Makua type occurs in sites similar to the West Molokai site, on rocky slopes in areas that are drier and more open than any of the other Oahu sites, and in vegetation consisting of mixed native and alien shrubs and grasses. Wild *H. brackenridgei* ssp. *mokuleianus* plants of all types lose their leaves at the beginning of the summer dry season, usually by June, and remain dormant until new growth appears with the wet season, usually by October. The three Oahu types vary in growth rates and age at which cultivated plants begin to flower. Most of the cultivated Makua stock flowers at younger than 6 months; cultivated stock of the other types begin to flower at ages ranging from 6 months to 4 years. Flowering occurs from December through June. Flowers open in the afternoon and early evening and remain open until early the next morning, and are pollinated by sphinx or hawk months. Mature seed capsules are present from February through June, and seeds of cultivated plants may remain viable in garden soil for up to 15 years. In the wild, seedlings are often found at locations where no mature plants have been seen for many years. The longevity of *H. brackenridgei* ssp. *mokuleianus* plants in the wild is undocumented, but it is considered a short-lived species because wild populations appear to undergo large fluctuations in numbers (Makua Implementation Team 2003). Other demographic information for *H. brackenridgei* ssp. *mokuleianus* in the wild is unknown, including longevity, number of seeds produced, survivorship to sexual maturity, pollination and seed dispersal, vegetative reproduction, and specific environmental requirements.

Threats to the Species *Hibiscus brackenridgei* was listed as endangered because of major, ecosystem-level threats to its survival and recovery. Populations are exposed to fire, browsing by cattle and goats, rooting by pigs, leaf damage by the Chinese rose beetle and other insects, competition with invasive non-native plants. In addition, *H. brackenridgei* plants are short-lived, and seedling survival varies dramatically with seasonal rainfall abundance (Makua Implementation Team 2003; U.S. Army Garrison 2005b). In addition, *H. brackenridgei* ssp. *mokuleianus* in areas near human habitation is threatened by hybridization and genetic contamination from the related, cultivated taxon *H. brackenridgei* ssp. *brackenridgei*, which is sold in commercial nurseries and does not occur naturally on Oahu or Molokai (Makua Implementation Team 2003). This taxon experiences large population fluctuations related to rainfall and its natural recruitment is severely reduced by feral ungulates and invasive weeds. Occurrences also are vulnerable to extirpation from naturally occurring events such as windstorms and/or reduced reproductive vigor due to small population size and limited distribution (59 FR 56333; 68 FR 35950; Service 1999a). The science of conservation biology has documented a general pattern of population collapse for a wide range of plant and animal species (Dennis *et al* 1991; Schemske *et al* 1994; Morris *et al* 1999; Menges 2000). According to this pattern, *H. brackenridgei* in the wild already is in a phase of "quasi-extinction" with numbers that have declined to the point where demographic stochasticity alone can result in extirpation. Thus, *H. brackenridgei* has a very high background risk of species extinction and any additional threats could eliminate expectation of its long-term persistence.

Conservation Needs of the Species Although recovery objectives may be refined as population viability analyses are conducted, the recovery plan for this species identifies interim objectives, downlisting objectives, and delisting objectives. Interim recovery objectives call for the stabilization of all existing populations of *H. brackenridgei*. To be considered stable, threats must be controlled, genetic storage must be maintained, and each of the populations must be naturally reproducing and increasing in number, with a minimum of 50 mature individuals per population. The Army's plant demography data will enable population

viability analyses to be conducted and the results may require a modification to the current stabilization targets. Species subject to common, large fluctuations in numbers may require a stabilization target of at least 100 mature individuals for each population unit, but because *H. brackenridgei* ssp. *mokuleianus* seeds are persistent in the soil seed bank, increasing the numerical criterion for stabilization is likely to be necessary to ensure the persistence of this species' population units.

Hibiscus brackenridgei downlisting criteria call for the establishment of five to seven populations containing a minimum of 300 mature, reproducing individuals, protected from threats. Delisting objectives currently call for the management of eight to ten populations of *H. brackenridgei* containing a minimum of 300 mature, reproducing individuals (Service 1999a). To achieve downlisting and delisting, locations of historical occurrences should be surveyed for new regeneration from seed (Makua Implementation Team 2003) and ungulate exclusion, fuelbreak establishment, weed control, and population augmentation should be completed at selected multi-island sites.

Ongoing Conservation Actions The Makua Implementation Team (2003) has developed stabilization protocols for *Hibiscus brackenridgei* ssp. *mokuleianus*, which are incorporated in the Makua Implementation Plan Addendum (U.S. Army Garrison 2005a). One population unit for each of the three morphological types is being managed for stabilization (U.S. Army Garrison 2005b). An additional population unit, Keaau, will be established for the short, Makua phenotype to further ensure persistence of this unique type. The management units are Haili to Kealia (subunits I and II), which is not fenced, and Lower Ohikilolo, which is fenced. Stock from three of the five wild population units has been established in inter situ and ex situ sites around Oahu. *Hibiscus brackenridgei* ssp. *mokuleianus* grows easily from cuttings, produces many flowers and seeds in a season, and there is good recruitment at the inter situ sites. Much of the seed collected, however, is not viable (U.S. Army Garrison 2005b).

In 2005, additional current State-wide ex situ collections for the species *Hibiscus brackenridgei* included 10 vegetative buds in micropropagation (Harold L. Lyon Arboretum), 23 cuttings in nurseries (Army Environmental Division, Oahu, and Harold L. Lyon Arboretum), 83 plants in nurseries (Harold L. Lyon Arboretum and Volcano Rare Plant Facility), 229 plants in botanical gardens (Amy Greenwell Ethnobotanical Garden, Maui Nui Botanical Garden, and Waimea Valley Audubon Center), two un-germinated seeds in a nursery (Harold L. Lyon Arboretum), 17,895 seeds in seed storage (Lyon Arboretum Seed Storage Facility and Maui Nui Botanical Garden), and three seedlings in a nursery (Harold L. Lyon Arboretum) (Service 2005b).

Critical Habitat Description A total of 1,814 ha (4,482 ac) of critical habitat, in seven separate units, was designated for *Hibiscus brackenridgei* on four islands. However, only Oahu critical habitat units provide habitat for the taxon *H. brackenridgei.* On Oahu, 661 ha (1,634 ac) of critical habitat was designated in three units on State (including Mokuleia Forest Reserve) and private lands. The three Oahu units provide habitat for three populations. To meet recovery goals, a population should be represented by at least 300 mature, reproducing individuals of *H. brackenridgei* (68 FR 35950).

The primary constituent elements for two of the critical habitat units on Oahu include slopes, cliffs, or arid ledges in lowland dry forest or shrubland at elevations of 32 to 490 m (105 to 1,607 ft). In addition, these units contain one or more of the following associated native plant species: *Bidens amplectens*, *Chamaesyce* sp., *Diospyros hillebrandii*, *Dodonaea viscosa*, *Doryopteris* sp., *Erythrina sandwicensis*, *Heteropogon contortus*, *Lepidium bidentatum*, *Melanthera remyi*, *Pleomele halapepe*, *Psydrax odorata*, *Reynoldsia sandwicensis*, *Sida fallax*, or *Waltheria indica*. The primary constituent elements for the other unit on Oahu, for the Makua type, include dry shrublands at elevations of 32 to 490 m (105 to 1,607 ft) and containing one or more of the following associated native plant species: *Doryopteris* sp., *Dodonaea viscosa*, *Heteropogon contortus*, *Sida fallax*, or *Waltheria indica*. The plant community, associated species, and elevations are indicative of important features such as soil moisture, nutrient cycling and availability, temperature ranges, and light levels which are primary constituent elements of the habitat required for the species' conservation (68 FR 35950).

Threats to the Critical Habitat *Hibiscus brackenridgei* critical habitat units are exposed to impacts from fire, grazing, pigs, non-native insects and pathogens, human disturbance, non-native invasive plants, natural disturbances, and human activity (Makua Implementation Team 2003; U.S. Army Garrison 2005b). In 2007 the Waialua Fire burned 360 ha (888 ac) (64 percent) of *H. brackenridgei* critical habitat unit C, accounting for an impact to 20 percent of the total area on all islands designated as critical habitat for this species.

Environmental Baseline of the Species and Critical Habitat - *Hibiscus brackenridgei*

Status of the Species in the Action Area As a result of the Waialua Fire and recent Army out-planting efforts, the Makua population unit in the training portion of the action area contains 48 percent of the total remaining mature, in situ individuals of *Hibiscus brackenridgei* ssp. *mokuleianus*. The 104 individuals account for 63 percent of all known individuals of this subspecies. These 104 Makua plants account for between 28 and 32 percent of all in situ individuals of the *Hibiscus brackenridgei* multi-island species as a whole (excluding inter situ, ex situ, and experimental out-plantings). The Makua population unit has been monitored since 2003, and has increased from 7 to 104 total individuals. With 34 mature individuals, the Makua population unit is not meeting minimum numerical criteria for stabilization (defined as 50 mature, reproducing individuals). Although the area occupied by this population unit historically burned in fires ignited by the military and the public, recent germination suggests the seed bank is still viable if the alien guinea grass is removed and controlled (U.S. Army Garrison 2005b).

The Makua population unit is located within the Lower Ohikilolo Management Unit at the seaward end of Ohikilolo ridge, in sparse, lowland dry cliff vegetation adjacent to non-native grassland. The Makua population unit's 104 total individuals are located in a high risk fire zone from military training. Since 2002, the Army has experimentally reintroduced 46 individuals into the Kaluakauila population unit; these plants are not counted as naturally occurring (in situ) individuals. The 2003 prescribed burn damaged three of these plants and killed one (U.S. Army Garrison 2004a). The Army will not continue to maintain the Kaluakauila ex situ population because of the high risk of fire at that location (U.S. Army Garrison 2005b). Additional ex situ individuals include 34 mature individuals out-planted in

the vicinity of the Makua Range Control office. Thus, *H. brackenridgei* ssp. *mokuleianus* in the action area is currently characterized by one population unit that does not currently meet numeric, threat control, or genetic storage minimum criterion for stabilization located within the high fire risk zone. Keaau, a second population unit which currently contains no plants is located in an area designated as low risk of training-related wildland fire (Figure 17).

Status of the Critical Habitat in the Action Area In total, the two portions of the action area contains two percent of all range-wide critical habitat designated for *Hibiscus brackenridgei*. Originally land was proposed as critical habitat for *H. brackenridgei* on the Makua Military Reservation; however, pursuant to 3(5)(A) and 4(b)(2) of the Act, proposed critical habitat was not designated on Army lands (68 FR 36001). Unit C is a 0.04-ha (0.1-ac) residual portion of that larger piece of proposed critical habitat and it is located along the southern edge of the installation on State and private lands. It is considered to have minimal existing conservation value for the species at this time because of heavy impacts from grazing and non-native grass. The Puulu to Alaiheihe fuelbreak portion of the action area contains six percent (35 ha (86 ac)) of *H. brackenridgei* critical habitat unit B. With the exception of a small sliver along its eastern edge, the entire fuelbreak action area is designated critical habitat for *H. brackenridgei*. Like the *H. brackenridgei* critical habitat found in the training portion of the action area, due to grazing and recent fires, the site is dominated by invasive, exotic grasses (Hawaii Gap Analysis Program, 2005 and Keir 2008).

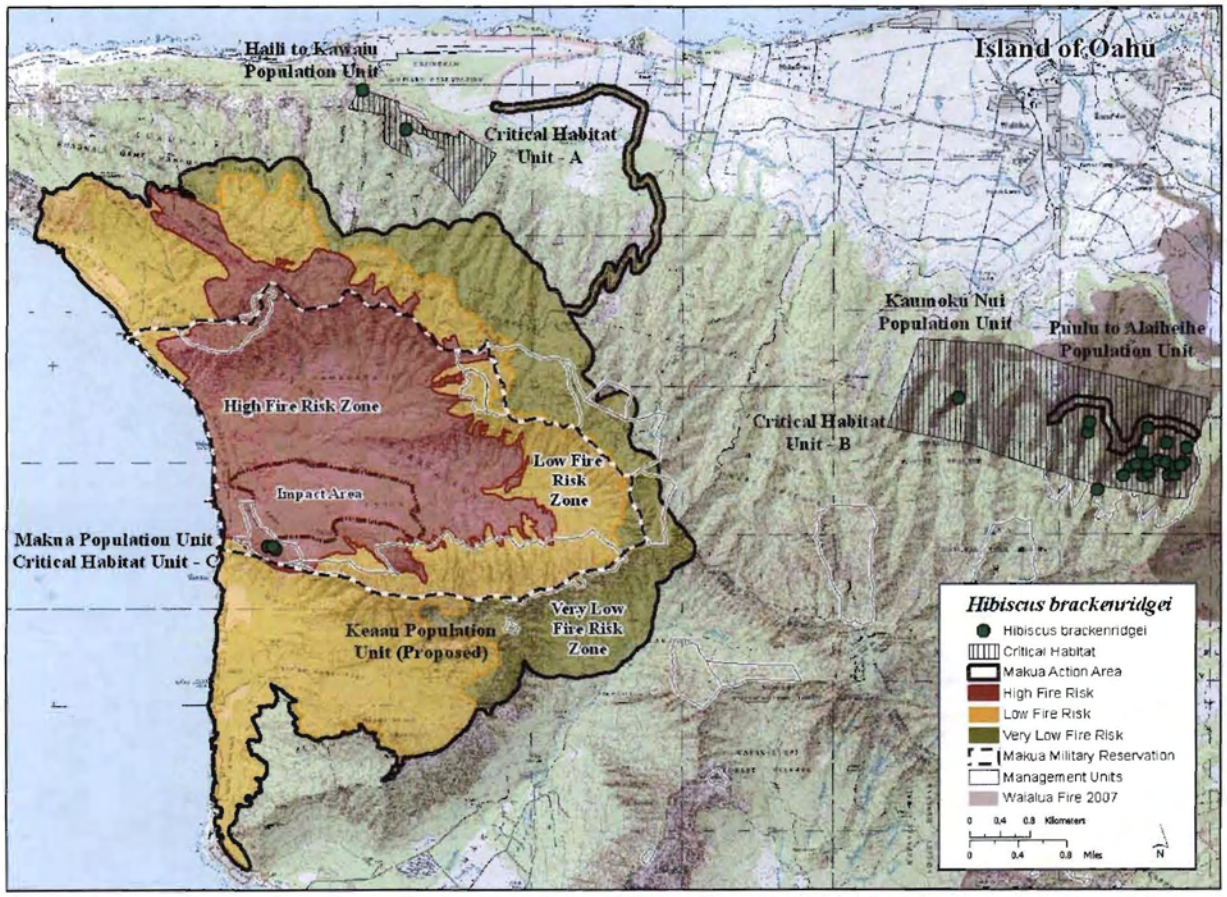

Figure 17. *Hibiscus brackenridgei* population units and critical habitat in the vicinity of the Makua Action Area.

Threats to the Species and Critical Habitat in the Action Area *Hibiscus brackenridgei* populations and critical habitat units within the action area are threatened by wildland fire, rodents, Chinese rose beetle, non-native invasive plants, natural disasters, and human activity. Within the training portion of the action area, *H. brackenridgei* ssp. *mokuleianus* are particularly vulnerable to wildland fires associated with both military training activities and local activities of the public, as well as competition from non-native grasses. Guinea grass requires significant control effort and is a major fire risk (U.S. Army Garrison 2005b). The *H. brackenridgei* ssp. *mokuleianus* in the action area have a very high background risk of extinction and any additional uncontrolled threats could eliminate the expectation of the population's long-term persistence. All but eight percent of the fuelbreak portion of the action area burned in the Waialua Fire. The three-ha (7-ac) area mapped as unburned appears to be in the vicinity of an area that was heavily impacted by grazing (Cherry 2008).

Conservation Needs of the Species and Critical Habitat in the Action Area Stabilization goals to improve the status of *H. brackenridgei* ssp. *mokuleianus* include management to attain four population units, each with a minimum of 50 mature, reproducing individuals. Two population units have been identified for stabilization within the training portion of the action area; Makua and Keaau. Because of its low numbers, this species is considered particularly at risk from project-related impacts and is included in Army plans for expedited stabilization.

The Army also proposes to reintroduce individuals from the Makua population unit into the Keaau population unit because *Hibiscus brackenridgei* ssp. *mokuleianus* occurs in a high fire risk zone within the training portion of the action area,. The Keaau site has a lower risk of burning because it is farther from Farrington Highway and from the training area, and because the slopes below the management unit are intermittently grazed. In the future, it may be possible to establish a grazed fuelbreak to protect the site (Lau 2008b). Keaau will be fenced and weeded as a fourth population unit to manage for *H. brackenridgei* ssp. *mokuleianus* stabilization. In addition, a post-fire revegetation plan and site-specific fuel modification are needed where this species occurs in the action area, and herbicide treatment and mowing along the firebreak roads should be maintained consistently (U.S. Army Garrison 2005b). The non-native insect *Niesthrea louisianica* (Rhopalidae) was recently observed on *H. brackenridgei* ssp. *mokuleianus* out-planted at Makua Range Control. This insect was introduced for study as a biocontrol agent for the non-native weed *Abutilon theophrasti* and reduces its seed viability by 98 percent. Research is needed to determine if this insect is a source of seed predation on *H. brackenridgei* ssp. *mokuleianus*, and if so, to develop control techniques (U.S. Army Garrison 2005b). Past fires at Makua, including the August 2005 white phosphorus fire, have jumped the firebreak road in the vicinity of the Makua population unit. Therefore removal of shrubs, trees, and heavy grass fuels along the inside edge of the firebreak road is identified as a high priority. In addition, fire-fighting and helicopter support are vital to protect this population unit from burning in fires ignited by the public and the Army (U.S. Army Garrison 2005b). Other general conservation needs of the species in the action area are the same as those described in the introduction to the "Status and Environmental Baseline of the Species and Critical Habitat" section of the Makua Biological Opinion.

Ongoing Conservation Actions for the Species and Critical Habitat in the Action Area The Makua population unit is being managed for stabilization as specified in the Makua

Implementation Plan Addendum (U.S. Army Garrison 2005b). The Makua population unit in the Lower Ohikilolo Management Unit is protected by a fence, goats have been virtually eradicated from Makua, and weeds are controlled around plant sites. A 30-m (98-ft) chemically controlled fuelbreak is maintained inside the firebreak road, a 10-m (33-ft) fuelbreak is maintained outside the firebreak road, and a 30-m (98-ft) wide, 1.4-ha (3.5-ac) fuelbreak is maintained directly around the *Hibiscus brackenridgei* ssp. *mokuleianus* population unit (U.S. Army Garrison 2005b). As of 2007, genetic storage goals for this population unit were approximately 70 percent complete, with 20 plants meeting the goals of the Makua Implementation Plan (U.S. Army Garrison 2005b).

The Keaau population unit is slated to be established, prior to implementation of weapons restrictions listed in Table PD 2, Column D of the Biological Opinion, by propagating and out-planting plant material from plants in the Makua population unit. The Army is developing a fuelbreak to protect the Keaau area from fires ignited by training and the public.

Status of the Critical Habitat – *Nototrichium humile*

The Makua Biological Opinion's description of *Nototrichium humile* critical habitat and that document's characterization of threats to this critical habitat remain valid. In summary, a total of 900 ha (2,224 ac) of critical habitat, in five separate units, was designated for *N. humile* on Oahu and Maui. On Oahu, 502 ha (1,241 ac) of critical habitat was designated in four units on State and private lands to provide habitat to support six populations of *N. humile*. On Maui, one unit on State and private lands was designated to provide habitat for one population. To meet recovery goals, each population would contain a minimum of 300 mature, reproducing individuals of *N. humile* (68 FR 35950).

The primary constituent elements of critical units on Oahu include cliff faces, gulches, stream banks, or steep slopes in dry or mesic forests often dominated by *Diospyros sandwicensis* or *Sapindus oahuensis,* at elevations between 185 and 806 m (607 and 2,644 ft). In addition, all Oahu units contain one or more of the following associated native plant species: *Abutilon sandwicense*, *Alyxia oliviformis*, *Antidesma pulvinatum*, *Artemisia australis*, *Bidens cervicata*, *Canavalia* sp., *Carex wahuensis*, *Charpentiera* sp., *Dodonaea viscosa*, *Elaeocarpus bifidus*, *Erythrina sandwicensis*, *Eugenia reinwardtiana*, *Hibiscus* sp., *Melanthera tenuis*, *Metrosideros polymorpha*, *Myoporum sandwicense*, *Myrsine lanaiensis*, *Nestegis sandwicensis*, *Peperomia* sp., *Pisonia umbellifera*, *Pleomele* sp., *Pouteria sandwicensis*, *Psydrax odorata*, *Rauvolfia sandwicensis*, *Reynoldsia sandwicensis*, *Sicyos* sp., *Stenogyne* sp., *Streblus pendulinus*, or *Syzygium sandwicensis*. The plant community, associated species, and elevations are indicative of important features such as soil moisture, nutrient cycling and availability, temperature ranges, and light levels, which are primary constituent elements of the habitat required for the species' conservation (68 FR 35950).

Environmental Baseline of the Critical Habitat

Status of the Critical Habitat in the Action Area The action area contains slightly more than one percent of the total critical habitat for *Nototrichium humile* on Oahu, including 6 ha (16 ac) within the training portion of the action area and 7 ha (17 ac) within the proposed Puulu to Alaiheihe fuelbreak. Originally land was proposed as critical habitat for *H. brackenridgei* on

the Makua Military Reservation; however, pursuant to 3(5)(A) and 4(b)(2) of the Act, proposed critical habitat was not designated on Army lands (68 FR 36001). Unit A is a 5-ha (13-ac) residual portion of that larger piece of proposed critical habitat and it is located along the northern edge of the installation on State land, almost entirely within Kaluakauila Management Unit at Makua where it is exposed to high risk of training-related fire. Less than one percent (1 ha (3 ac)) of the 229-ha (567 ac) critical habitat unit B, designated to provide habitat for two *N. humile* populations is located within the very low fire risk zone on the east edge of the training action area. Three percent (7 ha (17 ac)) of the 237-ha (586-ac) *N. humile* critical habitat unit C, designated to provide habitat for two *N. humile* populations, is located within the proposed Puulu to Alaiheihe fuelbreak (Figure 18). Vegetation within the fuelbreak portion of the action area is dominated by invasive, exotic guinea grass, as described in the general effects section of this Amendment.

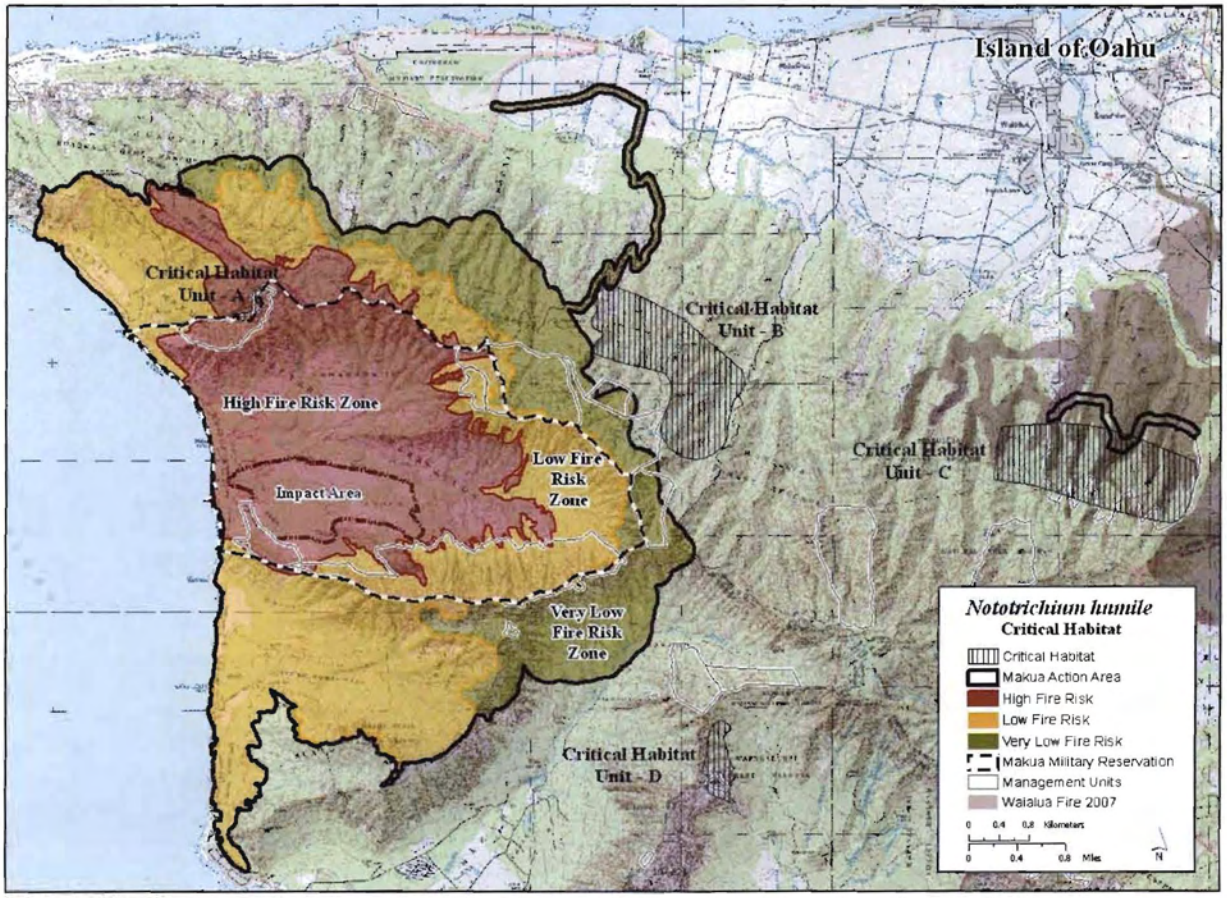

Figure 18. *Nototrichium humile* critical habitat in the vicinity of the Makua Action Area.

<u>Threats to the Critical Habitat in the Action Area</u> Threats to *Nototrichium humile* critical habitat in the training portion of the action area include fires ignited by the public and military training and invasion of alien vegetation are described in the Makua Biological Opinion. Based on historic fire perimeter maps, Unit A was within the perimeter of 1970 and 1984 fires ignited by the military at Makua (Costales 2006). Approximately 30 percent of critical habitat unit A was impacted by the 2003 escaped prescribed burn at Makua (Enriques 2003). Threats to *N. humile* critical habitat in the Puulu to Alaiheihe fuelbreak portion of the action area are identical to those in the training portion of the action area (detailed in the Makua Biological

Opinion), except the fuelbreak area is not threatened by fires associated with military training at Makua. Approximately 44 percent (104 ha (258 ac) of the 237-ha (586-ac) *N. humile* critical habitat unit C was burned in the Waialua Fire (see Figure 18).

Ongoing Conservation Actions for the Critical Habitat Within the Action Area The conservation actions that include Army fencing and control of non-native plants and rats described in the Makua Biolgical Opinion remain valid. Other than interagency fire protection efforts, no ongoing conservation actions benefit *N. humile* critical habitat in the Puulu to Alaiheihe fuelbreak portion of the action area.

EFFECTS OF THE ACTION

Effects of the action as described in the Project Description of the Makua Biological Opinion and analyzed in the General Effects and species specific effects sections of that Opinion are, with the exceptions noted in this Amendment, still valid. General effects of the proposed Puulu to Alaiheihe fuelbreak, as well as updated general effects of fire retardant and foam, which are applicable to all species and critical habitat addressed in this Amendment, are presented below. Species-specific analysis of effects of training, fuelbreak development, and other Army activities and conservation measures associated with the proposed action are addressed individually following the general effects section.

General Effects of the Proposed Puulu to Alaiheihe Fuelbreak

Development and maintenance of the proposed 35-ha (86-ac) grazed fuelbreak along the bottom edge of the Puulu to Alaiheihe Management Unit will result in adverse impacts to a small portion (one to 14 percent) of critical habitat units designated for six plant taxa (see Table 1). The consequence of grazing management in the fuelbreak area is the temporary loss of vegetative primary constituent elements, increased cover of invasive grass, and increased erosion. The loss of vegetative primary constituent elements within this portion of the critical habitat units will reduce their ability to provide for the conservation of populations of the taxa pursuant to recovery goals. Although years of more intensive grazing within the fuelbreak area will make it more difficult to restore native forest to this grazed area, this adverse impact is not permanent, and it is offset by the reduction in fire impact it affords the species and critical habitat areas above its location. Adverse effects of fuelbreak maintenance to critical habitat would be similar to ongoing impacts to the site associated with ranching, fire, and non-native plant invasion. Fifty three percent (113 ha (280 ac) of the 210-ha (519-ac)) Puulu to Alaiheihe Management Unit area was burned in the Waialua Fire. This fuelbreak, in conjunction with the proposed exclusion of ungulates from the proposed Puulu to Alaiheihe Management Unit, will provide suitable conditions for natural and management-assisted post-fire regeneration of burned areas. Without implementation of the proposed action, this privately-owned site and the forested areas above it are likely to sustain a net loss of recovery value as they continue to be impacted by major threats.

The adverse effects of grazing on shrub and tree survival and recruitment are well documented in Hawaii. Intensive prescribed grazing results in the death of hardwood adults and seedlings and a depletion of the hardwood soil seed bank (Cabin *et al* 2000, pp. 443-446, Blackmore and Vitousek 2000, pp. 627-628, Allen 2000, pp. 1039-1040, Castillo *et al* 2006, pp. 19-21).

Because hardwood species are among the primary constituent elements of critical habitat for all six taxa addressed in this Amendment, grazing will reduce the conservation value of the critical habitat areas within the fuelbreak.

The fuelbreak, with its integrated 60-m (197-ft) intensively grazed area of fuel, will effectively minimize fire risk to the species and critical habitat above it by halting the spread of guinea grass head fires and minimizing spot fires within the management unit. Guinea grass fires produce numerous short-range spot fires within 60 m (197 ft) of the head of the fire (J. Greenlee 2007). In the Waialua Fire area, heavily grazed pastures were not breeched by the guinea grass head fire (Figure 19, see Figure 6 photos). The guinea grass pastures within and below the proposed fuelbreak area were not intensively grazed at the time of the fire (Cherry 2008). Creation of the proposed fuelbreak will ensure fuels are continuously managed to minimize fire threat to the management unit.

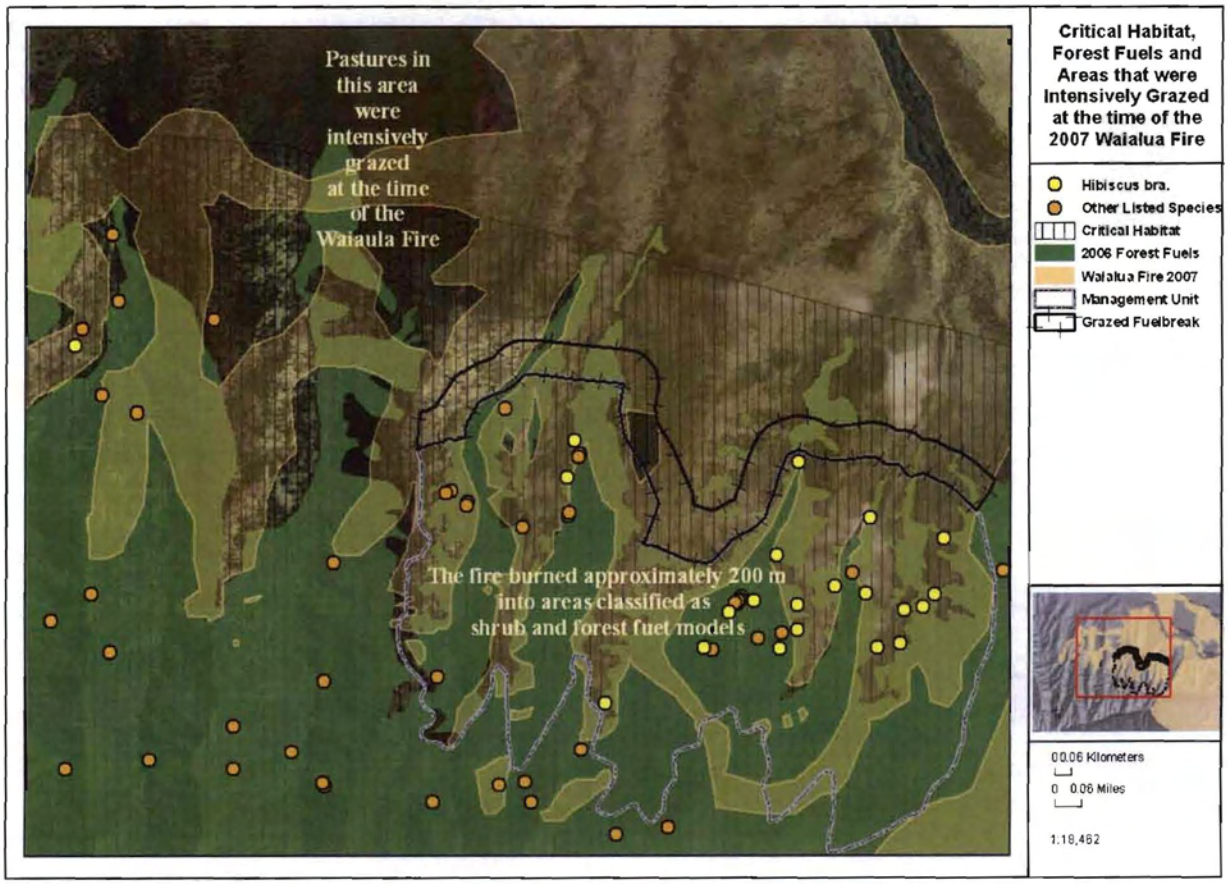

Figure 19. Grazed areas and Forest fuels impacted by the Waialua Fire in the Puulu to Alaiheihe Management Unit area.

By reducing the broad head fire area into a number of small spot fires and limited head fire breaching (in the 10 percent of the area that may not be maintained at the time of the fire), the fuelbreak will reduce the length of active fire perimeter, increasing the likelihood future fires will be contained. In the Waialua Fire, numerous long-range spot fires, ignited grass and forest fuels upwind of the grazed areas and grew large enough to coalesce due to the absence of adequate fire suppression response (Keir and Cannarella 2007). BehavePlus fire behavior

two studies (Larson and Duncan 1982, p. 701; Bradstock et al. 1987, p. 75) have shown high mortality in leguminous shrubs and forbs after retardant application. Indirectly, retardant can affect plant communities and rare plants by facilitating the invasion of non-native species (Bell 2003, p. 20-21, 23; Larson and Newton 1996, p. 140). Retardant application can also affect plant communities and rare plants indirectly by attracting more herbivore and browsers to an application site (Larson and Duncan 1982, p. 702), presumably because of the increased quality of the forage or an increase of biomass. Increases in biomass (Bell 2003 p. 2-3, 21; Larson and Newton 1996, p. 139; Larson and Duncan 1982, p. 701), and decreased plant diversity (Larson and Newton 1996, p. 140; Bradstock et al. 1987, p. 75) have also been noted in the literature but these effects may only last for one year (Bell 2003, p. 3, 20; Larson and Newton 1996, p. 139). These adverse effects to individual plants and critical habitat units would be offset by the increased effectiveness of the fire suppression effort at conserving nearby plant individuals and critical habitat.

Effects of the Action on *Abutilon sandwicense* Critical Habitat

Less than one percent (4 ha (10 ac)) of *Abutilon sandwicense* critical habitat unit A (accounting for approximately one half of a percent of all critical habitat designated for this taxa) occurs within the Puulu to Alaiheihe Fuelbreak portion of the Makua action area (Figure 20). Impacts of grazing management of the fuelbreak area are described in the general effects section of this Amendment. In summary, prescribed intensive grazing will minimize hardwood seedlings establishment, deplete the hardwood soil seed bank, and result in an increase in cover of invasive grass.

Because hardwood species are among the primary constituent elements of critical habitat for *Abutilon sandwicense,* fuelbreak maintenance will result reduced conservation value of this small portion of the critical habitat unit. However, the impacts of fuelbreak implementation will not be substantially different than the impacts of continued exposure to grazing and fire threats already present at the site. Ninety-six percent of *A. sandwicense* critical habitat in the fuelbreak portion of the action area was classified as alien vegetation (Hawaii Gap Analysis Program 2005), the site is currently managed as a pasture for cattle and goats (Cherry 2008) and all of the *A. sandwicense* critical habitat within the fuelbreak area was burned in the 2007 Waialua Fire (see Figure 20).

A total of 128 ha (317 ac) (21 percent) of *Abutilon sandwicense* critical habitat unit A will be protected from fire and grazing within the new Puulu to Alaiheihe Management Unit. Approximately 18 percent (105 ha (269 ac)) of the 604-ha (1,492-ac) *A. sandwicense* critical habitat unit A (13 percent of all *A. sandwicense* critical habitat) was burned in the 2007 Waialua Fire (see Figure 20).

Figure 20. *Abutilon sandwicense* critical habitat occurring within the Puulu to Alaiheihe fuelbreak portion of the action area.

Conclusion

Prescribed intensive grazing management of the proposed Puulu to Alaiheihe fuelbreak will temporarily reduce the establishment of shrubs and trees within less than one percent (4 ha (10 ac)) of *Abutilon sandwicense* critical habitat unit A. However, fuelbreak establishment and Army ungulate exclusion efforts will minimize fire risk to the 21 percent of critical habitat unit A that is within the Puulu to Alaiheihe Management Unit. Without Army management, large portions of critical habitat unit A would continue to 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, fires ignited by the public, and invasive plant encroachment). We considered this continued degradation of *A. sandwicense* critical habitat in the evaluation of the effects of the proposed action. Therefore, we have determined the development of the proposed fuelbreak will not result in adverse modification of critical habitat for *A. sandwicense.*

Effects of the Action on *Bonamia menziesii* Critical Habitat

A total of 34 ha (83 ac) of *Bonamia menziesii* critical habitat, accounting for approximately two percent of range-wide critical habitat for this species, and five percent of all of critical habitat designated for this species on Oahu, occurs within the two portions of the Makua action area (see Figure 12).

Training Effects Effects of the proposed action on *Bonamia menziesii* critical habitat within the training portion of the action area as described in the Makua Biological Opinion remain valid. In summary, four percent (28 ha (69 ac)) of all *B. menziesii* critical habitat designated on the island of Oahu is located in two units that occur entirely within the training portion of the Makua action area. The eight-ha (20-ac) critical habitat unit B, accounting for one percent of *B. menziesii* critical habitat on Oahu lies entirely within the zone at high risk of training-related wildfire. Three percent of the 20-ha (49-ac) unit A is within the high fire risk zone and the remaining portion is in the low risk fire zone. The edges of unit A appear to have been burned in fires attributed to the military in 1970 and 1984 (Costales 2006). Approximately 33 percent of the 7-ha (18-ac) critical habitat unit B was impacted by the 2003 escaped prescribed burn (Enriques 2003). 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 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.

The consequence of training-related fire is the loss of vegetative primary constituent elements and encroachment of non-native grasses and shrubs. The loss of vegetative primary constituent elements within these units reduces their ability to provide for the conservation of one population of *Bonamia menziesii* pursuant to recovery goals. The risk of training-related fire is minimized by the Army's implementation of weapons restrictions, improved grass mowing around the interior of the south lobe of the firebreak road, development of two fuelbreaks, and increased fire suppression staffing procedures described in the Makua Biological Opinion. In addition to reducing fire threat, the Army is enhancing the conservation value of critical habitat unit B by excluding ungulates and controlling non-native invasive plant species within approximately 66 percent of the unit occurring within Kaluakauila Management Unit.

Puulu to Alaiheihe Fuelbreak Effects One percent (6 ha (14 ac)), of the 94-ha (232-ac) critical habitat unit C is located in the Puulu to Alaiheihe fuelbreak portion of the action area (Figure 21). Impacts of grazing management of the fuelbreak area are described in the general effects section of this Amendment. In summary, prescribed intensive grazing will minimize hardwood seedlings establishment, deplete the hardwood soil seedbank, and result in an increase in cover of invasive grass.

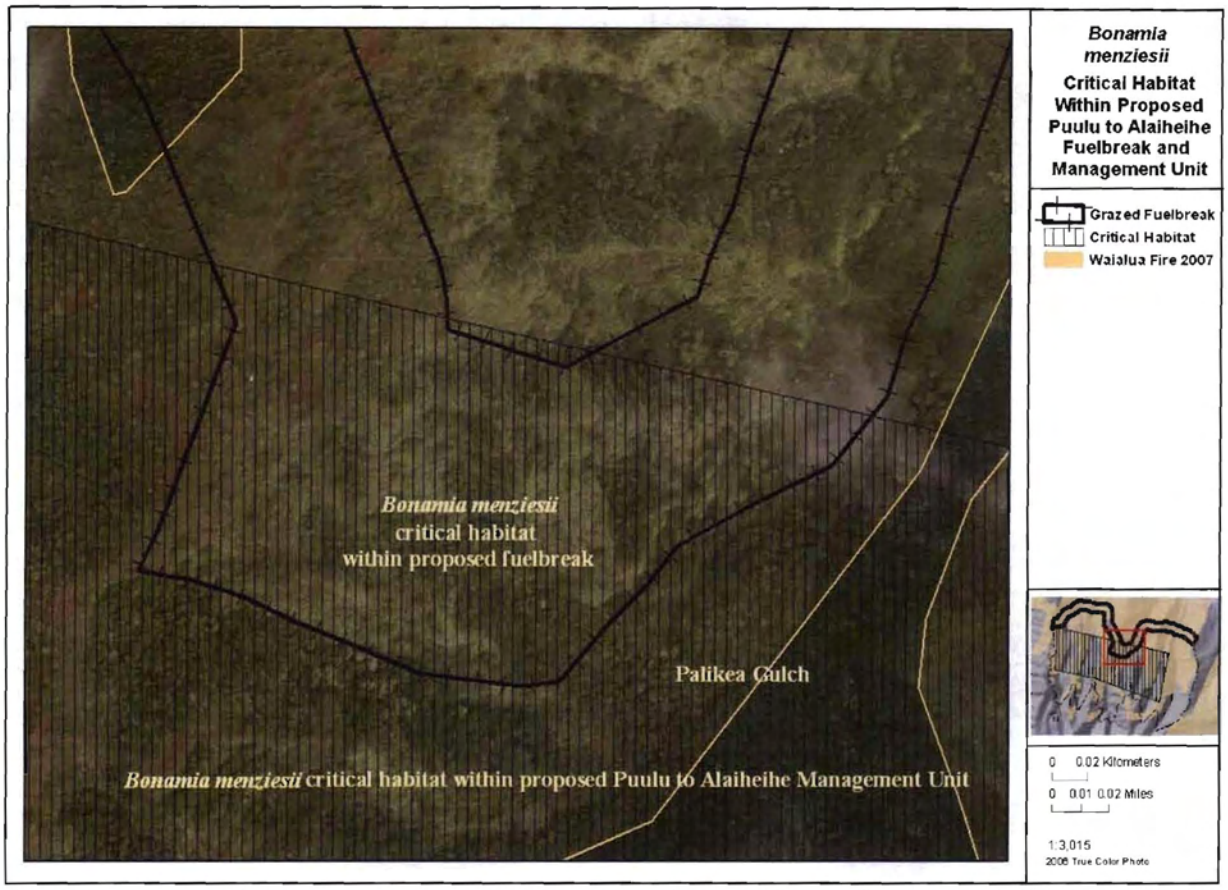

Figure 21. *Bonamia menziesii* critical habitat occurring within the Puulu to Alaiheihe fuelbreak portion of the action area.

Because hardwood species are among the primary constituent elements of critical habitat for *B. menziesii,* fuelbreak maintenance will result reduced conservation value of this portion of the critical habitat unit. However, the impacts of fuelbreak implementation will not be substantially different than the impacts of continued exposure to grazing and fire threats already present at the site. Ninety seven percent of *Bonamia menziesii* critical habitat in the fuelbreak portion of the action area was classified as alien vegetation (Hawaii Gap Analysis Program 2005), the site is currently actively managed as a pasture for cattle and goats (Cherry 2008) and all of the *B. menziesii* critical habitat within the fuelbreak area was burned in the Waialua Fire (see Figure 21).

The fuelbreak will minimize fire risk to the 94 percent (88 ha (218 ac)) of *Bonamia menziesii* critical habitat unit C that occurs within the Puulu to Alaiheihe Management Unit. Approximately 55 percent of the 94-ha (232-ac) *B. menziesii* critical habitat unit C (eight percent of the *B. menziesii* critical habitat on Oahu) was burned in the Waialua Fire (see Figure 21). In addition to reducing fire threat, the Army is enhancing the conservation value of critical habitat unit C by excluding ungulates and controlling non-native invasive plant species within the Management Unit.