroachment). We

considered this continued degradation of *M. pennatiformis* critical habitat in the evaluation of the effects of the proposed action. Most importantly, even though there may be a temporal loss of vegetation due to a fire, the restoration of these areas by the Army will provide habitat essential for the conservation of *M. pennatiformis* and allow for the long-term recovery goals of this species. Therefore, training-related fire events will not result in adverse modification of critical habitat for *M. pennatiformis*.

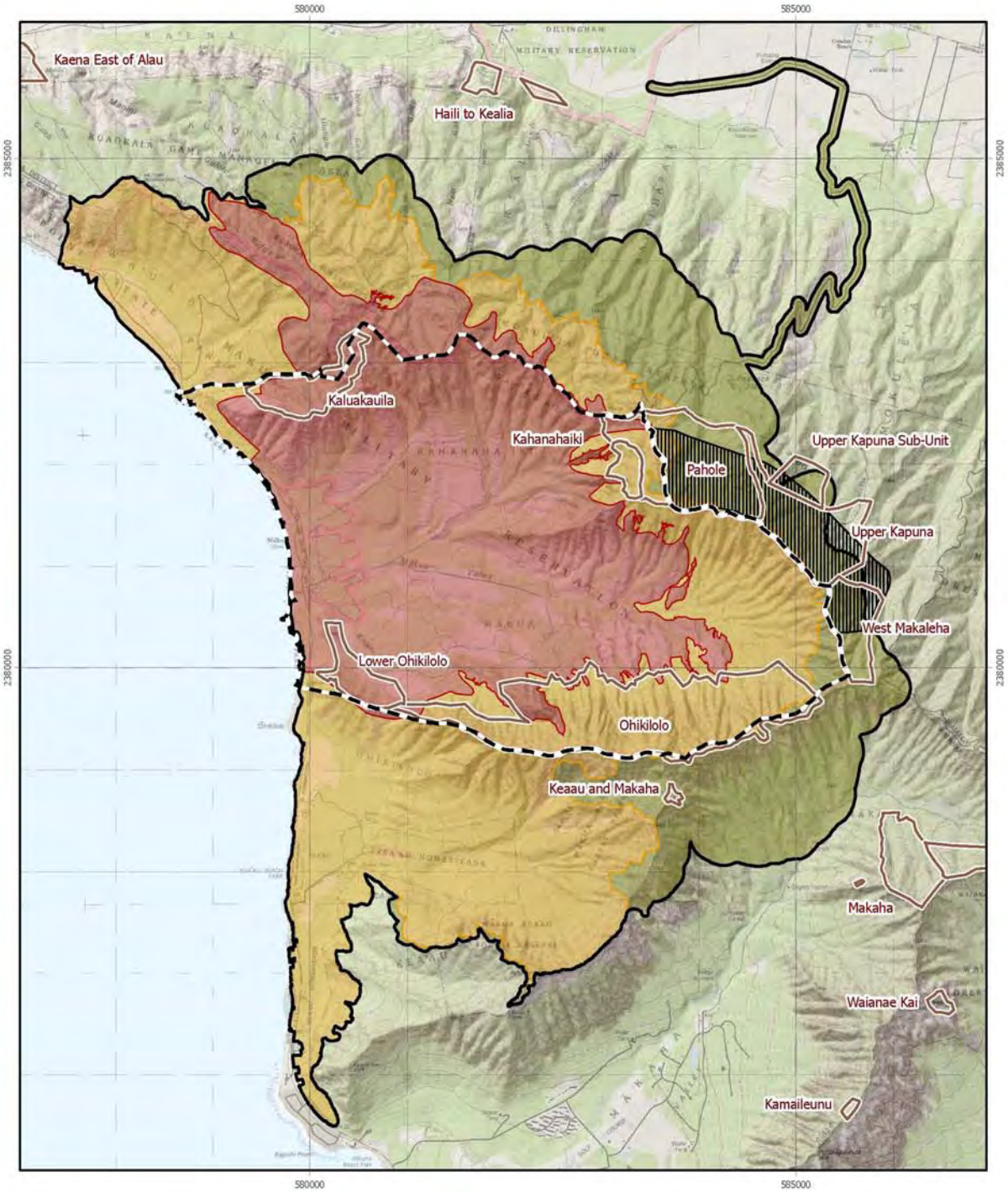



**Figure E 56**
**Mariscus pennatiformis**
Critical habitat

High Fire Risk Zone
Low Fire Risk Zone
Very Low Fire Risk Zone
Management Units
Makua Action Area
Makua Military Reservation

**Island of Oahu**

0 0.5 1 Miles
0 0.5 1 Kilometers
N
1:54,000
UTM Zone 4, NAD1983

**EFFECTS OF THE ACTION – *Melicope pallida* Critical Habitat**

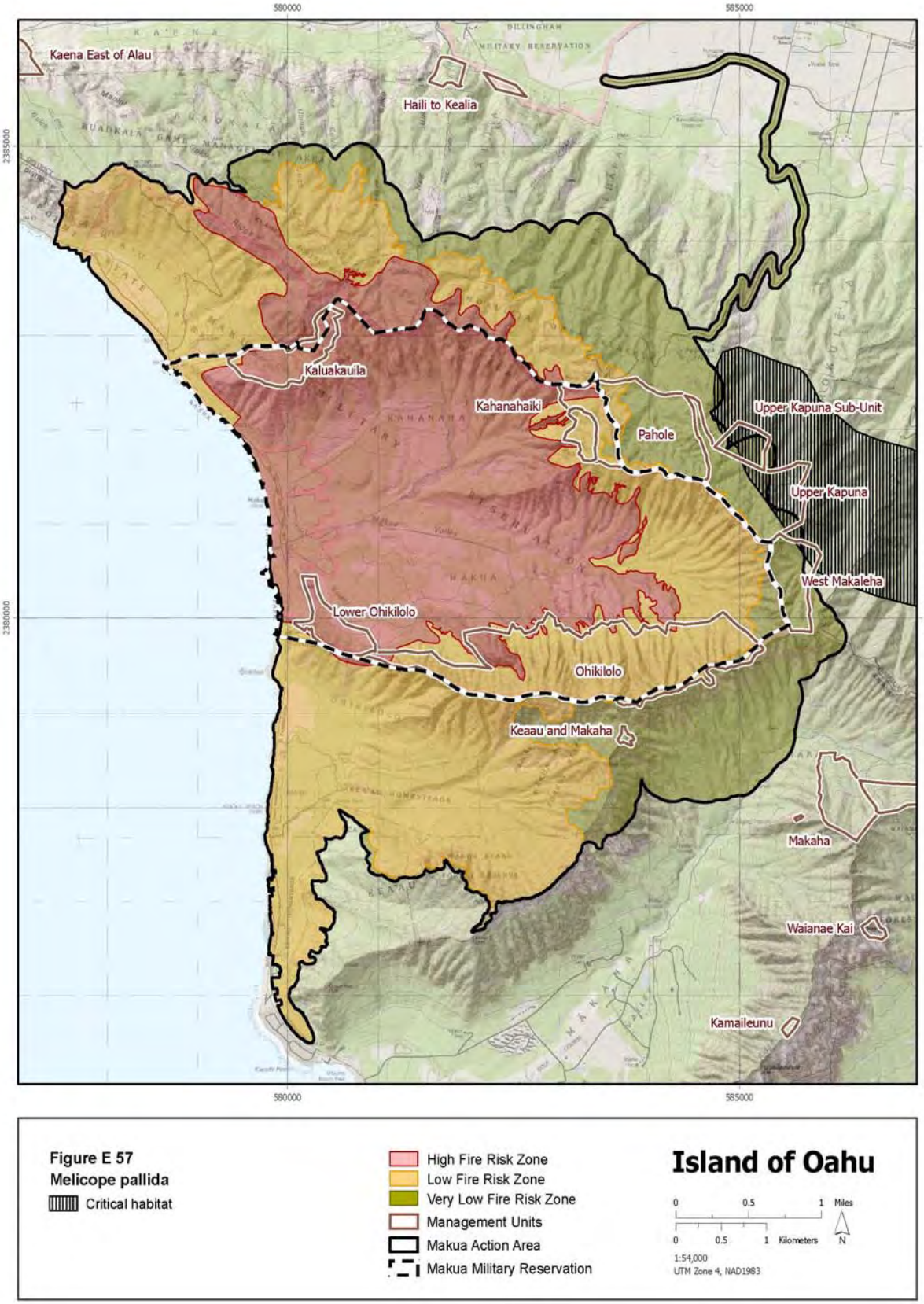
There is one designated critical habitat unit within the Makua action area for *Melicope pallida* (Figure E 57). This unit represents approximately 2 percent (28 ha; 69 ac) of the total critical habitat for this species. The unit is located in the northeastern portion of the action area in the very low fire risk zone with 28.06 ha (69.34 ac) in the area (see Figure E 57). This portion of the critical within the action area, along with 826 ha (2,042 ac) outside of the action area, was designated to provide habitat for the conservation of three populations, each of at least 100 mature, reproducing individuals of *M. pallida* (68 FR 35950). The primary constituent elements essential for this species include, but are not limited to, steep rock faces in lowland dry or mesic forests. The primary constituent elements that may be affected by a training-related fire include those associated native plant species found within lowland dry or mesic forests. It is estimated that 70 percent of the critical habitat is located in areas with less than 50 percent native plant cover (K. Kawelo pers. comm. 2004; 68 FR 35950). This indicates that this critical habitat unit is somewhat degraded by non-native plant encroachment. Non-natives increase the vegetative biomass, thus increasing the risk of fire. Habitat management is necessary to control these invasive plants, and, without this management, the habitat will continue to degrade.

There is a risk that a fire started in the impact area or a misfired round could ignite outside of the firebreak and burn into this unit. Sixty-eight percent of the critical habitat unit is in the Upper Kapuna, Upper Kapuna Sub-Unit and West Makaleha management units. Please see *Schiedea obovata* for more information on the management units and the resulting beneficial aspects of Army resource management actions in these units. The remaining critical habitat for *Melicope pallida* (9 ha; 22 ac) outside of the management units is spatially separated from the impact area by areas of low and very low fire risk and several management units. This critical habitat unit is located further to the north and therefore, a larger buffer exists between the impact area and the unit. A fire would have to travel a great distance through mesic forest to impact this critical habitat (see Figure E 57). The risk of fire is reduced due to the beneficial resource management actions conducted by the Army in the management units, low flammability of the surrounding vegetation (dry or mesic forests), and a large spatial separation from the impact area.

Conclusion

The critical habitat unit for *Melicope pallida* in the Makua action area is located entirely in the low and very low fire risk area. Implementation of all fire suppression measures incorporated into this action and the Army's standard operating procedures will reduce the likelihood that a fire will ignite and travel outside of the firebreak road or that a misfired round will ignite outside of the firebreak road. The risk of fire will be reduced due to the fuel reduction within the management units. The portion of the critical habitat that is within the Upper Kapuna, Upper Kapuna Sub-Unit and West Makaleha management units will be managed to improve its baseline quality, pursuant to the Makua Implementation Plan. Without this management, this critical habitat would eventually lose most of the elements essential to the survival and recovery of the species because of the ongoing threats to this habitat (e.g., ungulates and non-native plant encroachment). We considered this continued degradation of *M. pallida* critical habitat in the evaluation of the effects of the proposed action. Most importantly, even though there may be a temporal loss of vegetation due to a fire, the restoration of these areas by the Army will provide

habitat essential for the conservation of *M. pallida* and allow for the long-term recovery goals of this species. Therefore, training-related fire events will not result in adverse modification of critical habitat for *M. pallida*.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Kaena East of Alau
Haili to Kealia
Kaluakauila
Kahanahaiki
Pahole
Upper Kapuna Sub-Unit
Upper Kapuna
West Makaleha
Lower Ohikilolo
Ohikilolo
Keaau and Makaha
Makaha
Waianae Kai
Kamaileunu
Figure E 57
Melicope pallida
Critical habitat
High Fire Risk Zone
Low Fire Risk Zone
Very Low Fire Risk Zone
Management Units
Makua Action Area
Makua Military Reservation
Island of Oahu
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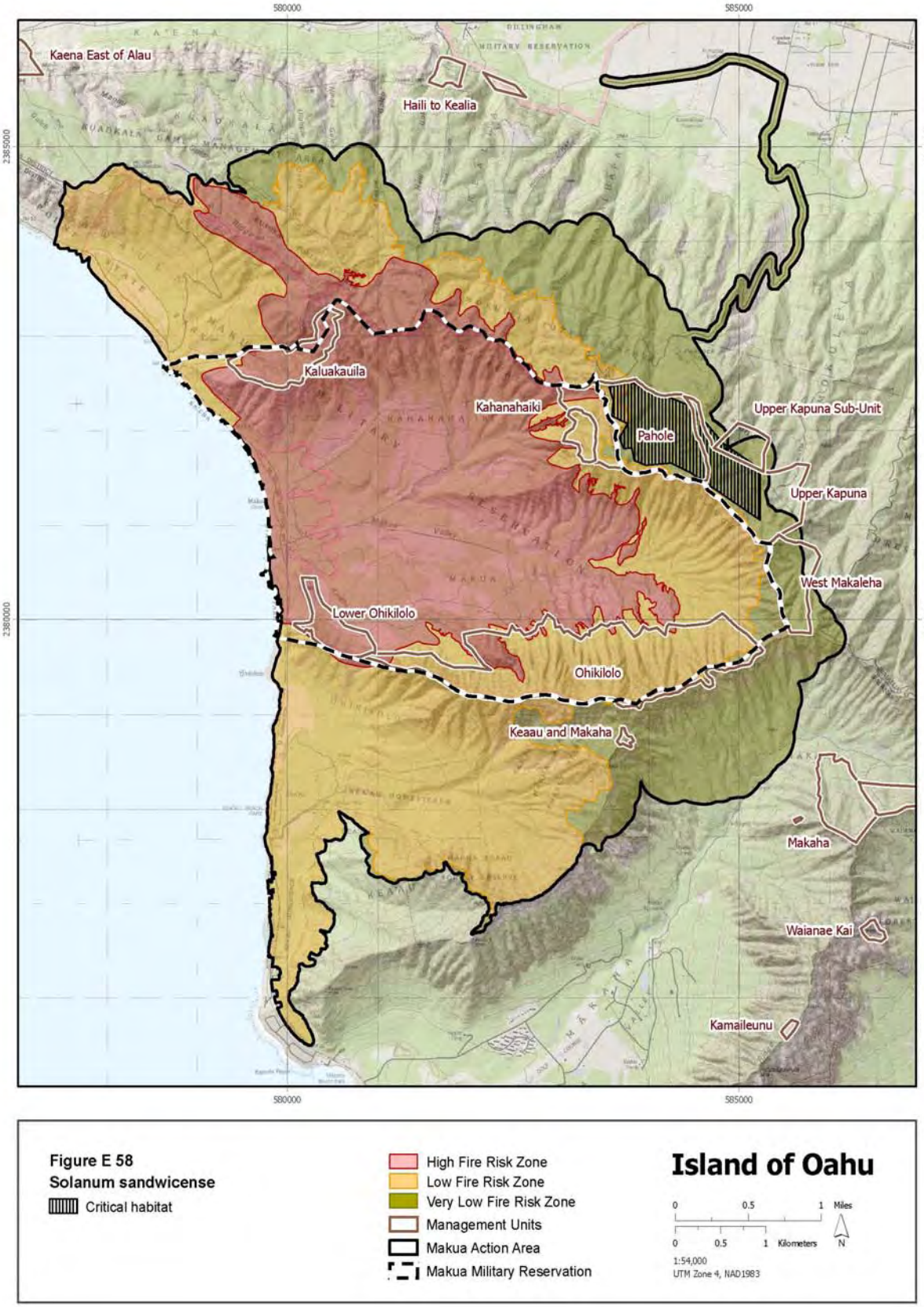
**EFFECTS OF THE ACTION – *Solanum sandwicense* Critical Habitat**

There is one critical habitat unit within the Makua action area, representing four percent (105 ha; 258 ac) of the total critical habitat for *Solanum sandwicense* (Figure E 58). The unit is located in the northeastern portion of the action area in the two low fire risk zones, with 5.32 ha (13.15 ac) in the low fire risk area and 99.16 ha (245.03 ac) in the very low fire risk area (see Figure E 58). This portion of the critical habitat was designated to provide for the conservation of one population of *S. sandwicense* with at least 300 mature, reproducing individuals (68 FR 35950). The primary constituent elements essential for this species include, but are not limited to, talus slopes or streambeds in open, sunny areas. The primary constituent elements that may be affected by a training-related fire include those associated native plant species found on talus slopes or streambeds in open, sunny areas. It is estimated that nearly one-half of the critical habitat is located in an area of greater than 75 percent native plant cover, indicating that this unit still maintains a healthy native plant component (K. Kawelo pers. comm. 2004; 68 FR 35950). However, in the absence of habitat management, fires resulting from future training actions could degrade this unit by removing the remaining vegetative primary constituent elements.

There is a risk that a fire could move east and impact this unit. The loss of vegetative primary constituent elements within this critical habitat unit would remove its ability to provide for the conservation of one population of *Solanum sandwicense*. However, this risk is reduced due to the beneficial actions conducted by the Army in the adjacent management units, the low flammability of the surrounding vegetation, and spatial separation from the impact area. A total of 102 ha (253 ac), or 98 percent, of the critical habitat in the action area is in the Pahole, Upper Kapuna Sub-Unit and Upper Kapuna management units. The Kahanahaiki Management Unit is immediately adjacent to the western edge of the critical habitat unit. This management unit will serve as a buffer between the critical habitat and the impact area due to the fuel reduction actions in the management unit. The Pahole Management Unit is fenced and the Army plans to fence the Upper Kapuna Management Unit, pursuant to the Makua Implementation Plan. The Army is working to reduce non-native plants in both of these management units. These threat abatement actions in the management units enhance the conservation value of the critical habitat. The remaining critical habitat (3 ha; 5 ac) outside of the management units is separated from the impact area by the two management units themselves. The fuel modification activities, plus other threat reduction measures implemented by the Army for species stabilization, will further reduce the risk of fire to the portion of the critical habitat outside of the management units.
To reduce the negative impacts to critical habitat from any fire that escapes the firebreak road, the Army has committed to revegetate burned areas with native plant species to restore the area to pre-burn conditions. The revegetation plan will address restoration of burned areas by replanting native plant species (primary constituent elements) and controlling non-native, competitive plant species. While there may be a temporal loss of the conservation value of this critical habitat unit during the revegetation process, the ability of this unit to provide habitat essential for the conservation of three populations of *Solanum sandwicense* will be retained in the long-term.

Conclusion

The critical habitat unit for *Solanum sandwicense* in the Makua action area is located in the low and very low fire risk area. Implementation of all fire suppression measures incorporated into this action and the Army's standard operating procedures will reduce the likelihood that a fire will ignite and travel outside of the firebreak road or that a misfired round will ignite outside of the firebreak road. The risk of fire will be reduced due to the fuel reduction actions within the Pahole, Upper Kapuna Sub-Unit and Upper Kapuna management units. The portion of critical habitat that is within these management units will be managed to improve its baseline quality pursuant to the Makua Implementation Plan. Without this management, this critical habitat unit would eventually lose most of the elements essential to the survival and recovery of the species because of the ongoing threats to this habitat (e.g., ungulates and non-native plant encroachment). We considered this continued degradation of *S. sandwicense* critical habitat in the evaluation of the effects of the proposed action. Most importantly, even though there may be a temporal loss of vegetation due to a fire, the restoration of these areas by the Army will provide habitat essential for the conservation of *S. sandwicense* and allow for the long-term recovery goals of this species. Therefore, training-related fire events will not result in adverse modification of critical habitat for *S. sandwicense*.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Kaena East of Alau
Haili to Kealia
Kaluakauila
Kahanahaiki
Pahole
Upper Kapuna Sub-Unit
Upper Kapuna
West Makaleha
Lower Ohikilolo
Ohikilolo
Keaau and Makaha
Makaha
Waianae Kai
Kamaileunu
Figure E 58
Solanum sandwicense
Critical habitat
High Fire Risk Zone
Low Fire Risk Zone
Very Low Fire Risk Zone
Management Units
Makua Action Area
Makua Military Reservation
Island of Oahu
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UTM Zone 4, NAD1983

**EFFECTS OF THE ACTION –** Oahu Tree Snail

There are approximately 1,500 individuals of *Achtinella mustelina* known from approximately 94 known populations at 120 point occurrences in the Waianae Mountains. Seventeen of these populations are within the Makua action area (Figure E 59) and they support approximately 430 individuals (approximately 28 percent of the total known individuals). The locations are Kahanahaiki (4 populations, approximately 86 snails); Pahole Gulch (2 population, 2 snails), Kapuna-Makua Ridge (3 populations, approximately 16 snails), and South Makua Ridge (8 populations, approximately 358 snails). For a complete analysis of the effects, also see the General Effects section of this document.

Introduction of Alien Plant and Animal Species

*Achtinella mustelina* is highly vulnerable to the direct effects of alien predators, especially rats and the predatory snails *Euglandina rosea* (Hadfield and Mountain 1980, Hadfield 1986, Hadfield and Miller 1989, Kinzie 1992; Hadfield, Miller and Carwile 1993). Disposal of food in the field associated with military troop activities in areas where tree snails occur may attract rats by temporarily increasing the local food supply for rats, contributing to an increase in local rat populations. Observations of MRE (meals, ready-to-eat) containers and other trash and food items along trails that support tree snails indicate that this has been a problem in the past(S.E. Miller, in litt. 1988; M.G. Hadfield, pers. comm. 1988). However, the Army's Standard Operating Procedures require all food and trash to be carried out, And therefore, we don't anticipate any impacts.

Oahu tree snails are dependent on native vegetation and are not generally known to establish viable occurrences on non-native plant species (Service 1993). Non-native plants are spread via seeds on boots, equipment, or clothing, or in the feathers, fur, and feces of pigs, goats, and birds. These effects are especially intense along trails or in areas that may be used for camping or bivouacs. Within the Makua, some upper elevation areas used for troop movements (such as the old Nike Missile site and Pahole) are in areas known to support tree snails. The introduction of non-native plant species to habitats currently considered suitable for Oahu tree snails will limit the snail's ability to establish new occurrences and will eventually lead to an overall decline in tree snail abundance. The risk and potential effects of non-native plant introductions vary among different portions of the action area, depending on the degree of troop and vehicle activities. However, once introduced into an area, these invasive plants can spread along trails or throughout the forest understory. The threat of non-native plants spreading from military activities will be reduced by the Army's proposed conservation measures that include cleaning boots, clothing, equipment, and vehicles prior to entering areas that support native vegetation, and controlling non-native plants along trails. Thus the overall threat from these invasive plants to Oahu tree snails covered in this consultation is considered to be low.

Impacts from Dismounted Troop Movement

Impacts from dismounted troop movement along trails and through the forested areas within the Makua action area are a significant threat to Oahu tree snails. Troop movements along trails and through forested areas may result in trampling of tree snails and their host plants, or

inadvertently knocking tree snails out of their host plants. Troop movements in areas that support Oahu tree snails are expected to be low because (1) troops are required to stay on established roads and trails; and (2) the Army will mark areas that support tree snails so that troop movement activities avoid the tree snails and their host plants. Based on these conservation actions, the overall threat from dismounted troop movements to Oahu tree snails covered in this consultation is considered to be low.

Restrictions on Access for Resource Management

Tree snail areas within the Makua action area require regular access for management due to the continuing threat of habitat degradation by feral pigs and non-native plants, and predation by rats and predatory snails. Currently, all of the known tree snail occurrences are outside of areas where access is limited due to training. Thus, the timing of training activities at Makua should have no effect on management of tree snails.

Fires from Military Training

The Oahu tree snail and its habitat in the action area will be exposed to direct and indirect effects of training-related wildland fire over the next 30 years, due to their occurrence within the low and very low fire risk zone of the Makua action area. One of the major effects of fire on Oahu tree snails, aside from burning and killing individual tree snails, is the loss of habitat needed to support the species. Fires facilitate the spread of non-native plants, which are not used as host plants by Oahu tree snails.

All Oahu tree snails and tree snail habitat within the Makua action area are at risk, albeit very low, of burning as a result of training-related wildland fire ignited by a misfired or malfunctioning Javelin or TOW, or a spot fire from an intense fire burning in Makua Valley under certain dry, windy weather conditions. Fire detecting and suppression response is designed to prevent a fire ignited by misfired weapons landing in forest and shrub areas from burning more than 0.1 ha (0.3 ac). Inadequate detection and suppression response could enable these fires to burn more than 40 ha (100 ac) in a 48-hour period (see General Effects – Fire Suppression).

In addition, two of the Oahu tree snail populations at Kahanahaiki Management Unit are within 150 m (492 ft) of the high fire risk zone. These populations are at risk of burning in fires that spread from fires that ignite in the high fire risk zone, from misfired or malfunctioning long-range weapons systems and munitions (tracers, AT-4 and SMAW anti-tank weapons, 2.75-caliber rockets, Javelin anti-tank missiles, and TOW missiles). The low risk of fire to these populations is further reduced by the firebreak or fuelbreak the Army is creating along the perimeter of the Kahahaiki Management Use (see Project Description section 3.1.4.1).

The overall risk of fire to Oahu tree snails will be minimized by training restrictions, fire management, and expedited stabilization actions for 12 at-risk plant taxa. In addition, as part of the proposed action, the Army will implement conservation and stewardship programs to reduce the risk of ignition and spread of training-related wildland fire (Wildland Fire Management Plan, Integrated Natural Resources Management Plan), and improve native habitat in population units

by excluding feral ungulates and controlling non-native weeds (Makua Implementation Plan Addendum).

Summary

The risk to Oahu tree snails from Army live-fire training has been reduced through the restrictions the Army has made to its routine training activities and the development and implementation of its fire suppression measures (see General Effects – Fire Supression). Despite the ongoing exposure of these snails to project impacts, Army conservation and stewardship programs will improve the baseline condition of *Achatinella mustelina* in the action area and throughout its range. Weapons restrictions, fuels management, fire suppression, invasive species control, and snail conservation actions over the next 30 years will all contribute to the improvement in the baseline of *A. mustelina*. The overall effect of the proposed action's stressors and subsidies will result in a net increase in baseline numbers, distribution, and reproduction of *A. mustelina* in and adjacent to the action area over the next 30 years, and so enhance the probability of persistence over the long term.

This tree snail species is not considered stable at this time, but the stabilization actions to be developed for the Makua Implementation Plan will benefit the species so that potential impacts associated with military training activities will be minimized in the short-term and the species will be stabilized in the long-term. When fully implemented, the Makua Implementation Plan should stabilize the Oahu tree snail and increase the environmental baseline of the species overall. Based on the actions and issues outlined in the Project Description and the Effects of the Action on the Listed Species sections above and the species stabilization actions as described in the Makua Implementation Plan, the Service believes that the risk of the Army's proposed action is outweighed by the long-term benefits from stabilizing this tree snail species.

Conclusion

After reviewing the current status, the environmental baseline, the effects of the proposed action, and the cumulative effects, it is our Biological Opinion that implementation of the proposed action discussed herein is not likely to jeopardize the continued existence of any species covered in this Biological Opinion or adversely modify or destroy any critical habitat. This conclusion is based on the following factors for the Oahu tree snails.

1. The Service's finding of no jeopardy in this Biological Opinion is based in large part on the conservation measures and stabilization plan that will be developed for Oahu tree snails by experts in natural resource management. Eight wild populations each containing 300 snails, will be stabilized. These units will be geographically distributed throughout the range of the species and will include as much of the genetic diversity of the species as remains in the wild.

2. Although some Oahu tree snails may be adversely affected by actions discussed in this consultation, the potential for direct injury or harassment of these tree snails has been minimized by incorporating a range of actions into the project design that will protect extant tree snail occurrences from Army training activities.

3. Captive propagation is recognized as a critical element in the process of stabilizing Oahu tree snails. The establishment of field populations that can sustain these species in the wild is the long-term goal of the conservation measures described in this Biological Opinion and in the implementation process. *Achatinella mustelina* are being successfully reared in captivity. Translocation from captive propagation to new field sites has been accomplished for closely related Hawaiian tree snail species. Captive propagation currently protects representatives of all eight evolutionarily significant units of *Achatinella mustelina*.

4. Implementation of the fire suppression measures and weapons restrictions will reduce the risk of fire escaping the impact area, which significantly reduces the potential impact of fire on *Actatinella mustelina* tree snail populations and habitat.

Army training actions described in the Biological Opinion are not anticipated to compromise the conservation and recovery process described in the Oahu Tree Snail Recovery Plan (Service 1993). This recovery plan is based on (1) the presence of a functionally intact native forest with a close or closed canopy and an understory of native plants that can support tree snail populations; (2) a tree snail population structure that includes all age classes and supports reproductive rates that are high enough to sustain the population; (3) a landscape distribution of populations that preserves the remaining genetic diversity of each of the tree snail species within its natural range; (4) ecological conditions that can support metapopulation dynamics where specific populations may decline or disappear over time while new populations within the landscape become established and grow; and (5) management of the threats that currently prevent the recovery of the species. Consequently, the Service has determined that adverse effects to Oahu tree snails that may result from Army training activities will not contribute to an appreciable reduction in the likelihood of survival or recovery of *Achatinella* tree snail species in the wild by reducing the number of snails or their reproduction or distribution.

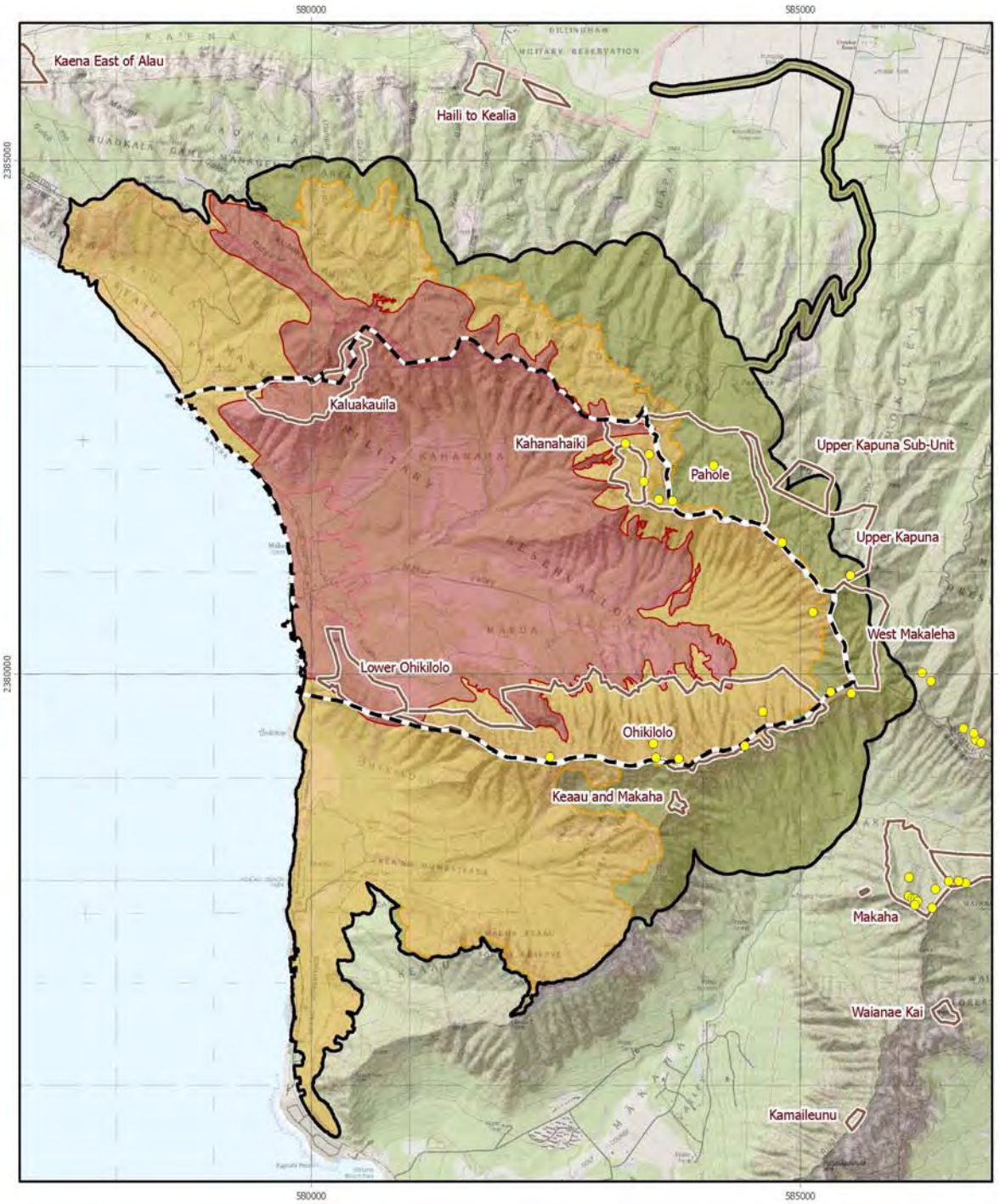


**Figure E 59**
**Achatinella mustelina**

- Species observation
- High Fire Risk Zone
- Low Fire Risk Zone
- Very Low Fire Risk Zone
- Management Units
- Makua Action Area
- Makua Military Reservation

**Island of Oahu**

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**EFFECTS OF THE ACTION – Oahu elepaio**

Of the 1,703 total range-wide individuals of *Chasiempis sandwichensis ibidis* **(**Oahu elepaio), 16 (less than one percent) are located within the Makua action area. Most Oahu elepaio occur within six populations in the Waianae and Koolau mountains (VanderWerf et al 2001). Most recent surveys indicate that Waianae Mountains populations have declined between 73 and 85 percent since 2001 (VanderWerf 2006 and Mosier pers. comm).

Direct mortality

Misfired or malfunctioning Javelin, TOW, and 2.75-caliber rockets, and ball ammunition rounds overshooting the target area may hit and kill Oahu elepaio within the action area (Figure E 60). Eight out of the 16 elepaio occupying territories in the action area occur within the surface danger zones of the proposed weapons, where direct mortality is possible. Oahu elepaio within 500 m (1,640 ft) of a Javelin detonation may be hit by warhead and missile debris. It is difficult to estimate the number of elepaio that could be hit by misfired and overshot ball ammunition, Javelin and TOW rounds, but it is extremely low.

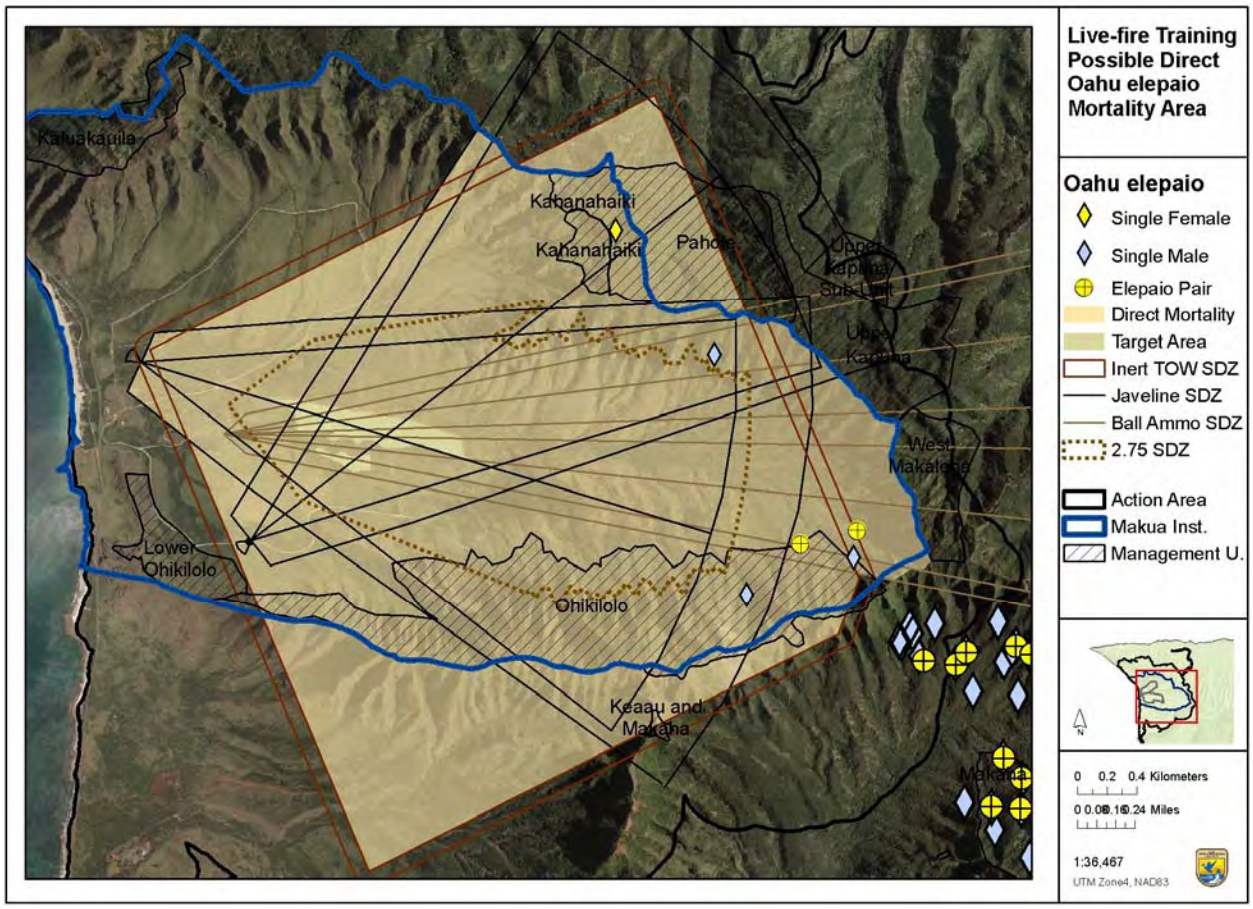



Figure E 60. Direct Oahu elepaio mortality due to weapon use is possible but unlikely inside the shaded area.

Fire Effects

Eight Oahu elepaio (two pairs, three single males, and one single female) occupy territories in the low fire risk zone at Makua (Figure E 61). These birds could be impacted by fires escaping initial attack containment in the high fire risk zone, a spot fire resulting from an intense grass fire in the valley during extreme weather conditions, or a fire resulting from misfired TOW, Javelin, and 2.75-caliber rockets. The other eight Oahu elepaio (one pair and six single males) maintain territories in the very low fire risk zone in Makaha Valley where a fire can start from a misfired long-range, live-fire weapons such as the TOW, or start from a spot fire.

Smoke and heat from wildland fire can cause direct mortality or reduced reproductive success of birds (Cahill and Walker 2000). Heat and smoke from a fire within or adjacent to an Oahua elepaio territory may kill the bird(s) within the territory. In addition, a fire that burns through the habitat will kill the plants and alter the habitat so that is no longer provides all of the functions (foraging, nesting, sheltering, dispersal) essential for the Oahu elepao. For example, the 2003 escaped prescribed fire burned portions of three elepaio territories that were occupied by single males. The habitat was altered and these burned areas no longer contain the elements needed by elepaio for foraging, nesting, sheltering or dispersal, and no longer support elepaio. In addition, a fire during the breeding season could result in the direct loss of a nest or abandonment of the nest if the adults die or have to leave the territory to escape the fire (Cahill and Walker 2000). In either case, the eggs and/or nestlings associated with the nest will be killed.

Firebreaks and fuelbreaks are designed to limit fire spread from the valley floor into elepaio habitat (see General Effects – Fire Suppression). In addition, fire detection and suppression response is designed to prevent a fire ignited by misfired weapons landing in forest and shrub areas from burning more than 0.1 ha (0.3 ac) (see General Effects - Fire Suppression). Inadequate detection and suppression response could enable these fires to burn more than 40 ha (100 ac) in a 48-hr period (see General Effects - Fire Suppression). However, to avoid the risk of an undetected fire, the Army will conduct an aerial survey in a helicopter for one hour post-training to check for smoke from a misfired round (see General Effects - Fire Suppression). In addition, post-fire restoration of burned Oahu elepaio critical habitat areas will minimize long-term impacts of live-fire training effects on this species.

Fire Retardant impacts to Oahu elepaio

During fire suppression operations, some helicopter fire suppression buckets may be filled with retardants in order to increase the effectiveness of the water being applied. Although the Oahu elepaio currently occupying the action area do not occur in areas where retardant is likely to be used, direct contact with chemical fire retardants may occur. Some fire retardants, including the Fire-Trol brand currently used by the Army, contain cyanide. Prolonged exposure to cyanide results in cancer and neurological disorders in humans but the effects of the chemicals on feathers or health of birds is not known. Direct contact with individual birds seems unlikely and prolonged exposure is not expected.

Noise impacts to Oahu elepaio

The proposed live-fire training and associated use of helicopters and other equipment will result in loud noise. Noise attenuation due to distance, terrain shielding, wind and noise attenuation will result in damping of the noise. Therefore, birds within Makua Valley will be exposed to louder sound than birds occurring outside the valley wall terrain barriers. Oahu elepaio occur approximately 1,700 m (5,577 ft) to 2,000 m (6,562 ft) from the target areas in Makua valley. Infrequently, helicopters performing fire suppression, natural resources, or training operations may fly within 15 m (50 ft) of elepaio, and personnel cadence, or Army Natural Resources Staff talking will occur within 15 m (50 ft) of birds.

Table E 17. Noise Levels of Live-Fire Training Compared With Familiar Noise Levels.

| Noise Source | Decibel (dBA) at 15 m (50 ft) from source | Approximate Decibel (dBA) at 1,700 m upwind* from source | References |
|---|---|---|---|
| **Rustling leaves, tall grass in a light to moderate wind, ambient elepaio habitat** | 35 to 55 dBA | 0 dBA | Resource Systems Group, Inc. 2006, VanderWerf *et. al.* 2000 |
| **Normal conversation, Office, Restaurant** | 60 dBA | 0 dBA | Wikipedia |
| **Shouting** | 65 dBA | 0 dBA | League for the Hard of Hearing 2007 |
| **Ambulance Siren** | 94 dBA | 24 dBA | Department of Defense 2007 |
| **Helicopter** | 95 to 107 dBA | 25 to 37 dBA | Santa Barbara County 2002, San Diego Gas and Electric 2006 |
| **Civil Defense Siren** | 124 dBA | 53 dBA | Department of Defense 2007 |
| **Rifle, Handgun, Shotgun** | 139 to 146 dBA | 69 to 75 dBA | League for the Hard of Hearing 2007 |
| **Artillery, 25 kg (55 lb) HE detonation** | 168 to 173 dBA | 98 to 103 dBA | Global Security.org 2007, League for the Hard of Hearing 2007 |

* Bruer and Khaer (2007)

Potential consequences of live fire training, personnel hiking or working, and fire suppression operations could include increased metabolism, nest abandonment, and temporary damage to auditory cells. VanderWerf (2000) studied the responses of Oahu elepaio at the Schofield Barracks West Range to 282 artillery (60 mm HE, 105 mm HE, and 155 mm HE) and demolition blasts located 100 to 1,000 m (328 to 3,281 ft) from elepaio nests, ranging in intensity from 81.4 to 116 dB. Effects of artillery blast noise were only detected in two instances: in both instances, an incubating male elepaio was preening his breast feathers with its head down when a blast occurred and it suddenly looked up and scanned immediately after the blast, as if attempting to visually locate the source of the sound. The response was minor and short-lived in both cases; the male lowered its head and resumed preening 1 to 2 seconds after each blast noise had subsided. The sounds that elicited these responses were 89 to 90 dB, not among the loudest sounds recorded at the nest sites. In no case did an elepaio flush from the nest or pause when returning to the nest in response to an artillery noise. This study suggests that Oahu elepaio reproductive success is not negatively impacted by noise associated with live-fire training.
The elepaio studied at Schofield Barracks West Range may be habituated to the noise associated with live-fire training and since training has not been conducted at Makua for several years, it may take some time for the birds at Makua to habituate to the noise. Birds habituate to noises and may not respond to stimuli when they do not perceive a direct threat. American black ducks (*Anas rubripes*) reacted to 39 percent of military aircraft overflights on their first day of exposure, but after two weeks they responded only six percent of the time. Incubating herring

gulls (*Larus argentatus*) and great black-backed gulls (*L. marinus*) habituated to the continual presence of humans by modifying their responses, but would continue to be disturbed when they perceived direct approach by a human walking directly toward their nest (Burger and Gochfeld 1981).

Because the occupied elepaio territories at Makua are approximately two times farther from the impact area than the birds studied at Schofield (VanderWerf et al 2000), noise impacts to elepaio at Makua are expected to be less than the impacts at Schofield, and are not expected to adversely affect the reproductive success or survival of Oahu elepaio (VanderWerf *et. al.* 2000).
We were concerned the Oahu elepaio may be exposed to sound levels which are known to cause permanent hearing loss in mammals. Sound levels over 85 dB are considered harmful to inner ear hair cells, 95 dB is considered unsafe for prolonged periods (Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, unpublished). Oahu elepaio may be exposed to sounds which may be loud enough to damage ear hairs. A review of avian hearing loss was conducted and it was determined that hearing loss in birds is difficult to characterize because birds, unlike mammals, regenerate inner ear hair cells, even after substantial loss (Corwin and Cotanche 1988, Stone and Rubel 2000). Therefore, we do not expect permanent hearing loss in Oahu elepaio to result from the proposed action.

Fencing and ungulate control

Browsing by feral goats and rooting by feral pigs has degraded the quality of the primary constituent elements in portions of elepaio critical habitat within the action area by reducing the forest density and inhibiting recruitment of native plants. By completing the ungulate exclusion fence surrounding Makua Valley and removing ungulates from all areas of elepaio critical habitat at Makua, the Army's action will reduce the rate of habitat degradation.

Predator control effects

The primary cause the recent decline of Oahu elepaio appears to nest predation due to rat predation (VanderWerf and Smith 2002). Populations that do not receive rodent control decline at an average rate of 24 percent per year, while sites with rodent control, on average, remain unchanged (VanderWerf and Smith 2002). In 2006, the Army's Natural Resources Staff conducted predator control in 17 elepaio territories at Schofield Barracks West Range, 25 territories at Honouliuli, 14 territories at Makaha, and 26 territories at Moanalua (82 territories total) (U.S. Army 2006). A 24-percent loss of birds in these 82 territories would have resulted in a reduction of 39 birds over a one year period. Predator control efforts within the Makua Action Area have been hampered by unexploded ordinance and other access issues. Completion of the proposed fence, and aerial application of rodenticide at Makua is likely to prevent reductions in elepaio numbers at Makua due to nest predation.

Conclusion

Mortality due to weapons use and wildland fire may result from the proposed action. Grass fires in Makua valley may burn into adjacent forested areas where Oahu elepaio occupy territories. Fires may be ignited within the forested areas by misfired 2.75-caliber rocket, Javelin, and TOW

weapons. Weapons restriction, fire suppression helicopter staffing, pre-planning and implementation of suppression actions by skilled NWCG-qualified supervisors, and new fuelbreaks and firebreaks will minimized the risk of fire burning occupied Oahua elepaio territories in the action area. Chemical fire retardants and noise associated with the proposed action are not likely to negatively impact Oahu elepaio. The potential loss of elepaio from the Army's proposed actions will be offset by the ongoing efforts of the Army's Natural Resources Staff as they implement stabilization actions for 28 plant species pursuant to the Makua Implemnetation Plan Addendum. Fencing, feral ungulate removal and rodent control are expected to minimize future reductions in elepaio numbers associated with habitat degradation and nest predation. Based on our analysis of the effects of the actions outlined in the project des ription including fire minimization measures, we believe that no more than one Oahu elepaio pair and one nest will be killed during the next 30 years.

**Effects of the Action on Oahu Elepaio Critical Habitat**

The Makua action area includes 1,106 hectares (2,734 acres) of Oahu elepaio critical habitat in Unit 1 (66 FR 63752). Elepaio critical habitat in the Makua action area represents approximately four percent of the 26,868 hectares (66,390 acres) designated as critical habitat for this species on the island, and approximately 25 percent of critical habitat Unit 1 (see Figure E 61). The primary constituent elements required by the Oahu elepaio for foraging, sheltering, roosting, nesting, and rearing of young are undeveloped wet, mesic, and dry forest habitats with a closed canopy and a dense understory. In addition, the primary constituent elements associated with the biological needs of dispersal and genetic exchange among populations are undeveloped wet or dry shrub land and wet or dry cliff habitats (Service 2001). Any action that affects structure of the forest canopy or understory has the potential to adversely modify or destroy elepaio critical habitat. Actions that affect the size, distribution, and distance between forested areas have the potential to adversely modify the value of critical habitat for dispersal.

<u>Fires from Current Military Training and Transformation</u>

The potential long-term effects of fire on elepaio critical habitat are serious. Fires destroy forest needed by elepaio for foraging, nesting, and sheltering, thereby reducing the amount of habitat available to elepaio and limiting their population. Fires remove or alter the primary constituent elements of elepaio critical habitat by burning forest altogether, opening the canopy, and thinning the understory. Fires also facilitate the spread of alien plant species not used by elepaio, such as *Casuarina* spp. and *Eucalyptus robusta*, because these species burn readily and grow back more quickly than native plants following a fire. *Eucalyptus* and *Casuarina* forests often prevent the formation of a dense understory.

Of the 1,106 ha (2,734 ac) of elepaio critical habitat in the Makua action area, 178 ha (441 ac) are regarded to have high fire risk, 388 ha (960 ac) are located in the low fire risk zone, and 540 ha (1,333 ac) occur in the very low fire risk zone. In September 2003, a prescribed burn in Makua escaped and burned approximately 61 ha (150 ac) of designated Oahu elepaio critical habitat, including portions of three elepaio territories. Fires also burned forest in this area before it was designated as critical habitat for the elepaio. Fires at Makua that escape the firebreak road primarily burn areas that have burned previously, but each new fire may also extend a short

distance into previously unburned areas of mesic forest in elepaio critical habitat, resulting in replacement of native plant species by fire tolerant alien species and expansion of fire prone habitats that do not contain the primary constituent elements needed by elepaio (see General Effects - Fire Suppression). This vegetative replacement reduces the amount of forest habitat suitable for elepaio and limits the potential elepaio population size. If fires continue to burn critical habitat and these areas are not restored, it can be expected that most or all of the elepaio critical habitat at Makua eventually will be converted to open forest, shrubland, or grassland that does not contain the primary constituent elements needed by elepaio for foraging, sheltering, roosting, nesting, and rearing of young, thereby destroying the function of most or all of the critical habitat in Makua Valley. Elepaio may use dry shrub habitat for dispersal among populations, but they do not establish territories in shrub habitat and use it only transiently. If the areas containing the primary constituent elements needed for foraging, sheltering, and nesting are destroyed and no elepaio populations persist, then the function of areas containing the primary constituent elements needed for dispersal among populations also is destroyed. The potential threat to 178 ha (441 ac) of elepaio critical habitat in the Makua action area from the direct and indirect effects of fires caused by military training is high and low to very low in the remaining 928 ha (2,293 ac), but the application of weapons restrictions, fire suppression staffing guidelines, and additional fuelbreaks and firebreaks will minimize the risk of fire to elepaio and elepaio critical habitat areas. In addition, post-fire restoration of any burned elepaio critical habitat areas is expected to ensure that any losses of elepaio habitat would be temporal.

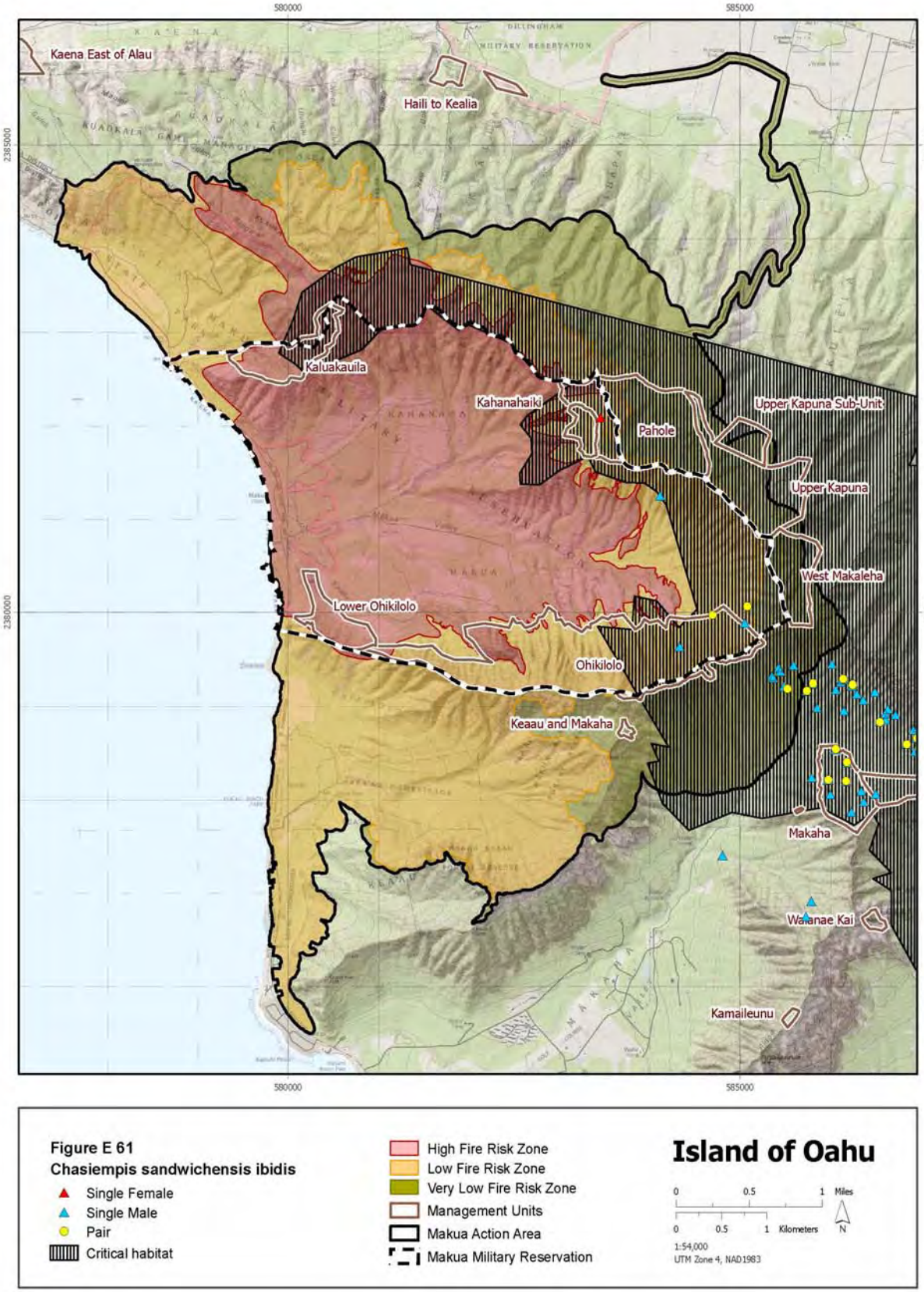
Ungulate control

The browsing of feral goats and the rooting of feral pigs can lead to a long-term loss of forest habitat by reduction in recruitment of canopy tree species and opening of the understory and spread of alien plant species. If feral ungulate populations are not controlled, the habitat quality and primary constituent elements needed by elepaio will be slowly degraded, eventually resulting in complete loss of their value for the conservation of the species. Proposed completion of the ungulate exclosure fence surrounding Makua Valley, removal of ungulates will prevent future ungulate degradation of Oahu elepaio critical habitat in Makua Valley.

Conclusion

While there is a risk of fire impacting Oahu elepaio critical habitat, the Service concludes that there is a greater likelihood that the proposed action will result in overall maintenance of the critical habitat even when fire risk is considered. The risk of adverse modification from training in Makua Military Reservation is low because only four percent of the critical habitat lies within the Action Area. However, critical habitat lands within the Action Area would be an integral part of any viable elepaio population in the northern Waianae Mountains, and are needed to conserve the complete geographic, morphological, and behavioral variation in elepaio across the island. The proposed action is not likely to adversely modify or destroy critical habitat and unlikely to diminish the value of the critical habitat for the conservation of the species. Effective implementation of the weapons restrictions, fire suppression staffing, firebreaks and fuelbreaks, control of feral ungulates and rodents, and post-fire restoration of burned Oahu elepaio critical habitat areas, is expected to prevent destruction or degradation of habitat needed by elepaio for foraging, sheltering, nesting, and dispersing within the Makua action area. This conclusion relies

heavily on successful implementation of the conservation actions described above, and the efficacy of these actions in reducing threats must be monitored. If the actions are found not to be effective, the reasons for their ineffectiveness must be rectified and this conclusion must be revisited.


580000
585000
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Kaena East of Alau
Haili to Kealia
Kaluakauila
Kahanahaiki
Pahole
Upper Kapuna Sub-Unit
Upper Kapuna
West Makaleha
Lower Ohikilolo
Ohikilolo
Keaau and Makaha
Makaha
Wainae Kai
Kamaileunu
Figure E 61
Chasiempis sandwichensis ibidis
Single Female
Single Male
Pair
Critical habitat
High Fire Risk Zone
Low Fire Risk Zone
Very Low Fire Risk Zone
Management Units
Makua Action Area
Makua Military Reservation
Island of Oahu
0 0.5 1 Miles
0 0.5 1 Kilometers
N
1:54,000
UTM Zone 4, NAD1983

## CUMULATIVE EFFECTS

Cumulative effects are those impacts of future State and private actions that are reasonably certain to occur within the area of action subject to consultation. Cumulative effects include the impacts of future State, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this Biological Opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to Section 7 of the Endangered Species Act.

Listed resources in the Makua action area are likely to be exposed to stressors associated with fires ignited by local arson incidents or by human carelessness, if these fires spread to population units, management units, or critical habitat within the action area. Brushfires are common throughout leeward Oahu each summer and are reasonably certain to occur in the future. During June through August 2005, for example, brushfires over approximately 2,327 ha (5,750 ac) in the Waianae area (Waianae Valley, Waianae, Maili, and Lualualei) were attributed to arson or fireworks (*Honolulu Advertiser*, January 2, 2006). Non-military fires of unknown origin burned about 405 ha (1,000 ac) in the Keawaula portion of the action area in July 2006 (*Honolulu Advertiser*, July 14, 2006; U.S. Army Garrison 2006b). Non-military fires also have burned parts of Makua Military Reservation from ignitions along Farrington Highway outside the installation (U.S. Army Corps of Engineers 2005). One such fire in July 2006 spread into the Lower Okikilolo Management Unit of Makua, where it burned within 50 m (165 ft) of *Chamaesyce celastroides* var. *kaenana* plants and within 150 m (495 ft) of *Hibiscus brackenridgei* ssp. *mokuleianus* plants. This fire also burned, and likely destroyed, up to 22 *Melanthera tenuifolia* plants in a unique, low-elevation site for this species (U.S. Army Garrison 2006a). Another July 2006 fire burned from along Farrington Highway up to the Kaluakauila Management Unit, where it impacted more than 81 ha (200 ac) that supported experimental reintroductions of *Hibiscus brackenridgei* ssp. *mokuleianus* and natural occurrences of *Chamaesyce celastroides* var. *kaenana* (U.S. Army Garrison 2006d). Loss of individuals and occurrences within population units outside the action area could significantly reduce the available seed source for propagation and outplanting of target and at-risk taxa both within and outside the action area. Cumulative effects related to non-military wildfire will be minimized by the Army's development and implementation of wildland fire management plans for management units on Army lands and adjacent State lands.

Future State actions in the action area include continued management of State lands according to their current designations as Forest Reserves or Natural Area Reserves. The State will continue to manage threatened and endangered species on their lands to the best of their ability. In addition, there will be continued threats to listed species in the action area from feral ungulates because of State regulated hunting activities in Forest Reserves and Game Management Areas.

## CONCLUSION

After reviewing the current status of the species and critical habitats, the environmental baseline for species and critical habitat in the action area, and the effects of military training at Makua, including the cumulative effects, it is our biological opinion that implementation of the proposed action is not likely to jeopardize the continued existence of any species covered in this opinion, or adversely modify or destroy designated critical habitat addressed in this opinion. This

reinitiation was a risk assessment regarding the potential of a fire igniting and burning species or critical habitat.

The no jeopardy conclusions are based on the following: (1) Army conservation and stewardship programs that will increase the baseline number of individuals pursuant to the criteria stipulated in the Makua Implementation Plan and the Makua Implementation Plan Addendum for 28 species; (2) weapons restrictions, fuels management, fire suppression, and construction of fuelbreaks and firebreaks, to minimize the risk of wildland fire; and (3) invasive species control such as rat baiting, ungulate removal and invasive plant management. Please see each of the species specific conclusion sections in the effects analysis for the basis of how we reached these conclusions.

Our determination that implementation of the proposed action would not adversely modify or destroy critical habitat is based largely on the Army's multiple actions to minimize and reduce the risk of fire, minimize introduction and spread of non-native species, increase the current baseline for primary constituent elements of critical habitat. In addition, if a fire should escape the firebreak road, the affected critical habitat will be restored. Any losses that occur after implementation of these actions will be short term in nature and will not result in permanent destruction or alteration of the physical and biological features of critical habitat. Please see each of the species specific critical habitat conclusion sections in the effects analysis for more specific discussion of how we reached these conclusions.

## INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined (50 CFR 17.3) by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by the Service (50 CFR 17.3) as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are non-discretionary, and must be undertaken by the Army so that they become binding conditions in order for the exemption in section 7(o)(2) to apply. The Army has a continuing duty to regulate the activity covered by this incidental take statement. If the Army (1) fails to assume and implement the terms and conditions or (2) fails to require any contractors to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to any permit or contract, then the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the Army must report the progress of the action and its impact on the species to the Service as specified in the incidental take statement [50 CFR § 402.14(i)(3)].

Sections 7(b)(4) and 7(o)(2) of the Act generally do not apply to listed plant species. However, limited protection of listed plants from take is provided to the extent that the Act prohibits the removal and reduction to possession of federally listed endangered plants or the malicious damage of such plants on areas under Federal jurisdiction, or the destruction of endangered plants on non-Federal areas in violation of State law or regulation or in the course of any violation of a State criminal trespass law (HRS 195D).

**Amount or Extent of Take**

This Biological Opinion anticipates the following forms of incidental take:

1. The Service anticipates that take will occur in the form of harm (due to the loss of habitat), harassment, and death as a result of Army activities described in this Biological Opinion. The Service anticipates that the loss of no more than one occurrence of *Achatinella mustelina* comprised of 10 to 40 individuals will occur over the next 30 years.

2. The Service anticipates that take will occur in the form of harm (due to the loss of habitat), harassment, and death as a result of Army activities described in this Biological Opinion. The Service anticipates the take of one (1) Oahu elepaio pair and one (1) nest (which may contain up to 3 eggs or 3 nestlings, or a combination of nestlings and eggs not to exceed a total of 3 will occur over the next 30 years.

The Service will not refer the incidental take of any migratory bird for prosecution under the Migratory Bird Treaty Act of 1918, as amended (16 U.S.C. §703-712), if such take is in compliance with the terms and conditions specified herein.

**Effect of Take**

In this Biological Opinion, the Service determined that this level of anticipated take is not likely to jeopardize the continued existence of the *Achatinella mustelina* or Oahu elepaio, or destruction or adverse modification of Oahu elepaio critical habitat.

**Reasonable and Prudent Measures**

The reasonable and prudent measures given below, with their implementing terms and conditions, are designed to minimize the impacts of incidental take that might otherwise result from the proposed actions. If, during the course of the actions, the level of incidental take is exceeded, the action agency is required to reinitiate consultation and review the reasonable and prudent measures provided in this Biological Opinion. In addition, the Army must cease the activities that caused the taking; must immediately provide an explanation of the causes of the taking; and must review with the Service the need for possible modification of the reasonable and prudent measures. The Army will offset unavoidable impacts through the implementation of the conservation measures as described in the Project Description. The Army will implement the conservation measures as identified in the Project Description of this Biological Opinion.

The Service believes the following Reasonable and Prudent Measures are necessary and appropriate to minimize incidental take of *Achatinella mustelina* and Oahu elepaio. The measures described below are non-discretionary and must be implemented.

1. Minimize impacts of military activities and actions on survival and reproduction of *Achatinella mustelina* within the Makua action area.

2. Minimize direct impacts of military activities on survival and reproduction of Oahu elepaio within the Makua action area.

3. Minimize loss of Oahu elepaio habitat within the Makua action area.

4. Minimize threat of alien rats to Oahu elepaio within the Makua action area.

**Terms and Conditions**

In order to be exempt from the prohibitions of section 9 of the Act, the agency must comply with the following terms and conditions, which implement the reasonable and prudent measures described above. These terms and conditions are non-discretionary.

1. Minimize impacts of military activities and actions on survival and reproduction of *Achatinella mustelina* within the Makua action area.

   1.1. All enclosures of known tree snail occurrences must be completed within five years of the issuance of the Biological Opinion.

   1.2. The Army will report in writing on an annual basis to the Service on the following items: (1) status of the known occurrences; (2) number and location of high explosives or pyrotechnics that land outside of the impact area; (3) the extent of damage or fires that result from these high explosives or pyrotechnics; and (4) how close to known tree snail occurrences were the high explosive impacts.

   1.3. The Service shall be notified within one (1) working day of any take of *Achatinella mustelina*.

   1.4. The depository designated to receive specimens of *Achatinella mustelina* or shells that are collected is the B.P. Bishop Museum, 1525 Bernice Street, Honolulu, Hawaii, 96817 (telephone: 808/547-3511). If the B.P Bishop Museum does not wish to accession the specimens, the permittee should contact the Service's Division of Law Enforcement in Honolulu, Hawaii (telephone: 808/541-2681; fax: 808/541-3062) for instructions on disposition.

2. Minimize direct impacts of military activities on survival and reproduction of Oahu elepaio within the Makua action area.

   2.1. Prior to initiating live-fire training at Makua, an appendix to this Biological Opinion will be prepared, detailing and clarifying, in text format, the weapons restrictions

summarized in Table PD 2. If the Standard Operating Procedures detail the weapons restrictions in text form as well as in tables, completion of revised Standard Operating Procedures would satisfy this provision. The text will be approved by the Service prior to implementation of live-fire training at Makua.

2.2. The Army will notify the Service within 24 hours of any fires that burn any portion of a known elepaio territory and the number of elepaio territories affected.

2.3. The Army will report to the Service quarterly in writing the number of high explosive rounds that land outside the south lobe of the firebreak road, the locations where such rounds land, and whether these locations are within any known elepaio territories

2.4. The depository designated to receive specimens of any Oahu elepaio that are killed is the B.P. Bishop Museum, 1525 Bernice Street, Honolulu, Hawaii, 96817 (telephone: 808/547-3511). If the B.P Bishop Museum does not wish to accession the specimens, the permittee should contact the Service's Division of Law Enforcement in Honolulu, Hawaii (telephone: 808/541-2681; fax: 808/541-3062) for instructions on disposition.

3. Minimize loss of Oahu elepaio habitat within the Makua action area.

3.1. Army Natural Resource Staff will have adequate access and will implement a rat control program, in all occupied Oahu elepaio breeding territories within the Makua action area. Until aerial dispersal of rodenticide is approved, Natural Resources Staff will bait and set a sufficient number of traps and bait stations every one to two weeks during the breeding season to control rat predation.

3.2. The Army will report annually to the Service in writing the number of elepaio territories in which rats were controlled, the location of each territory in which rats were controlled, the methods by which rats were controlled in each territory, the dates on which rat control activities were conducted in each territory, and the status of elepaio in each territory from the previous year.

4. Minimize threat of alien rats to Oahu elepaio within the Makua action area.

4.1. Construction of an ungulate-proof fence encircling the Makua Military Reservation installation boundary will be completed within three years of the date of completion of this Biological Opinion.

4.2. To prepare for aerial dispersal of rodenticide, ungulates will be removed from Makua Military Reservation within five years of the completion of this Biological Opinion.

4.3. The fence will be maintained and Makua Military Reservation will be kept free of ungulates.

4.4. When aerial rodenticide is approved for use, it will be applied in accordance with its label (e.g., fenced and "ungulate-free") for the control of rats throughout the Makua action area and management units outside the action area.

## CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Endangered Species Act (Act) directs Federal agencies to utilize their authorities to further the purposes of the 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. The recommendations provided relate only to the proposed action and do not necessarily represent complete fulfillment of the Army's section 7(a)(1) responsibilities for the species. In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats, the Service requests notification of the implementation of any conservation recommendations.

1) The Army has an expansive and comprehensive database to document pertinent information regarding each species. We recommend the Army hire an individual to update and maintain the biological database, add additional plant location data, link population unit data with GIS data points.

2) We recommend the Army fund additional invertebrate pest management research to identify effective control or eradication methods for pests of concern such as *Euglandina rosea*, black-twig borer, and slugs.

3) The Army should maintain fire suppression staffing and helicopter availability for rapid deployment to wildland fires in the vicinity of any management unit, inside and outside of the action area, when live herbaceous fuel moisture is below 120 percent. Large fires may develop quickly when the grass is cured and strategic use of limited personnel and helicopter resources will be necessary to ensure the protection of stabilization populations of endangered plants growing in the Waianae Mountains.

4) To facilitate reintroduction and fire suppression planning, Army Natural Resources Staff should add GPS locations of individual plants to their GIS database.

5) To facilitate communications between Makua and wildland firefighters and cooperators stationed outside Makua valley, the Army should install a new radio repeater within range of Makua Valley.

6) The Army should increase nursery facilities 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. This native plant stock and seed could be used by the Integrated Training Area Management staff for their revegetation projects. Also, there would be plant materials readily available in case a fire does burn critical habitat and habitat restoration is warranted.

7) The Army should continue to pursue the establishment of shaded fuelbreaks, vegetated by native species, adjacent to existing forest and shrub vegetation, to further minimize fire risk to existing forest areas.

8) The Army should be a Cooperator on the National Environmental Policy Act documents for the registration of the aerial broadcast of a rodenticide for conservation purposes in Hawaii.

9) The Army should establish protocols for hydro-mulching or other large-scale native plant seeding to be used in native habitat restoration efforts.

10) In order to substantially reduce the fire risk associated with live-fire training, close Makua to live-fire training (except for short-range training ammunition blanks used in specified areas) when live herbaceous fuel moisture falls below 100 percent.

## REINITIATION STATEMENT

This concludes formal consultation on this action. 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 operation causing such take must cease pending reinitiation. The Army will coordinate with the Service if a fire due to military activities or actions occurs outside of any of the firebreak roads established at Makua. No military training activities with live-fire weaponry, except for those that are addressed in this consultation may be used at this installation without coordination with the Service. As stated in the Conclusion (above), the Service's finding of no adverse modification 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 without Service coordination, 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,

Patrick Leonard
Field Supervisor

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