BIOLOGICAL OPINION
of the
U.S. FISH AND WILDLIFE SERVICE
for
ROUTINE MILITARY TRAINING AT MAKUA MILITARY RESERVATION

July 23, 1999

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United States Department of the Interior

FISH AND WILDLIFE SERVICE

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In Reply Refer To: 1-2-99-F-01

James T. Hirai
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Schofield Barracks, Hawaii 96857

Dear Colonel Hirai:

This responds to your November 4, 1998, request for formal consultation under section 7 of the Endangered Species Act of 1973 (16 U.S.C.1531-1544, Stat. 884), as amended (Act), relative to routine military training at Makua Military Reservation (MMR) on the island of Oahu. The U.S. Department of the Army (Army) is the action agency for this project. Your November 4, 1998, request was received on November 5, 1998. The statutory deadline for completing this consultation, March 19, 1999, was extended by mutual consent of the U.S. Fish and Wildlife Service (Service) and the Army until July 23, 1999. This document represents the Service's biological opinion on the effects of the proposed project on 41 federally listed threatened and endangered (T&E) species (Attachment 1) in accordance with section 7(a)(2) of the Act.

This biological opinion (BO) is based on the following information: 1) the Army's November 2, 1998, Biological Assessment for Programmatic Section 7 Consultation on Routine Military Training at Makua Military Reservation (BA); 2) the Army's May 4, 1999, Makua Endangered Species Mitigation Plan (Mitigation Plan); 3) the biological literature (see Literature Cited section at the end of the document); and 4) other information sources. Our log number for this consultation is 1-2-99-F-01. Copies of pertinent materials and documentation are maintained in an administrative record in the Service's office in Honolulu, Hawaii.

Consultation History

The Service has been providing technical assistance to the Army since 1984, to assist in the conservation and management of T&E species on Army lands. Early informal consultations (1990 and earlier) for activities at MMR included actions such as Army maneuvers, habitat restoration, fire control, and facility development. One formal consultation was completed in 1985 and involved conducting a controlled burn in order to reduce existing vegetation and allow for the removal of unexploded ordnance found in the area. Another formal consultation concerning *Achatinella mustelina* (Oahu tree snail) was completed in April 1991. This formal consultation was conducted in five phases and resulted in all targets being moved to within the

firebreak road. This greatly reduced the possibility of fires starting outside the firebreak from the impact of high explosive ordnance. In 1994, the Army suspended training with live ammunition as a result of a fire caused outside the firebreak road by a tracer bullet. During this six-month suspension, the Army realigned the targets in order to minimize the chances of ammunition landing outside the firebreak road.

Since the suspension of training in 1994, the Army has informally consulted on many actions at MMR. An informal consultation was completed in 1995 for a prescribed burn. This prescribed burn was different from previous burns because a small area outside of the firebreak road was included in the area planned for burning. The Army conducted this prescribed burn outside the firebreak road and it escaped, which resulted in some loss of native habitat and listed plant species (USFWS 1995a). Other informal consultations completed since 1990 include: 1) erosion control for *Sanicula mariversa*; 2) insecticide treatment for *Flueggea neowawraea*; 3) construction and operation of a tree snail sanctuary for *Achatinella mustelina*; and 4) goat control.

Actions pertaining directly to this consultation began officially on April 9, 1997, when the Army transmitted the following documents to the Service for review and comment:

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

Army and Service personnel met on June 5, 1997, to discuss the adequacy of the Army's Ecosystem Management Plans. On June 19, 1997, the Army transmitted revised chapters of the Ecosystem Management Plan for Army training areas on Oahu to the Service for review. The Service provided comments to the Army on all the above-listed documents and on these revised chapters on July 2, and July 29, 1997, respectively.

On August 4, 1997, the Service and Army met to discuss the Service's July 29, 1997, comments. Another meeting was held on August 22, 1997, to discuss additional information needed for section 7 consultation on Oahu Army lands. The group discussed some of the information that was gathered since the last meeting on August 4, 1997, and assignments to gather additional information were made. The Service followed up this meeting with a letter dated September 17, 1997, providing a checklist of action items that the Service hoped would facilitate the exchange of information and move the consultation process forward in an organized and timely manner. On September 17, 1997, Army and Service personnel met again and discussed the option of consulting on one installation at a time. Information and updates were also provided at this meeting.

On October 14, 1997, Service and Army personnel met to discuss the Army's approach to the MMR consultation. During this meeting the main points discussed were: 1) the process for completing consultation; 2) the Army environmental division's role as liaison between the Service and the trainers; 3) the Army's analysis of training impacts; and 4) the impacts of training (by species) and actions to avoid/mitigate the impacts.

On November 26, 1997, Army personnel delivered revisions to the Makua portion of the Oahu Ecosystem Management Plan. The Service provided comments to these revisions in a letter dated December 30, 1997. The Army responded to these comments on January 15, 1998.

On March 7, 1998, a fire of unknown origin started next to Farrington Highway and burned approximately 40 hectares (ha) (100 acres) to the northwest of the northern firebreak road. On March 18, 1998, two fires were started at MMR outside of the firebreak road. The first fire started next to the southern firebreak road from a grenade simulator and burned approximately 8 ha (20 acres) to the south of the firebreak road. The second fire started next to the southern firebreak road from a TOW missile, which ricocheted and landed outside the road. The fire burned approximately 12 ha (30 acres) to the northeast of the firebreak road. On March 20, 1998, a Service biologist accompanied Army biologists to determine the extent of the damage to native forest and any listed species from the fires. No known listed endangered or threatened species were burned in the fires.

On March 23, 1998, the Service wrote a letter to the Army recommending that all further activities that may cause fires at MMR cease immediately, pending an investigation of the problems associated with fire initiation and control. The Army temporarily suspended training at MMR.

The Service met with Army personnel on March 25, 30, 31, and April 1, 1998, following the March 7 and March 18, 1998, fires. These meetings were held to discuss the Pililaau Range Makua Military Reservation's Standard Operating Procedures (SOP), the "stand-down" at MMR, and recommendations concerning fire at MMR. During these meetings the Army requested the Service's informal review and comments on the SOP.

On May 4, 1998, the Army wrote a letter to the Service outlining the actions that were taken to avoid further fires outside of the firebreak road. The Army also highlighted the results of their internal review concerning fires at MMR and requested comments regarding a proposed course of action and the resumption of limited live-fire training. On May 15, 1998, Service and Army personnel met at Makua to clarify the activities that the Army was proposing to resume at MMR. That afternoon, Service personnel, State Department of Land and Natural Resources fire experts, and Army personnel and fire experts conducted a field trip to determine the boundaries of the action area for the formal consultation based on fire threats. The Service wrote a letter to the Army dated May 21, 1998, stating that as long as certain criteria were met, the Service concurred with the Army's decision to resume its use of limited low fire risk ordnance at MMR. Training resumed subsequent to the Army's receipt of this letter and consisted of limited live-fire training.

The Service provided comments on the Army's draft SOP on June 19, 1998.

On June 30, 1998, the Army wrote a letter to the Service requesting comments on the use of additional ammunition at MMR. The Service responded on July 2, 1998, stating that there was insufficient information for the Service to determine the effects of the Army's proposed actions

on listed and proposed species. In a letter dated August 14, 1998, the Army stated that they were hoping to provide the Service with a draft BA by mid to late August.

On September 16, 1998, the Army reported that a fire had started outside the firebreak road to the north of the southern firebreak road from mortar. This fire burned approximately 324 ha (800 acres). It was later determined that some native forest was burned and that, although the fire burned close to T&E species, none were damaged. The Army sent another fax to the Service on September 17, 1998, stating that a "hot spot" flared up from the previous day's fire.

On September 17, 1998, the Service wrote a letter recommending that the Army cease all potentially fire-producing activities at MMR and immediately initiate an investigation to assess the cause(s) of the fire and assess the damages, particularly to federally protected species and their habitat at MMR and surrounding environments. The Army ceased all training at MMR, completed a biological survey, and initiated an investigation of the fire. No training at MMR has occurred since.

On November 4, 1998, the Army submitted the BA and initiated formal section 7 consultation. On December 1, 1998, the Service acknowledged receipt of the Army's November 4, 1998, letter and suggested some additional mitigation measures for the Army's consideration.

On November 17, 1998, Service management and Army command personnel met to discuss the suggested mitigation measures, and on December 24, 1998, the Service transmitted a copy of a draft Mitigation Plan to the Army.

In a letter dated February 3, 1999, the Army confirmed that both the Service and Army agreed to extend the consultation period for 60 days until April 4, 1999. On February 18, 1999, the Service met with the Army to discuss implementation and other aspects of the draft Mitigation Plan. On April 1, 1999, the Army wrote another letter confirming another extension of the consultation period for 30 days to May 4, 1999.

The Army's final Mitigation Plan was hand-delivered to the Service on May 4, 1999, with a request that this plan be included as an addendum to the BA for the consultation. With this plan the Army also agreed to change its proposed action to incorporate a list of restrictions as described in the letter and Part IIIA.ii. of the Mitigation Plan.

BIOLOGICAL OPINION

Description of the Proposed Action

This project description summarizes information taken from the November 2, 1998, Biological Assessment for Programmatic Section 7 Consultation on Routine Military Training at Makua Military Reservation and the May 4, 1999, Makua Endangered Species Mitigation Plan. These two documents were submitted by the Army and, taken together, provide a complete description of the proposed action. The proposed action is to conduct routine military training, operations, maintenance, and construction at MMR in support of routine training and to undertake several management activities for the promotion of survival and recovery of endangered, threatened, and proposed species that occur in the action area. Although actual training activities are conducted only within the environs of MMR, the impacts (such as fire and spread of alien species) from

such training are not restricted to MMR. The area affected directly or indirectly by these impacts is defined in the BA (page 8) as the action area (Makua action area).

MMR is used for both live and blank ammunition training, and units travel to the training area by both surface and air. All types of units, including field artillery, air defense artillery, engineer, infantry, military intelligence, military police, transportation, quartermaster (supply), signal (radio communication), chemical (smoke screen generation), and aviation, use MMR. The range at MMR accommodates squad (9 persons), platoon (27-33 persons), company (100-150 persons), or battalion (500 persons) size units, but, on the ground, primarily company sized training occurs. MMR is used for live fire and maneuver training, primarily at company level and larger, and is the only training area on Oahu that will support limited attack helicopter gunnery training.

MMR is mainly used for the Company Combined Arms Assault Course, which is within the southern firebreak road. Live ammunition is used and the course has electronically operated "pop-up" targets for soldiers to shoot at and mock-enemy objectives for them to overtake as they maneuver from objective to objective. All high explosive, fire-causing ammunition is aimed to land within the confines of the firebreak roads. Firebreaks are defined and described in the SOP, which is located in Annex A of Appendix C in the BA. Currently, the area within the northern firebreak road is not used heavily. Occasionally mortars and anti-tank inert rockets are fired from that area into the area within the southern firebreak road. The rest of the installation is surrounded by steep valley walls, which act as a buffer and safety danger zone for munitions in case of ricochets. MMR's training area is shown in Figure 3 of the BA, Weapons and Objectives.

The complete list of weapons and ammunition that are proposed for use are listed in Table 1 of the BA, Weapons/Munitions and Potential Impacts to Species. Descriptions of most of the weapons are provided in Appendix B of the BA. Although Appendix B indicates several different types of ammunition that can be fired from each weapon, only ammunition listed in Table 1 of the BA is to be used. For example, many weapons can fire illumination rounds, but this ammunition is not listed in Table 1 of the BA. Illumination rounds are not approved for use at MMR. If a unit brings an illumination round onto the range by accident, it is required to remove it as soon as possible.

All ammunition will be aimed to land within the confines of the southern firebreak road from directions shown in Figure 3 of the BA, Weapons and Objectives. Indirect fire weapons such as mortars and howitzer cannons have a potential range that is farther than the limits of the firebreak road. However, the direction and angle at which they are aimed and amount of powder bags that are used for each shot are precautions used to limit the distance to which the ammunition will travel. Although ball and tracer ammunition are fired from within the firebreak road, occasionally ammunition has the chance to ricochet or be overshot and may land outside the firebreak road. While both ball and tracer ammunition can ricochet outside of the firebreak, tracers have the greatest chance of causing a fire. This ammunition emits a glow from intense heat up to a predetermined distance so that troops shooting them can see where their bullets are landing and thereby adjust their aim. Tracer ammunition is manufactured to burn hot only for predetermined distances. The soldiers are only allowed to shoot at targets that are aligned such that, if overshot, the tracer will burn out and cease its fire-producing potential before exiting the firebreak road.

Training takes place under procedures described in the SOP. The SOP outlines precautions and fire minimization and suppression procedures that will be followed by range personnel and soldiers. It also provides procedures to protect biological and archaeological resources.

Routine training in the main part of the installation occurs approximately 230 days per year. Other days are used for range maintenance and repairs, open houses, and the Army's ecosystem management program work. No military training activities, except for those that are approved by the Service on a case-by-case basis, occur outside the firebreak roads.

Units generally arrive and occupy an assembly area in the westernmost field near the north gate where they plan training, receive environmental and fire safety briefings, prepare equipment, generally get ready for the training they are to accomplish, and bivouac if necessary. Once preparations are complete, units usually spend several days on the range, and may travel back to the cantonment area (Schofield Barracks, Kaneohe Bay Marine Corps Air Station, etc.) to resupply or rest and refit.

Besides active Army units in Hawaii, other military units such as the Hawaii Army National Guard (State of Hawaii), U.S. Army Reserves, U.S. Air Force, U.S. Navy, and U.S. Marine Corps train at MMR. Their scenarios on land are basically the same as that of the Army's except that the location of MMR is conducive to beach landings by the Marines. Any potential adverse impacts to threatened and endangered marine species as a result of amphibious landings have not been addressed in this BO and will need to be addressed separately by the U.S. Marines. All military units using MMR can use weapon systems or ammunition only in a manner specified in the BA and the SOP.

The following actions and their potential effects are described in sections 4.2, and 4.3.1 through 4.3.6 in the BA:

- Fire control by prescribed burning.
- Range maintenance and construction.
- Integrated Training Area Management (ITAM) program.
- Ecosystem Management Program.
- Vehicle and troop movement from MMR to other military reservations.
- Other activities - open houses, range visits, daily work by range personnel.

The Army's proposed actions were originally presented in the BA and subsequently modified with the incorporation of the following restrictions specified in the Mitigation Plan:

1) Weapons will be aimed so that the intended path of the ammunition prior to the intended target will not be outside the firebreak road (except those approved by the Service on a case-by-case basis).
2) Targets will be placed to minimize the possibility of ammunition going outside the firebreak road to the maximum extent possible.
3) The use of munitions and weapons or activities (as identified in Table 1 of the BA) will not commence until the fire management plan is developed and implemented.
4) Tracers and other ammunition that have a high likelihood of producing fire will not be used except in the green fire danger rating after the fire plan is complete and implemented.

5) Only weapons and munitions listed in Table 1 of the BA (with the exception of those listed under #4 above) will be used once the fire plan is completed and implemented, unless changed in consultation with the Service.
6) Firing of any kind will not be done in the orange fire danger rating as currently defined in the SOP.
7) Biannual reports of all fire starts will be submitted in the same format as Appendix G in the BA.
8) In the event that a fire occurs outside of the firebreak road, the Army will immediately cease all military training within Makua and focus on suppressing the fire. As agreed during the consultation process, the Army will reinitiate consultation if a fire occurs outside of the firebreak road due to military activities. It may be determined through consultation that any action that caused a fire outside of the firebreak road will no longer be allowed to continue at Makua until the mitigation is fully functional. Once all mitigation is fully functioning, the Army may decide to reconsult on allowing certain munitions or actions that may be considered more risky or that may have caused problems in the past.

The Service will review and provide input on the fire management plan and work in conjunction with the Army to identify the specific actions that must be implemented before live-fire training can recommence. The conservation measures the Army is taking to minimize the effects of military training on T&E species within the Makua action area and to promote the conservation of such species are specified in the BA and the Mitigation Plan and are incorporated into this BO by reference. These actions are summarized in Table 2 and Appendix F of the BA, and Tables 2 and 4 of the Mitigation Plan and attached to this BO as Attachment 2. In order to assist the Army in accomplishing the mitigation actions identified in the BA and Plan, an implementation plan will be developed by an implementation team within one year of the completion of this BO.

Biology and Population Status of the Species

A complete description of the biology and population status of the species covered in this BO are located in the Biological Background section of the Makua Endangered Species Mitigation Plan. The following is a summary of these descriptions.

Alectryon macrococcus var. *macrococcus*

The habitat of *Alectryon macrococcus* is dry forest, once widespread on leeward exposures of all of the Hawaiian Islands, but now almost completely eliminated. Historically, *Alectryon macrococcus* was known from Kauai, Oahu, Molokai, and West Maui in dry forests (USFWS 1997). *Alectryon macrococcus* var. *macrococcus* occurs on Kauai, Oahu, Molokai, and West Maui. Six populations/occurrences of *Alectryon macrococcus* var. *macrococcus*, totaling fewer than 100 plants, are known on Kauai. There are a total of approximately 13 populations/occurrences on Oahu, made up of an estimated 400 individuals which occur at numerous sites in the Waianae Mountains and much less often in the Koolau Mountains. On Molokai there are five extant populations/occurrences, totaling six plants. The three existing occurrences on West Maui total just a few plants. Most of these 27 populations/occurrences number only one or two individuals each. Two populations/occurrences each have between 50 and 200 individuals; otherwise most populations/occurrences contain very few individuals. The entire subspecies currently numbers about 500 individuals (USFWS 1997).

Alsinidendron obovatum

Alsinidendron obovatum typically grows on ridges and slopes in lowland diverse mesic forest at elevations of 560 to 760 meters (1,850 to 2,500 feet) (USFWS 1995b, Wagner *et al*. 1990). Historically, *Alsinidendron obovatum* is known from the northern and southern ends of the Waianae Range. This species remains on State-owned land in Pahole Natural Area Reserve (NAR) in four locations totaling approximately 30 individuals and from Army land in Kahanahaiki Gulch (1 individual) within Makua Military Reservation. The five known populations/occurrences contain approximately 31 individuals total (USFWS 1998b; K. Kawelo and J. Rohrer, personal communications 1998; T. Takahama, personal communication 1998).

Bonamia menziesii

Bonamia menziesii is found on steep slopes as well as on level ground in dry to mesic forest and sometimes in wet forest. Historically, *Bonamia menziesii* was known from scattered locations on Kauai, the Waianae Mountains of Oahu, scattered locations on Molokai, and one location on West Maui, and eastern Hawaii. Currently, *Bonamia menziesii* is known from many populations/occurrences on Kauai, Oahu, Maui, Lanai, and the island of Hawaii totaling as many as several thousand individuals with the largest populations/occurrences found on Kauai (USFWS 1998c).

Cenchrus agrimonioides* var. *agrimonioides

Cenchrus agrimonioides var. *agrimonioides* is usually found on dry, rocky ridges or slopes, or ridges in mesic forest. Historically, *Cenchrus agrimonioides* var. *agrimonioides* was known from the Waianae Mountains of Oahu, Kaaukuu on Lanai, and the south slope of Haleakala and Ulupalakua on Maui. Undocumented observations of this taxon have been reported from unspecified locations on the island of Hawaii. Currently *Cenchrus agrimonioides* var. *agrimonioides* is known from six populations/occurrences on Oahu and one on Maui. The total number of individuals statewide is fewer than 100.

Chamaesyce herbstii

Chamaesyce herbstii typically grows in mesic lowland forests or diverse mesic forests. Historically, *Chamaesyce herbstii* was known from scattered populations/occurrences in the northern and central Waianae Mountains on the island of Oahu. Currently this species is known from four populations/occurrences in the central and northern Waianae Mountains (USFWS 1998c; K. Kawelo and J. Rohrer, personal communications 1998; T. Takahama, personal communication 1998). The total number of plants is estimated to be fewer than 100.

Ctenitis squamigera

This species is found in the forest understory in mesic forest and diverse mesic forest. Historically, *Ctenitis squamigera* was recorded from Kauai, Oahu, Molokai, and the island of Hawaii. The ten populations/occurrences (approximately 100 individuals) that have been observed within the last 20 years are in the Waianae Mountains of Oahu, Lanai, East and West Maui, and Molokai (USFWS 1998d).

Cyanea grimesiana* ssp. *grimesiana

Cyanea grimesiana ssp. *grimesiana* is typically found in mesic forest or on rocky or steep slopes of stream banks. Historically, *Cyanea grimesiana* ssp. *grimesiana* was known from at least 40 populations/occurrences located in the Waianae and Koolau mountains on Oahu, Wailau Valley and Puu Kahea on Molokai, central and northern Lanai, and scattered locations on Maui (USFWS 1998b). Currently, *Cyanea grimesiana* ssp. *grimesiana* is known from 15 populations/occurrences on Oahu, Molokai, Lanai, and Maui (USFWS 1998c). Fewer than 50 individuals statewide currently represent this species.

Cyanea longiflora

Cyanea longiflora is usually found on steep slopes or ridge crests in mesic forest in the Waianae Mountains or wet forest in the Koolau Mountains. Historically, *Cyanea longiflora* was known from five populations/occurrences in the Waianae Mountains and six populations/occurrences in the Koolau Mountains of Oahu (USFWS 1998b). Currently, three populations/occurrences are known from the Waianae Mountains. These three populations/occurrences contain a total of approximately 120 plants (HHP 1997; K. Kawelo and J. Rohrer, personal communications 1998; T. Takahama, personal communication 1998).

Cyanea superba* ssp. *superba

Cyanea superba ssp. *superba* grows in the understory on sloping terrain on well-drained, rocky substrate. Historically, *Cyanea superba* ssp. *superba* is known from the "Gulches of Makaleha on Mt. Kaala" in the Waianae Mountains of Oahu. After its collection in 1870, *Cyanea superba* ssp. *superba* was not seen until its rediscovery in the Waianae Mountains in 1971. Presently, *Cyanea superba* ssp. *superba* is known from only one small population/occurrence of 4 plants in Makua Military Reservation. Another population/occurrence of fewer than five plants was recently extirpated on State land in Pahole Gulch (K. Kawelo and J. Rohrer, personal communications 1998). A third population/occurrence, previously reported, appears to be based on a misidentification (USFWS 1998b).

Cyrtandra dentata

Cyrtandra dentata typically grows in gulches, slopes, or ravines in mesic forest. *Cyrtandra dentata* was historically known from six populations/occurrences in the Waianae Mountains and three populations/occurrences in the Koolau Mountains of Oahu. Currently, this species is found only in the Waianae Mountains in Pahole NAR in Pahole Gulch (50 to 100 individuals) and Kapuna Valley (50 to 100 individuals); Army land at Makua Military Reservation in Kahanahaiki Gulch (50 individuals); and in Ekahanui Gulch (7 individuals) within The Nature Conservancy's Honouliuli Preserve. This species is represented by between 157 to 257 individuals (USFWS 1998b).

Delissea subcordata

Delissea subcordata typically grows on moderate to steep gulch slopes in mesic native or alien dominated forests. Historically, *Delissea subcordata* was known from 21 scattered populations/occurrences in the Waianae Mountains and eight populations/occurrences in the Koolau Mountains of Oahu. A specimen collected by Mann and Brigham in the 1860's and

labeled as from the island of Kauai is believed to have been mislabeled (USFWS 1998b). Currently, *Delissea subcordata* is known only from the Waianae Mountains in 18 populations/occurrences (HHP 1997). The total number of plants in the remaining populations/occurrences is estimated to be fewer than 80.

Diellia falcata

Diellia falcata is a terrestrial fern that typically grows in deep shade or open understory in dry forest. Historically, *Diellia falcata* was known from almost the entire length of the Waianae Mountains as well as from the Koolau Mountains of Oahu (USFWS 1998b). *Diellia falcata* is currently found in the Waianae Mountains. The 22 known populations/occurrences, which are found within an area of about 3.2 by 18 kilometers (2 by 11 miles), contain an estimated 5,540-6,540 individuals (HHP 1997). Fourteen populations/occurrences each number between 40-2,000 individuals and eight populations/occurrences each number fewer than ten individuals. Recent field observations indicate that this plant may be more locally common than previous records suggest (K. Kawelo and J. Rohrer, personal communications 1998).

Dubautia herbstobatae

Dubautia herbstobatae typically grows on rock outcrops on north-facing ridges in dry shrubland. *Dubautia herbstobatae* was historically known from the Waianae Range of Oahu (USFWS 1998b). *Dubautia herbstobatae* is extant in the northern Waianae Mountains (HHP 1997). No other locations are known for this recently discovered species. The four known populations/occurrences, which are scattered over an area of about 1.6 by 4.8 kilometers (1 by 3 miles), contain approximately 1,025 individuals (USFWS 1998b; K. Kawelo and J. Rohrer, personal communications 1998; T. Takahama, personal communication 1998).

Euphorbia haeleeleana

Euphorbia haeleeleana is usually found in lowland mixed mesic or dry forest. *Euphorbia haeleeleana* is known historically from 15 populations/occurrences numbering between 450 and 625 individuals from northwestern Kauai and the Waianae Mountains of Oahu. On Kauai, 11 populations/occurrences totaling approximately 360 to 510 individuals of *Euphorbia haeleeleana* are known from valley slopes and cliffs along Kauai's northwestern coast. On Oahu, four populations/occurrences of approximately 90 to 115 individuals are known from the northern Waianae Mountains (USFWS 1998c).

Flueggea neowawraea

Flueggea neowawraea occurs in dry to mesic forest. Historically, *Flueggea neowawraea* was known from Waihii near Kapuna on Molokai, but is now presumed extirpated from that island. This species was also known from the Kealia Trail, Kahanahaiki Valley, and Pohakea Gulch in the Waianae Mountains of Oahu and from the islands of Kauai and Hawaii. Currently, *Flueggea neowawraea* is known on Kauai, Oahu, Maui, and the island of Hawaii. Statewide, the species totals over 30 populations/occurrences containing approximately 112 to 158 individuals (USFWS 1998c; K. Kawalo and J. Rohrer, personal communication 1998; T. Takahama, personal communication 1998).

Hedyotis degeneri* var. *degeneri

Hedyotis degeneri typically grows in diverse mesic forest. Historically, *Hedyotis degeneri* is known from Mt. Kaala in the northern Waianae Mountains. *Hedyotis degeneri* var. *degeneri* is known from five populations/occurrences consisting of six individuals on Kamaileunu Ridge, 12 individuals near Pahole Gulch within the action area, and three populations/occurrences of one individual each in Makaleha Valley, totaling 21 individuals (USFWS 1998b; K. Kawelo and J. Rohrer, personal communications 1998; T. Takahama, personal communication 1998).

Hedyotis parvula

Hedyotis parvula typically grows on and at the bases of cliff faces, rock outcrops, and ledges in dry habitat. Historically, *Hedyotis parvula* was known from the central and southern Waianae Mountains, from Makaleha Valley to Nanakuli Valley. This species grew on Makaleha Ridge in 1986 and on Makua-Keaau Ridge in 1976, on State and federally owned land. *Hedyotis parvula* is currently known from four populations/occurrences. Two of these populations/occurrences are found on Makua Military Reservation (150 individuals total), one population/occurrence is on Palikea Ridge between Nanakuli and Lualualei (60-75 individuals), and one population/occurrence is located west of Palawai Gulch (ten individuals), totaling 220-235 individuals (USFWS 1998b; K. Kawelo and J. Rohrer, personal communications 1998; T. Takahama, personal communication 1998).

Hesperomannia arbuscula

Hesperomannia arbuscula typically grows on slopes and ridges in mesic to wet forest. Historically, *Hesperomannia arbuscula* is known from the central and southern Waianae Mountains from Makaleha to Puu Kanehoa, and from West Maui. Currently, this species is extant on Oahu and West Maui. The four known populations/occurrences on Oahu total between 53 and 55 plants and are within an area of about 4.8 by 8 kilometers (2 by 5 miles). Including the fifth population/occurrence from West Maui, this species numbers between 54 and 56 individuals (USFWS 1998b; K. Kawelo and J. Rohrer, personal communications 1998; T. Takahama, personal communication 1998).

Lepidium arbuscula

Lepidium arbuscula generally grows on exposed ridge tops and cliff faces in mesic vegetation communities. Historically, *Lepidium arbuscula* was known from 11 populations/occurrences in the Waianae Mountains. *Lepidium arbuscula* now remains in ten populations/occurrences in the Waianae Mountains. Fewer than 900 individuals of this species remain. Three populations/occurrences number between 100 to 600 individuals; however, three populations/occurrences number fewer than ten individuals (Manini Gulch and Mohiakea Gulch) (USFWS 1998b; K. Kawelo and J. Rohrer, personal communications 1998; T. Takahama, personal communication 1998).

Lipochaeta tenuifolia

Lipochaeta tenuifolia typically grows on ridge tops and cliff faces in open areas and protected pockets of diverse mesic forest. Historically, *Lipochaeta tenuifolia* was known from the central Waianae Mountains (Wagner *et al*. 1990). The three current known populations/occurrences, in

an area of about 8 by 10 kilometers (5 by 6 miles), contain an estimated 2,000 individuals. The subpopulations/occurrences in Makua Military Reservation represent the largest concentration of known plants (HHP 1997).

Lobelia niihauensis

Lobelia niihauensis typically grows on exposed mesic to dry cliffs. Historically, *Lobelia niihauensis* was known in the Waianae Mountains of Oahu, western Kauai, and the island of Niihau (USFWS 1998b). *Lobelia niihauensis* is currently extant only on Kauai and Oahu. The populations/occurrences are located within an area of about 8 by 16 kilometers (5 by 10 miles) on Oahu, and in an area of about 13 by 16 kilometers (8 by 10 miles) on western Kauai. Together with the Oahu plants, 20 populations/occurrences with approximately 1,585 to 3,555 individuals are extant (HHP 1997).

Lobelia oahuensis

Lobelia oahuensis is found on summit cliffs in cloud-swept wet forests or in areas of low-shrub cover that are frequently exposed to heavy wind and rain. Historically, *Lobelia oahuensis* was known from Kahana Ridge, Kipapa Gulch, and the southeastern Koolau Mountains of Oahu (USFWS 1998b). Currently, there are eleven populations/occurrences totaling about 110 individuals of *Lobelia oahuensis*. Except for two populations/occurrences that contain between 30 to 40 individuals, the remaining nine populations/occurrences all contain fewer than ten individuals (USFWS 1998b).

Neraudia angulata* var. *angulata

Neraudia angulata var. *angulata* typically grows on slopes, ledges, or gulches in diverse mesic forest. Historically, *Neraudia angulata* var. *angulata* was known from nearly the entire length of the Waianae Mountains, from Kaluakauila Gulch nearly to Puu Manawahua (USFWS 1998b, Wagner *et al*. 1990). This taxon is currently known from Kaluakauila Gulch and along Makua-Keaau Ridge to Makaha-Waianae Kai Ridge. The five known populations/occurrences, which are within an area of about 4.8 by 18 kilometers (3 by 11 miles), are estimated to comprise approximately 80 individuals. All of the existing populations/occurrences contain fewer than 12 individuals, except for the population/occurrence in MMR and a population/occurrence of 12 individuals in the State's Waianae Kai Forest Reserve (HHP 1997). *Neraudia angulata* var. *angulata* was found for the first time in Makua Military Reservation during a 1993 HHP survey. More than 50 plants were seen on the southern side of Makua Valley and a single plant was seen at the head of Kahanahaiki Valley (U.S. Army 1998b).

Neraudia angulata* var. *dentata

Neraudia angulata var. *dentata* typically grows on slopes, ledges, or gulches in diverse mesic forest. Historically, *Neraudia angulata* var. *dentata* was known from almost the entire length of the Waianae Mountains, from Kaluakauila Gulch nearly to Puu Manawahua (USFWS 1998b, Wagner *et al*. 1990). This species is currently known from Kaluakauila Gulch and along Makua-Keaau Ridge to Makaha-Waianae Kai Ridge (HHP 1997). The eight known populations/occurrences, which are within an area of about 4.8 by 18 kilometers (3 by 11 miles), are estimated to comprise less than 40 individuals. Except for one population/occurrence that

contains approximately 20 individuals, all of the remaining populations/occurrences contain fewer than five individuals (U.S. Army 1998b).

Nototrichium humile

Nototrichium humile typically grows on cliff faces, gulches, or steep slopes in remnants of open dry forest. Historically, *Nototrichium humile* was known from the entire length of the Waianae Mountains, from near Kaena Point to Nanakuli Valley on Oahu, and from Lualailua Hills on East Maui (USFWS 1998b, Wagner *et al*. 1990). *Nototrichium humile* is still extant on Oahu and Maui. Six of the seven known populations/occurrences grow within an area of about 4.8 by 18 kilometers (3 by 11 miles) in the Waianae Mountains and total approximately 1,500 individuals. The single Maui population/occurrence is not well documented (USFWS 1998b).

Peucedanum sandwicense

This species grows in cliff habitats from sea level to above 900 meters (3,000 feet) (USFWS 1995b). Historically, *Peucedanum sandwicense* was known from Molokai, Maui, and Kauai. Discoveries in 1990 extended the known distribution of this species to the island of Oahu, where two populations/occurrences totaling about 85 individuals exist in the Waianae Mountains. Currently, this species still exists on these islands. The total number of plants in the 16 known populations/occurrences of this species is estimated to be between 1,000 and 5,000 individuals (USFWS 1995b).

Phyllostegia kaalaensis

This species is found in mesic mixed (native/alien) forest or *Pisonia umbellifera* (papala kepau)-*Sapindus oahuensis* (aulu) forest. *Phyllostegia kaalaensis* has historically been known from only six scattered populations/occurrences in the Waianae Mountains of Oahu. The six populations/occurrences of *Phyllostegia kaalaensis*, containing a total of fewer than 50 plants, are in Waianae Kai State Forest Reserve (about 30 individuals); Pahole Gulch NAR (ten or more individuals); central Ekahanui Gulch (1 individual) and south Ekahanui Gulch (2 populations/occurrences, 2 individuals) in The Nature Conservancy's Honouliuli Preserve; and Palikea Gulch in Mt. Kaala NAR (1 individual) (HHP1997).

Plantago princeps* var. *princeps

Plantago princeps is typically found on steep slopes, rock walls, or at the bases of waterfalls. Historically, *Plantago princeps* was found on Kauai, Oahu, Molokai, Maui, and the island of Hawaii. It is no longer extant on the Big Island. *Plantago princeps* var. *princeps* was known only from Oahu, from the Nuuanu Pali and Kalihi in the Koolau Mountains and from Makaleha and Napepeiauolelo Gulch in the Waianae Mountains (USFWS 1998c). Six current populations/occurrences and an estimated 175 to 242 individuals of *Plantago princeps* var. *princeps* are known from the Waianae Mountains on Oahu.

Pritchardia kaalae

Pritchardia kaalae is typically found on steep slopes and gulches in mesic forest or shrubland. Historically, *Pritchardia kaalae* was known from scattered populations/occurrences in the central and north-central Waianae Mountains of Oahu (HHP 1997, USFWS 1998b). Currently five populations/occurrences of *Pritchardia kaalae* are known from the central Waianae Mountain Range, totaling about 140 individuals.

Sanicula mariversa

Sanicula mariversa typically grows on well-drained, dry slopes. Historically, *Sanicula mariversa* was known from the central Waianae Mountains, from Makua-Keaau Ridge to Kaluaa-Lualualei Summit Ridge (USFWS 1998b). *Sanicula mariversa* is now known from only 30 individuals at Makua-Keaau Ridge, 45 individuals at Makua-Keaau Ridge, and two individuals on Kamaileunu Ridge. The three known populations/occurrences, which cover 0.6 kilometers (0.4 miles), contain approximately 77 individuals (HHP 1997; T. Takahama, personal communication 1998).

Schiedea hookeri

Schiedea hookeri is usually found in diverse mesic or dry lowland forest. Historically, *Schiedea hookeri* was known from the Waianae Mountains of Oahu and from a single fragmentary collection from Haleakala on Maui, which may represent *Schiedea menziesii* rather than *Schiedea hookeri*. Currently *Schiedea hookeri* is known from 11 populations/occurrences in Oahu's Waianae Mountains. Between 220 and 330 individuals are scattered on slopes and ridges from Kaluakauila Gulch to Lualualei Valley (USFWS 1998c).

Schiedea kaalae

Schiedea kaalae typically grows on steep slopes and shaded sites in diverse mesic forests. Historically, *Schiedea kaalae* was known from the north central and south central Waianae Mountains and the northern Koolau Mountains of Oahu (USFWS 1998b). *Schiedea kaalae* remains in six known populations/occurrences in the Waianae Mountains, which are distributed over an area of about 1.6 by 16 kilometers (1 by 10 miles), and two known populations/occurrences in the Koolau Mountains, which are about 7 kilometers (4 miles) apart. This species is represented by fewer than 20 individuals (HHP 1997).

Schiedea nuttallii

Schiedea nuttallii typically grows in diverse lowland mesic forest. Historically, *Schiedea nuttallii* was known from scattered locations on southeastern Kauai, Oahu, Molokai, and Maui. Two populations/occurrences of *Schiedea nuttallii* are found on Kauai and three populations/occurrences are found on Oahu. The populations/occurrences statewide contain between 55 and 105 individuals. Ten to 50 individuals are on Kauai and 45 individuals are on Oahu (USFWS 1998c).

Silene lanceolata

The populations/occurrences of *Silene lanceolata* on the island of Hawaii grow in shrubland and on aa lava. On Molokai, this species grows on cliff faces and ledges of gullies in dry to mesic shrubland. Historically, *Silene lanceolata* was found on Kauai, at Makua on Oahu, below Puu Kolekole on East Molokai, at Maunalei on Lanai, and on Mauna Kea of Hawaii Island. *Silene lanceolata* is extant on the islands of Molokai, Oahu, and Hawaii. A single population/occurrence of approximately 100 individuals was found in 1987 on Molokai. The three Hawaii Island populations/occurrences are distributed over a distance of roughly 15 kilometers (9 miles). A fifth population/occurrence was discovered in 1991 by Steve Perlman at Makua Military Reservation in the Waianae Mountains on the island of Oahu. This population/occurrence consists of approximately 40 individuals (USFWS 1996, U.S. Army 1998a and b). The total number of *Silene lanceolata* individuals consists of more than 2,640 individuals.

Spermolepis hawaiiensis

Spermolepis hawaiiensis is known from various vegetation types, including lowland dry shrubland, cultivated fields, and pastures. Historically, *Spermolepis hawaiiensis* was known from Waimea on Kauai, Koko Head on Oahu, Paomai and Kahinahina on Lanai, and Apua on Hawaii. Currently, a total of 12 populations/occurrences of *Spermolepis hawaiiensis* is known on Kauai, Oahu, Molokai, Lanai, West Maui, and Hawaii. The total number of individuals statewide is probably between 5,000 and 10,000 individuals (USFWS 1998c).

Tetramolopium filiforme

Tetramolopium filiforme typically grows on dry cliff faces and ridges. Historically, *Tetramolopium filiforme* was known from the northern Waianae Mountains from Ohikilolo Ridge, Keaau Valley, and Makaha Valley (USFWS 1998b). The five known current populations/occurrences, which are distributed over an area of about 3.2 by 8 kilometers (2 by 5 miles), are estimated to contain approximately 1,550 individuals (HHP 1997).

Viola chamissoniana* ssp. *chamissoniana

Viola chamissoniana ssp. *chamissoniana* typically grows on dry cliffs in mesic shrubland. Historically, *Viola chamissoniana* ssp. *chamissoniana* was known from the central and southern Waianae Mountains (USFWS 1998b). *Viola chamissoniana* ssp. *chamissoniana* is currently known from six populations/occurrences, which are scattered over an area of about 4 by 13.6 kilometers (2.5 by 8.5 miles), and total 255 to 315 individuals (HHP 1997).

Oahu Tree Snail *(Achatinella mustelina)*

Achatinella mustelina is an arboreal, nocturnal fungivore that grazes fungus from the surface of leaves (Henshaw, in Pilsbry and Cooke, 1912-1914; Hadfield and Miller 1989). The snails occur on a wide variety of native plants and are occasionally observed on alien vegetation. *Achatinella mustelina* was historically found in the mesic and wet forests and shrublands of the Waianae Mountains on the island of Oahu, Hawaii (Pilsbry and Cooke 1912-1914). Any attempt at assessing the current range and abundance of *Achatinella mustelina* is tentative at best, due to the continuing decline in the numbers of individuals and populations/occurrences and a continuing

restriction of the range currently occupied by the species. The overall trend in the northern and southern Waianae Mountains shows a great decline in the remaining populations/occurrences and the loss of many local populations/occurrences since 1990. At the present time, there is no indication that these declines will stop.

Oahu Elepaio (*Chasiempis sandwichensis ibidis*)

Oahu elepaio are found in a variety of forest types and are generalized and adaptable in their habitat requirements. Studies conducted by Eric VanderWerf *et al*. (1997a) showed most elepaio were found in mid-elevation valleys in mesic forests dominated by non-native and native plant species containing a tall tree canopy and well developed understory. Oahu elepaio was once widespread in forested areas throughout Oahu (Conant 1995). However, there are no known historical records that identify specific locations of the Oahu elepaio. The Oahu elepaio currently occupies an area of 4,700 ha (11,600 ac). This represents approximately 4 percent of its original range. The most recent population estimate for this species indicates that between 1,300 and 1,400 birds remain. There are seven geographically isolated populations of this species; three in the Koolau Mountains and four in the Waianae Mountains (VanderWerf 1997a). Fifty-seven percent of the population occurs in the Waianae Mountains and forty-three percent in the Koolau Mountains.

Oahu Creeper (*Paroreomyza maculata*)

Very little is known about the Oahu creeper. Shallenberger and Pratt (1978) reviewed past observations and records of the Oahu creeper and provide the following information. The Oahu creeper was observed feeding on trunks and large limbs probing in the bark for insects. There is very little historical information regarding the Oahu creeper, perhaps due to the difficulty of distinguishing it from the amakihi. Out of 41 recorded sightings of the Oahu creeper between 1940 to 1978, only three could be counted as virtually certain, and a majority of the observations were made in the area of the Aiea and Poamoho Trails (Shallenberger and Pratt 1978). The most recent sighting (unconfirmed) of a creeper occurred at Poamoho in the Koolau Mountains in January 1997 by Randy Kennedy with the Department of Land and Natural Resources Division of Forestry and Wildlife (K. Kawelo and J. Rohrer, personal communications 1998).

Hawaiian Hoary Bat (*Lasiurus cinereus semotus*)

Whether native vegetation is required by, or is important to, Hawaiian hoary bats is not known. It is a solitary bat and roosts among foliage in trees. The Hawaiian hoary bat has been reported from the islands of Hawaii, Maui, Oahu, Kauai, and Molokai, but may be resident on only Hawaii, Kauai, and Maui. Presently, the largest populations/occurrences are thought to be on Kauai and Hawaii. Population estimates for all islands have ranged from hundreds to a few thousand, but these estimates are not based on systematic surveys. Although these estimates may represent informed impressions, they are based on limited and incomplete data. Therefore, inferences regarding the current distribution of the Hawaiian hoary bat should be drawn with caution (USFWS 1998e).

Environmental Baseline

The environmental baseline describes the status of the species and factors affecting the environment of the species or critical habitat in the proposed action area contemporaneous with

the consultation in process. The baseline includes State, local, and private actions that affect a species at the time the consultation begins. Unrelated Federal actions that have already undergone formal or informal consultation are also a part of the environmental baseline. Federal actions within the action area that may benefit listed species or critical habitat are also included in the environmental baseline.

A complete description of the status of the species within the action area is described in the individual species Current Status section of the Mitigation Plan. This section is located in Part II: Biological Background of Species in the Makua Action Area; Current Status (pages 8-56). The Current Management Actions section, which is located in Part III: Mitigation for Training Impacts in the Makua Action Area of the Mitigation Plan (pages 76-108) contain the complete description of State, local, and private actions that affect each species covered in this BO at the time of this consultation; unrelated Federal actions that have already undergone formal or informal consultation; and Federal actions within the action area that may benefit listed species. The BA also contains environmental baseline information in the section entitled Environmental Baseline and Other Army Consultations for Listed Species within the Makua action area (pages 22-24). The following is a summary of these descriptions:

Alectryon macrococcus* var. *macrococcus

Approximately 16% (83 individuals) of the total 500 individuals of *Alectryon macrococcus* var. *macrococcus* occur within the Makua action area (USFWS 1997).

To protect the population/occurrence of *Alectryon macrococcus* var. *macrococcus* at Naval Magazine Lualualei, the U.S. Navy is working to control alien plants in areas where individuals of *Alectryon macrococcus* var. *macrococcus* are located. The Navy also allows recreational hunting on their lands to control the feral pig population (USFWS 1997).

The Army is conducting management actions as described in the Mitigation Plan and BA. Approximately ten individuals are protected within a fenced area in Pahole NAR, where the major habitat-altering weeds are being controlled (T. Takahama, personal communication 1998).

Alsinidendron obovatum

All of the known 31 individuals of *Alsinidendron obovatum* occur within the Makua action area. (USFWS 1998b; K. Kawelo and J. Rohrer, personal communications 1998; T. Takahama, personal communication 1998).

Currently, no on-the-ground management actions are known for this species outside of the Makua action area.

The Army is conducting management actions as described in the Mitigation Plan and BA. Eight individuals of *Alsinidendron obovatum* have been planted in an exclosure at Pahole NAR and one population/occurrence of approximately 20 individuals is within the fence. The Hawaii Division of Forestry and Wildlife (DOFAW) has plans to fence the remaining population/occurrence of 10 individuals in 1999 (T. Takahama, personal communication 1998).

Bonamia menziesii

In the Makua action area, ten individuals of *Bonamia menziesii* are found in Kaluakauila and four to six individuals on the lower end of Ohikilolo Ridge (K. Kawelo and J. Rohrer, personal communications 1998). Less than 1% (14-16 individuals) of the several thousand *Bonamia menziesii* plants are found within the Makua action area.

Other than the actions the Army is conducting as described in the Mitigation Plan and BA, no other on-the-ground management actions are currently known for this species.

Cenchrus agrimonioides* var. *agrimonioides

At least 75% (71 individuals) of the fewer than 100 known individuals of *Cenchrus agrimonioides* var. *agrimonioides* occur within the Makua action area.

A long-range management plan for Honouliuli Preserve has been drafted, which will include actions for alien plant management, ungulate control, fire control, rare species recovery, and native habitat restoration. It is expected that these actions will benefit *Cenchrus agrimonioides* var. *agrimonioides* within the preserve (USFWS 1998c).

The Army is conducting management actions as described in the Mitigation Plan and BA. The *Cenchrus agrimonioides* var. *agrimonioides* plants at Pahole NAR are found within a fenced exclosure and major habitat-altering weeds are being controlled (T. Tahahama, personal communication 1998).

Chamaesyce herbstii

At least 87% (60 individuals) of the fewer than 100 individuals of *Chamaesyce herbstii* occur within the Makua action area (USFWS 1998c).

Currently, no on-the-ground management actions are known for this species outside of the Makua action area.

The Army is conducting management actions as described in the Mitigation Plan and BA. Fencing and removal of feral pigs in the Pahole drainage was completed by DOFAW in July 1997, and currently protects about one half of the Pahole population. Weeding continues in the surrounding areas. Plants in the Pahole drainage have been measured and mapped, and seeds have been collected from plants outside the fence for nursery cultivation and reintroduction into the fenced areas (USFWS 1998b).

Ctenitis squamigera

Four individuals are found in the East Rim management unit of Makua Military Reservation. The Makua population/occurrence represents 4% (4 individuals) of the known 100 individuals of *Ctenitis squamigera* (USFWS 1998d).

Other than the actions the Army is conducting as described in the Mitigation Plan and BA, no other on-the-ground management actions are currently known for this species.

Cyanea grimesiana* ssp. *grimesiana

Approximately 10% (5 individuals) of the fewer than 50 individuals of *Cyanea grimesiana* ssp. *grimesiana* occur within the action area. A recent treatment of several species of *Cyanea* in Hawaii has revised *Cyanea grimesiana* ssp. *grimesiana* to include only Oahu and Molokai populations/occurrences (Lammers 1998). If this treatment is accepted, then only 14 individuals are known for this taxon and 50% are found in the action area (USFWS 1998c).

A long-range management plan for Honouliuli Preserve has been drafted which will include actions for alien plant management, ungulate control, fire control, small mammal control, rare species recovery, and native habitat restoration. It is expected that these actions will benefit *Cyanea grimesiana* ssp. *grimesiana* within the preserve (USFWS 1998c).

Other than the actions the Army is conducting as described in the Mitigation Plan and BA, no other on-the-ground management actions are currently known for this species within the Makua action area.

Cyanea longiflora

Approximately 80% (100 individuals) of the 120 known individuals of *Cyanea longiflora* occur within the Makua action area (HHP 1997; K. Kawelo and J. Rohrer, personal communications 1998; T. Takahama, personal communication 1998).

No ongoing management actions are currently known for this species outside of the Makua action area.

The Army is conducting management actions as described in the Mitigation Plan and BA. Fencing and removal of feral pigs in the Pahole drainage was completed by DOFAW in July 1997. Weeding continues in the surrounding areas. Plants in the Pahole drainage have been measured and mapped, and seeds have been collected from plants outside the fence for nursery cultivation and reintroduction into the fenced areas (T. Takahama, personal communication 1998).

Cyanea superba* ssp. *superba

All of the known 4 naturally occurring individuals of *Cyanea superba* ssp. *superba* exist in a fenced exclosure within the action area (USFWS 1998b).

No ongoing management actions are currently known for this species outside of the Makua action area.

The Army is conducting management actions as described in the Mitigation Plan and BA. Fencing and removal of feral pigs in the Pahole drainage where the second population/occurrence was formerly located was completed by DOFAW in July 1997. Weeding was conducted in the surrounding areas. Forty individuals grown from the Pahole Gulch population/occurrence of *Cyanea superba* ssp. *superba* were planted in three different exclosures in Pahole (T. Takahama, personal communication 1998).

Cyrtandra dentata

At least 97% (150-250 individuals) of the total 157 to 257 known individuals of *Cyrtandra dentata* occur within the action area (USFWS 1998b).

Currently, no on-the-ground management actions are known for this species outside of the Makua action area.

The Army is conducting management actions as described in the Mitigation Plan and BA. Fencing and removal of feral pigs in Pahole drainage was completed by DOFAW in July 1997 for one of the two populations/occurrences within Pahole. Weeding continues in the surrounding areas (USFWS 1998b).

Delissea subcordata

At least 50% (40 individuals) of the fewer than 80 known individuals of *Delissea subcordata* occur within the action area, and approximately half of these occur on Army lands (USFWS 1998b).

Four individuals were outplanted in a fenced exclosure in Kaluaa Gulch in Honouliuli Preserve in November 1994. Three survive, with two producing flowers and fruit, yet no recruitment has been observed. The individuals in Palawai Gulch within Honouliuli Preserve will be included in a fenced exclosure that The Nature Conservancy plans to construct in 1999 (USFWS 1998b).

Other than the actions the Army is conducting as described in the Mitigation Plan and BA, no other on-the-ground management actions are currently known for this species within the Makua action area.

Diellia falcata

Approximately 4% of the known 5,540-6,540 individuals of *Diellia falcata* occur in the action area (USFWS 1998b)

Other than the actions the Army is conducting as described in the Mitigation Plan and BA, no other on-the-ground management actions are currently known for this species.

Dubautia herbstobatae

Nearly 100% (1,000 individuals) of the known 1,025 individuals of *Dubautia herbstobatae* occur within the action area (USFWS 1998b; K. Kawelo and J. Rohrer, personal communications 1998; T. Takahama, personal communication 1998).

Other than the actions the Army is conducting as described in the Mitigation Plan and BA, no other on-the-ground management actions are known for this species.

Euphorbia haeleeleana

Approximately 75 to 95% of the Oahu plants and 16% of the 450-625 known statewide individuals of *Euphorbia haeleeleana* occur within the Makua action area (USFWS 1998c).

Other than the actions the Army is conducting as described in the Mitigation Plan and BA, no other on-the-ground management actions are currently known for this species.

Flueggea neowawraea

Approximately 30% of the known Oahu individuals and less than 10% (10 individuals) of the total 112 to 158 statewide individuals of *Flueggea neowawraea* occur within the Makua action area (USFWS 1998c; K. Kawalo and J. Rohrer, personal communication 1998; T. Takahama, personal communication 1998).

One of the *Flueggea neowawraea* plants on the Navy's Lualualei Naval Reservation has been fenced for protection from cattle and feral pigs. A program of alien plant removal within the exclosure is ongoing (USFWS 1998c). A long-range management plan for Honouliuli Preserve has been drafted, which will include actions for alien plant management, ungulate control, fire control, small mammal control, rare species recovery, and native habitat restoration. It is expected that these actions will benefit *Flueggea neowawraea* within the preserve (USFWS 1998c).

Other than the actions the Army is conducting as described in the Mitigation Plan and BA, no other on-the-ground management actions are currently known for this species within the Makua action area.

Hedyotis degeneri* var. *degeneri

At least 70% (12 individuals) of the 21 known individuals of *Hedyotis degeneri* var. *degeneri* occur within the action area (USFWS 1998b; K. Kawelo and J. Rohrer, personal communications 1998; T. Takahama, personal communication 1998).

Other than the actions the Army is conducting as described in the Mitigation Plan and BA, no other management actions are currently known for this species.

Hedyotis parvula

At least 65% (150 individuals) of the known 220-235 individuals of *Hedyotis parvula* occur within the action area (USFWS 1998b; K. Kawelo and J. Rohrer, personal communications 1998; T. Takahama, personal communication 1998).

Other than the actions the Army is conducting as described in the Mitigation Plan and BA, no other on-the-ground management actions are currently known for this species.

Hesperomannia arbuscula

Approximately 25% (13 individuals) of the known 54-56 individuals of *Hesperomannia arbuscula* occur within the Makua action area in Kapuna Gulch (USFWS 1998b; K. Kawelo and J. Rohrer, personal communications 1998; T. Takahama, personal communication 1998).

Currently, no on-the-ground management actions are known for this species outside of the Makua action area.

The Army is conducting management actions as described in the Mitigation Plan and BA. DOFAW has weeded the Pahole population/occurrence. They also plan to outplant this species at one of the Pahole outplanting exclosures (USFWS 1998b).

Lepidium arbuscula

At least 9% (80 individuals) of the fewer than 900 individuals of *Lepidium arbuscula* occur within the Makua action area (USFWS 1998b; K. Kawelo and J. Rohrer, personal communications 1998; T. Takahama, personal communication 1998).

Other than the actions the Army is conducting as described in the Mitigation Plan and BA, no other on-the-ground management actions are currently known for this species.

Lipochaeta tenuifolia

The subpopulations/occurrences in Makua Military Reservation represent the largest concentration of known plants. Approximately 60% (590 individuals) of the estimated 1,000 individuals of *Lipochaeta tenuifolia* are found within the Makua action area (HHP 1997). The State is conducting some rat and mongoose control in Mt. Kaala NAR that may benefit this species (T. Takahama, personal communication 1998).

Other than the actions the Army is conducting as described in the Mitigation Plan and BA, no other management actions are currently known for this species within the Makua action area.

Lobelia niihauensis

In the Makua action area, *Lobelia niihauensis* is known from Makua and Kahanahaiki Valleys. Most of these plants are on the cliffs on the southern side of Makua Valley, where more than 400 plants were seen during the HHP survey in 1993 (U.S. Army 1998b). The Makua population/occurrence (approximately 420 individuals) represents over 60% of the known individuals on Oahu and 15% of the known 1,585-3,555 individuals of *Lobelia niihauensis* statewide.

Other than the actions the Army is conducting as described in the Mitigation Plan and BA, no other management actions are currently known for this species.

Lobelia oahuensis

The individual in the Makua action area represents less than 1% of total 110 individuals of *Lobelia oahuensis* (USFWS 1998b).

Other than the actions the Army is conducting as described in the Mitigation Plan and BA, no other management actions are currently known for this species.

Neraudia angulata* var. *angulata

Approximately 60% (50 individuals) of the known 80 individuals of *Neraudia angulata* var. *angulata* occur within the Makua action area (U.S. Army 1998b).

Other than the actions the Army is conducting as described in the Mitigation Plan and BA, no other management actions are currently known for this species.

Neraudia angulata* var. *dentata

Approximately 15% (6 individuals) of the less than 40 known individuals of *Neraudia angulata* var. *dentata* occur within the Makua action area (HHP 1997).

Alien plant control and population reintroduction are identified as management actions in the Navy's management plan for the 113 hectare (280 acre) Halona management area on Lualualei Naval Magazine, where the 20 individuals appear vigorous and reproducing. Fire control and management are also identified for all populations/occurrences in Lualualei (U.S. Navy 1997).

Other than the actions the Army is conducting as described in the Mitigation Plan and BA, no other management actions are currently known for this species within the Makua action area.

Nototrichium humile

The Makua action area contains nearly 90% (1320 individuals) of the known 1,500 individuals of *Nototrichium humile* on Oahu, with an unknown but probably very small number of individuals at the one known location on Maui (USFWS 1998b).

One individual of *Nototrichium humile* has been outplanted by The Nature Conservancy in a fenced exclosure in Honouliuli Preserve (B. Morgan, personal communication 1997). A small exclosure in Nanakuli Forest Reserve including *Nototrichium humile* is managed by maintaining firebreaks and monitoring rare plants (DOFAW 1997). A 12-hectare (30 acre) ungulate exclosure has been constructed near Puu Hapapa on Lualualei Naval Magazine by the Navy, which includes several individuals of this species at two locations within the exclosure. Alien plant control and fire management are also identified in the Navy's management plan for this area (U.S. Navy 1997).

Other than the actions the Army is conducting as described in the Mitigation Plan and BA, no other management actions are currently known for this species within the Makua action area.

Peucedanum sandwicense

Less than 1% of the known 1,000-5,000 individuals of *Peucedanum sandwicense* occur within the Makua action area (USFWS 1995b).

Other than the actions the Army is conducting as described in the Mitigation Plan and BA, no other management actions are currently known for this species.

Phyllostegia kaalaensis

The Pahole population/occurrence of this species, which is within the Makua action area, represents approximately 20% (10 individuals) of the less than 50 known individuals of *Phllostegia kaalaensis* (HHP1997).

Currently, no on-the-ground management actions are known for this species outside of the Makua action area.

The Army is conducting management actions as described in the Mitigation Plan and BA. The ten individuals in Pahole NAR are within a 100 hectare (250 acre) fenced exclosure. Weeding continues in the surrounding areas of Pahole (T. Takahama, personal communication 1998).

Plantago princeps* var. *princeps

Approximately 20% (30 individuals) of the estimated 175-242 individuals of *Plantago princeps* var. *princeps* occur within the Makua action area, and approximately 80% occur on Army land, including the Schofield population/occurrence (USFWS 1998c).

The draft long-range management plan for Honouliuli Preserve identifies alien plant control, ungulate control, fire control, rare species recovery, and native habitat restoration as future management actions (TNCH 1997). It is expected that these actions will benefit *Plantago princeps* var. *princeps* within the preserve (J. Crummer, personal communication 1998; USFWS 1998c).

The Army is conducting management actions as described in the Mitigation Plan and BA. The *Plantago princeps* var. *princeps* plants at Pahole NAR are within the large fenced exclosure. DOFAW hopes to propagate plants at its Pahole Plant Nursery when seed is available (B. Garnett, personal communication 1997).

Pritchardia kaalae

Approximately 35% (60 individuals) of the known 140 individuals of *Pritchardia kaalae* occur in the Makua action area (USFWS 1998b).

The State is conducting some rat control in Mt. Kaala NAR that may benefit this species (T. Takahama, personal communication 1998).

Other than the actions the Army is conducting as described in the Mitigation Plan and BA, no other management actions are currently known for this species within the Makua action area.

Sanicula mariversa

The entire known distribution containing approximately 77 individuals of *Sanicula mariversa* occurs within the Makua action area, except for two individuals on Kamaileunu Ridge in Waianae Kai Forest Reserve (USFWS 1998b).

Other than the actions the Army is conducting as described in the Mitigation Plan and BA, no other management actions are currently known for this species.

Schiedea hookeri

Less than 2% (10 individuals) of the known 220- 330 individuals of *Schiedea hookeri* occur within the Makua action area and less than 4% occur on Army land, including the Schofield population/occurrence (USFWS 1998c).

Other than the actions the Army is conducting as described in the Mitigation Plan and BA, no other management actions are currently known for this species.

Schiedea kaalae

Over 15% (3 individuals) of the less than 20 known individuals of *Schiedea kaalae* are found within the Makua action area (USFWS 1998b).

Currently, no on-the-ground management actions are known for this species outside of the Makua action area.

The Army is conducting management actions as described in the Mitigation Plan and BA. Fencing and removal of feral pigs in the Pahole drainage was completed by DOFAW in July 1997. Weeding continues in the surrounding areas (USFWS 1998b). Individuals of *Schiedea kaalae* have been outplanted in Pahole NAR (DOFAW 1997).

Schiedea nuttallii

Thirty to 50% (28 individuals) of the known 55-105 individuals of *Schiedea nuttallii* are within the Makua action area (USFWS 1998c).

A long-range management plan for Honouliuli Preserve has been drafted which will include actions for alien plant management, ungulate control, fire control, rare species recovery, and native habitat restoration (TNCH 1997). It is expected that these actions will benefit any plants of *Schiedea nuttallii* still extant within the preserve.

The Army is conducting management actions as described in the Mitigation Plan and BA. Weeding continues in the areas surrounding this species in Pahole NAR (T. Takahama, personal communication 1998).

Silene lanceolata

The Makua population/occurrence represents less than 2% of the known 2,640 individuals of *Silene lanceolata*, while Army lands, including Pohakuloa Training Area, contain 96% of the total individuals (USFWS 1996).

Other than the actions the Army is conducting as described in the Mitigation Plan and BA, no other management actions are currently known for this species.

Spermolepis hawaiiensis

The Makua population/occurrence represents less than 1% of the total 5,000-10,000 individuals of *Spermolepis hawaiiensis* and all Army lands represent approximately 10% of the entire species.

Other than the actions the Army is conducting as described in the Mitigation Plan and BA, no other management actions are currently known for this species.

Tetramolopium filiforme

All but 11 of the 1,550 individuals of *Tetramolopium filiforme* occur within the Makua action area (USFWS 1998b).

Other than the actions the Army is conducting as described in the Mitigation Plan and BA, no other management actions are currently known for this species.

Viola chamissoniana* ssp. *chamissoniana

Over 85% (285 individuals) of the known 255-315 individuals of *Viola chamissoniana* ssp. *chamissoniana* are found in the Makua action area (USFWS 1998b).

Alien plant control, population reintroduction, and fire control and management are identified as management actions in the Navy's management plan for the 113 ha (280 acre) Halona management area on Lualualei Naval Magazine for three individuals of this species (U.S. Navy 1997).

Other than the actions the Army is conducting as described in the Mitigation Plan and BA, no other management actions are currently known for this species within the Makua action area.

Oahu Tree Snail *(Achatinella mustelina)*

Based on the amount of known snail habitat (USFWS 1993) that is within the action area, approximately 40% of the known populations/occurrences occur within the action area, with an additional 10% or less in the Schofield Barracks area.

Currently, no on-the-ground management actions are known for this species outside of the Makua action area.

In conjunction with the State of Hawaii NAR staff at Pahole and additional support from the Service, Dr. M.G. Hadfield is continuing to develop captive propagation techniques; methodology for protection of *Achatinella mustelina* populations in the field; research on tree snail ecology and life history; and methodology for reintroducing field populations from captively reared tree snails. The management of landscape-level threats is not being addressed. Such management includes methods for wide-ranging control of rat and predatory snail populations and the control of alien ungulates and vegetation that threaten the habitat required by the tree snails. Pahole is the site of Hadfield's long-term study site, which also serves as the study site for evaluating methods of local protection of tree snails field populations. The Army is assisting Hadfield with this work in Pahole, Ohikilolo, and has constructed a predatory exclusion box, as described in the general mitigation sections on rats and invertebrates. DOFAW has constructed a protective barrier around their snail sanctuary in Pahole that excludes rats and the predatory snail *Euglandina rosea*.

Oahu Elepaio (*Chasiempis sandwichensis ibidis*)

There are 6 known elepaio within the Makua action area, which represent <1% of the total estimated 1,300 individuals of Oahu elepaio. Also, there are approximately 400 elepaio within Schofield Barracks West Range, which represent 31% of the total individuals of Oahu elepaio (VanderWerf 1997b).

The State of Hawaii Division of Forestry and Wildlife has funded and/or conducted the following activities for Oahu elepaio: 1) an island-wide survey to determine the abundance and distribution of Oahu elepaio; 2) mist-netted and banded elepaio to mark individuals for demographic studies; 3) collected information on disease prevalence; 4) monitored survival of banded elepaio in Pia, Kuliouou, and Wailupe Valleys; 5) removed rats within breeding territories in Pia and Kuliouou Valleys in an attempt to increase elepaio nesting success; 6) monitored reproductive success of elepaio in Pia, Kuliouou, and Wailupe Valleys (southern Koolau Mountains); 7) conducted an artificial nest experiment with cameras to document the identity of predators; and 8) compiled recent observations of Oahu elepaio to construct a current range map using GIS (VanderWerf 1997a).

Other than the actions the Army is conducting as described in the Mitigation Plan and BA, no other management actions are currently known for this species within the Makua action area.

Oahu Creeper (*Paroreomyza maculata*)

The Nature Conservancy Hawaii Heritage Program Database contains two records of Oahu creeper within the action area. There is a 1939 sighting of an Oahu creeper within the action area and another in 1976 (HPP 1997)

Other than the actions the Army is conducting as described in the BA, no other management actions are currently known for this species.

Hawaiian Hoary Bat (*Lasiurus cinereus semotus*)

There has been one sighting of a solitary bat above Ohikilolo Ridge within the action area (C.Crooker and E. Sharpe, U.S. Fish and Wildlife Service, personal communications 1998).

Other than the actions the Army is conducting as described in the Mitigation Plan and BA, no other management actions are currently known for this species.

Effects of the Action on Listed Species

The most significant effect routine military training will have on the T&E species in the Makua action area is the occurrence of fire due to military activities. Most training takes place on the valley floor and not at higher elevations where most of the T&E species are located. However, wildfires starting outside the firebreak from ricocheting ammunition such as tracers, mortars or rockets landing outside the impact area, or wildfires starting inside the firebreak that jump outside the firebreak, may burn T&E species and their habitat. Tracer ammunition has the greatest potential to start fires.

Fire has the potential to kill listed plants, Oahu tree snails (*Achatinella mustelina*), and elepaio (*Chasiempis sandwichensis ibidis*). This may occur by directly burning individuals or by causing abandonment of active elepaio nests. Fire may also destroy habitat needed for the species' survival (e.g., important nesting trees) and contribute to the overall degradation of habitat through the promotion of the spread of alien weed species. Because there are no records to support the use of the Makua action area by the Oahu creeper (*Paroreomyza maculata*), and Hawaiian hoary bat (*Lasiurus cinereus semotus*) for nesting or roosting, fire will probably not directly effect these species.

Fire history records for the Makua action area are sketchy and inconsistent. In the past, fires have burned into the adjacent land of Mr. Albert Silva, the Kuaokala Game Management Area, and the U.S. Air Force Kaena Point Satellite Tracking Station. State of Hawaii records show that large fires started in MMR in 1970 and 1975. The 1970 fire is thought to have started along Farrington Highway from a discarded cigarette. That fire burned 617 ha (1,525 acres) of State conservation land in the Makua-Keaau and Kuaokala Forest Reserve and some land in the U.S. Air Force Kaena Point Satellite Tracking Station. It was stopped for the most part at the Kuaokala Road, which prevented it from burning down farther north into Mokuleia and the Dillingham Military Reservation. The fire got very close to entering the State's Pahole NAR. The 1975 fire started from military training and burned 150 ha (370 acres) on the State's Kuaokala Game Management Area.

In June 1995, a prescribed burn by the Army went out of prescription and burned extensive areas within MMR and into the State's Kuaokala Game Management Area. The Service and the Army conducted a joint after-action survey and the Service prepared a report of the findings. The report indicated that individuals of 5 species of endangered plants probably perished in that fire (USFWS 1995a).

Some fire history from August 1995 to the present is shown in Appendix G of the BA, Fire Incident Summary Report, but the information is not complete regarding locations of all the fires, the causes, and the fire burn index reading at the time. In 1997, there were three small fires that occurred outside the southern firebreak road. In 1998, there were four fires that occurred outside the firebreak road, three of which were started by military training. Although no listed species died in the fires, one fire came within 30 meters (100 feet) and another came within 100 meters (328 feet) of listed plant species.

Over the short term, fire is less likely to adversely affect species on the upper elevations of the Makua Keaau Ridge, in the Pahole NAR, and in the Mokuleia Game Management Area, than species in other areas towards the ocean, such as Kaluakauila and the area over the Kaneana Cave. This is because the vegetation to the East is wetter and does not burn as easily as the drier vegetation to the West, and the predominate trade winds blow from the East North Easterly direction so fires are more likely to burn faster in a westerly direction. This would provide more time for fire fighting efforts to prevent fires from burning in the Makua Keaau Ridge, Pahole NAR, and Mokuleia Game Management Area directions. However, over the long term as fires consume more trees, and grassy weeds move in to replace them, the grass/forest boundary would gradually move toward these areas and the listed species in these areas would be adversely affected.

Prescribed burning is a proven method to reduce vegetative fuel loading and thereby minimize the risk of a large wildfire burning out of control. However, there is always a potential for

prescribed burning to get out of the controlled burn area outside the firebreak road, thereby potentially burning T&E species and their habitat.

In addition to directly destroying native Hawaiian plants and animals, fire facilitates the spread of noxious alien weeds because native Hawaiian plants are not well adapted to fire (Cuddihy and Stone 1990). These alien weeds not only outcompete and eliminate native plants in the environment, but also increase the fuel load capacity in such environments.

Alien plant and animal species may also be introduced by military units returning from deployments to foreign countries, coming from the mainland U.S., or from neighbor islands (Army returning from PTA and Hawaii Army National Guard from neighbor islands), coming from other training areas on Oahu, or traveling from MMR to other areas on Oahu.

Routine military training as described above has the potential to introduce alien species by carrying them on clothing, shoes, equipment, and vehicles. Over time, they have the potential to spread to areas with listed species, damaging them, disrupting their reproductive cycles, and/or competing with them for sunlight, water, space, and nutrients. Possible points of introduction by military training are mostly on or within the firebreak roads and the staging area on the northwestern field near the north gate.

Maintenance and/or construction of firebreak and fuelbreak roads, range vegetation and soils, and targets/training objectives may also result in the introduction of alien species in the materials such as crushed rock or sand, soils, or vegetation.

Other activities at MMR have the potential to introduce alien species, which can adversely affect listed species. These are activities such as: 1) MMR open houses to the public; 2) range visits by persons on official business; and 3) daily work by range control personnel. The potential for weed introductions from these activities is very low because: 1) open houses are done very infrequently (once or twice per year) and the public only sets foot around the range control building and a few spots along the firebreak road; 2) range visits by official visitors (e.g., contractors, persons in political office, native Hawaiian people conducting cultural/religious practices at Ukanipo Heiau) are infrequent and involve only a few people; and 3) range control personnel assigned to MMR clean their clothes and gear before entering MMR.

There are no known effects of noise on plants and snails. Adverse effects of noise from live-fire explosions to birds and bats within the Makua action area have also never been documented. However, exploding ordnance is more difficult to habituate to than regular, repeated noises such as generators. The shock wave and or the noise from a bomb blast may cause the species to abandon nests for some period of time. Elepaio may be particularly susceptible to noise disturbance because this species is territorial, very vocal, and assumed to have a very acute sense of hearing (Paul Banko, U.S. Geological Survey, Biological Resources Division; Al Lieberman, The Peregrine Fund; Eric VanderWerf, University of Hawaii personal communications 1998). The Army's Environmental Division will monitor the Oahu elepaio, Oahu creeper, and the Hawaiian hoary bat within the Makua action area. Should such monitoring reveal impacts from noise associated with training, the Army will reinitiate consultation with the Service.

Native land snails, including the endangered *Achatinella mustelina*, may be negatively impacted by the down draft of helicopters flying low over their habitat. Currently, the Army only flies over existing populations/occurrences to fight fire and for environmental work. As long as the

training flights remain away from *Achatinella mustelina* populations/occurrences, this impact is likely to be minimal.

Because training takes place at MMR and the Army retains the land, the Army's Natural Resources component of the Ecosystem Management Program provides protection to the listed species there. However, bullets from gunfire to control goats have the potential to hit T&E species or to start a fire. Natural resources work has the potential to introduce weed species, but the work is done by personnel who are very conscious of weed threats and clean their gear prior to entry into the field.

Cumulative Effects

Cumulative effects include the effects of future State, local or private actions that are reasonably certain to occur in the action area considered in this BO. 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 ESA.

Future State actions in the proposed action area include continued management of State lands according to their current designations as Forest Reserves or NARs. The State will continue to manage the T&E species on their lands to the best of their ability. No specific future State, local, or private actions are proposed that have not been discussed as part of their current management actions in the Environmental Baseline section above.

Conclusion

After reviewing the current status of the species covered in this BO, the environmental baseline of the species in the action area, and the effects of routine military training at MMR, including the cumulative effects, it is the Service's biological opinion that the proposed action with accompanying conservation measures as described in the BA and the Mitigation Plan, is not likely to jeopardize the continued existence of the species covered in this BO. This finding is based in large part on the conservation measures built into the project by the Army, as described in the Mitigation Plan. The Service believes that the conservation measures built into the project by the Army will minimize the adverse effects of routine military training at MMR on T&E species. No critical habitat has been designated for the species covered in this BO; therefore, none will be affected.

INCIDENTAL TAKE

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

intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are non-discretionary, and must be undertaken by the Army 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 fails to assume and implement the terms and conditions, 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

Upon the resumption of live-fire training exercises at MMR, with its accompanying risk of fire and potential alien species introductions, we anticipate that take will occur in the form of harm (due to the loss of habitat) and death as a result of Army activities described in this BO. The Service anticipates the loss of up to one tree or bush that is known to harbor, or have harbored in the last 15 years, Oahu tree snails (*Achatinella mustelina*), no more than one active Oahu elepaio (*Chasiempis sandwichensis ibidis*) nest, or the abandonment of one active elepaio nest.

EFFECT OF THE TAKE

In the accompanying biological opinion, the Service determined that this level of anticipated take is not likely to result in jeopardy to the species or destruction or adverse modification of critical habitat.

REASONABLE AND PRUDENT MEASURES

The Service believes the following reasonable and prudent measure is necessary and appropriate to minimize the impacts of incidental take on Oahu tree snails (*Achatinella mustelina*) and Oahu elepaio (*Chasiempis sandwichensis ibidis*).

1) Monitor and report any incidental take that occurs.

TERMS AND CONDITIONS

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

2) Provide the Service with an annual report containing the conservation measures that were accomplished during the year.

3) The Service shall be notified within 3 working days if any take of Oahu tree snails (*Achatinella mustelina*), Oahu elepaio (*Chasiempis sandwichensis ibidis*), Oahu creeper (*Paroreomyza maculata*), and Hawaiian hoary bat (*Lasiurus cinereus semotus*) occurs.

4) The depository designated to receive any killed specimens is the B.P. Bishop Museum, 1525 Bernice Street, Honolulu, Hawaii, 96817 (telephone: 808/547-3511). If the B.P Bishop Museum does not with 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.

The Service believes that no more than one tree or bush that is known to harbor, or have harbored in the last 15 years, Oahu tree snails (*Achatinella mustelina*), no more than one active Oahu elepaio (*Chasiempis sandwichensis ibidis*) nest, or the abandonment of one active elepaio nest will be incidentally taken as a result of the proposed action. The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize the impact of incidental take that might otherwise result from the proposed action. If, during the course of the action, this level of incidental take is exceeded, such incidental take represents new information requiring reinitiation of consultation and review of the reasonable and prudent measures provided. The Army must immediately provide an explanation of the causes of the taking and review with the Service the need for possible modification of the reasonable and prudent measures.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. The recommendations provided here 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.

1) It is reasonable to believe that with the implementation of all the precautions and conservation measures cited in the BA and Mitigation Plan, routine military training at MMR will not jeopardize species covered in this BO. However, as an extra precaution, the Service recommends that the Army use a tiered approach to implementing training at MMR until some of the species-specific mitigation is actually in place for species most vulnerable to fire. For example, the Service suggests that the Army not use tracers or other ammunitions that may have a medium to high likelihood of starting fires (including those having a higher incident of starting fires, but rated as medium in the BA) until species most vulnerable to fire have some mitigation in place. The following are some (but possibly not all) of the species which are most vulnerable to fire: *Cyanea superba* ssp. *superba*; *Lipochaeta tenuifolia*; *Nototrichium humile*; and *Tetramolopium filiforme.* The Service would be happy to assist the Army in making these initial determinations.

2) The Service encourages the Army to incorporate the species covered in this BO that did not need species-specific conservation measures as determined in the Mitigation Plan into the mitigation areas and perform additional conservation measures for these species. These species are: *Bonamia menziesii*; *Diellia falcata*; *Euphorbia haeleeleana*; *Lepidium arbuscula*; *Lobelia niihauensis*; *Lobelia oahuensis*; *Peucedanum sandwicense*; *Schiedea hookeri*; *Silene lanceolata*; *Spermolepis hawaiiensis*; *Chasiempis sandwichensis ibidis*; *Paroreomyza maculata*; and *Lasiurus cinereus semotus*.

3) In addition to #2 above, the Service encourages the Army to incorporate species of concern and other rare species within the action area into the mitigation areas and perform conservation measures for these species. These species include: *Amastra rubens*; *Asio flammeus sandwichensis*; *Auricuella* sp. aff. *castanea*; *Auricuella* sp. aff. *perpusilla*; *Auricuella ambusta*; *Bobea sandwicensis*; *Bobea timonioides*; *Capparis sandwichiana*; *Cookeconcha* sp.; *Cyanea lanceolata* spp. *calycina*; *Dissochondrus bilflorus*; *Dubautia sherffiana*; *Exicarpos gaudichaudii*; *Labordia kaalae*; *Laminella sanguinea*; *Leptachatina* sp.; *Lindsaea repens* var. *macraeana*; *Lobelia yuccoides*; *Megalagrion nigrohamatum nigrolineatum*; *Melicope makahae*; *Melicope sandwicensis*; *Morinda trimera*; *Neraudia melastomifolia*; *Nesoluma polynesicum*; *Nothocestrum latifolium*; *Panicum beecheyi*; *Partulina dubia*; *Platydesma cornuta* var. *decurrens*; *Pleomele forbesii*; *Pleuropoma sandwichienis*; *Pteralyxia macrocapra*; *Schiedea ligustrina*; *Schiedea manii*; and *Schieda pubescens* var. *purpurascens*; *Strongylodon ruber*; and *Tetraplasandra kavaiensis*.

In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats, the Service requests notification of the implementation of any conservation recommendations.

CONCLUSION

This concludes formal section 7 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 operations causing such take must cease pending reinitiation.

As agreed during the consultation process, the Army will reinitiate consultation if a fire occurs outside of the firebreak road due to military activities. No military training activities, except for those that are approved by the Service on a case-by-case basis, may occur outside the firebreak roads. Furthermore, as stated in our Conclusion (above), the Service's finding of no jeopardy in this BO is based in large part on the conservation measures described in the Mitigation Plan and built into the project by the Army. Should there be a failure to carry out any or all of the described measures, or if these measures are modified in any way, reinitation of consultation will be required.

If you have any questions concerning this BO, please contact Assistant Field Supervisor Karen Rosa or Fish and Wildlife Biologist Elizabeth Sharpe (phone: 808/541-3441; fax: 808/541-3470).

Sincerely,

/s/ Robert P. Smith

Robert P. Smith
Pacific Islands Manager

Attachments

cc: Larry Salata, USFWS, Portland, OR

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Attachment 1. Species covered in the Biological Opinion for Routine Military Training at Makua Military Reservation.

Alectryon macrococcus var. *macrococcus*
Alsinidendron obovatum
Bonamia menziesii
Cenchrus agrimonioides var. *agrimonioides*
Chamaesyce herbstii
Ctenitis squamigera
Cyanea grimesiana ssp. *grimesiana*
Cyanea longiflora
Cyanea superba ssp. *superba*
Cyrtandra dentata
Delissea subcordata
Diellia falcata
Dubautia herbstobatae
Euphorbia haeleeleana
Flueggea neowawraea
Hedyotis degeneri var. *degeneri*
Hedyotis parvula
Hesperomannia arbuscula
Lepidium arbuscula
Lipochaeta tenuifolia
Lobelia niihauensis
Lobelia oahuensis
Neraudia angulata var. *angulata*
Neraudia angulata var. *dentata*
Nototrichium humile
Peucedanum sandwicense
Phyllostegia kaalensis
Plantago princeps var. *princeps*
Pritchardia kaalae
Sanicula mariversa
Schiedea hookeri
Schiedea kaalae
Schiedea nuttallii
Silene lanceolata
Spermolepis hawaiiensis
Tetramolopium filiforme
Viola chamissoniana ssp. *chamissoniana*
Oahu tree snail (*Achatinella mustelina*)
Oahu elepaio (*Chasiempis sandwichensis ibidis*)
Oahu creeper (*Paroreomyza maculata*)
Hawaiian hoary bat (*Lasiurus cinereus semotus*)

Appendix F - Makua Military ReservationThreats and Actions

Species of Special Consideration	Scientific Name	Federal status E=endangered	# in Action Area known by Army	Statewide Total	Main Military Threats				Non-military Threats										Mitigation actions (See key)										Species Co-location Sites for Mitigation				
					Fire Zone A	Fire Zone B	Fire Zone C	Alien species intro	Goats	Pigs	Cattle	Weeds	Rats	Euglandina rosea	Disease	Slugs	Black twig borer	Erosion	Propagate	Monitor known populations	Survey	Outplant	Ungulate control	Weed control	Erosion control	Rat Control	Slug Control	Insect control	Mitigation out of action area	Lower Kaala NAR	Makaleha forest	Honouliuli (TNCH)	BWS Makaha	Waianae Kai
	LISTED PLANTS																																
*	*Alectryon macrococcus macrooccus*	E	83	<300		x	x	x	x	x	x	x	x				x		x	x	x	1	1,2,3,4,5, 8,9	1,2,3,4, 6,7		x		x	x	x	x	x	x	x
*	*Alsinidendron obovatum*	E	170	12			x	x		x		x							x	x		1	1,4,9	1,7					x				
	Bonamia menzesii	E	24	200	x	x		x	x	x	x	x							x	x			2,3	3							x		
*	*Cenchrus agrimonioides agrimonioides*	E	142	<100		x	x	x		x		x							x	x		1	1,9	1,7					x		x		x
*	*Chamaesyce herbstii*	E	172	<200			x	x		x		x							x	x		1	4,9	7					x			x	
	Ctenitis squamigera	E	4	80		x		x	x	x		x							x	x	x		2,4,5	2,4						x	x		
*	*Cyanea grimesiana grimesiana*	E	4+	<50			x	x		x		x	x			x			x	x	x	1	1,9	1,7		x	x		x	x		x	
*	*Cyanea longiflora*	E	204	220-300			x	x		x		x	x			x			x	x		1	9	7		x	x		x			x	x
*	*Cyanea superba superba*	E	5	5		x		x		x		x	x			x			x	x		1	6	1		x	x		x				
*	*Cyrtandra dentata*	E	110	<50			x	x		x		x							x	x			1,9	1,7					x				
*	*Delissea subcordata*	E	65	<50-<100		x	x	x		x		x	x			x			x	x		1	1,6,9	1,7		x	x		x	x		x	
	Dielilia falcata	E	283	5540-6540		x	x	x		x		x							x	x			1,2,5,9	1,2,7						x		x	x	x
*	*Dubautia herbstobatae*	E	1020	300-3000		x		x	x			x						x	x	x			2		2				x				x
	Euphorbia haeleeleana	E	87	450-625		x		x		x	x	x							x	x	x	4	3,7	3,5									
	Flueggea neowawraea	E	11	100-167		x	x	x	x	x		x					x		x	x	x	1	1,2,5,6,9	1,2,7	2			x		x	x	x	x
*	*Hedyotis degeneri degeneri*	E	32	30			x	x		x		x							x	x		1	9	7					x		x		
*	*Hedyotis parvula*	E	100+	100-230		x		x	x	x		x						x	x	x	x		2		2				x		x		
	Hesperomannia arbuscula	E	13	86			x	x		x		x							x	x			9	7								x	
	Lepidium arbuscula	E	134	1000	x	x		x	x	x		x						x	x	x			2		2						x		x
*	*Lipochaeta tenuifolia*	E	1000's	2000	x	x		x	x			x						x	x	x			2		2				x	x		x	x
	Lobelia nihauensis	E	430	5000		x		x	x			x	x			x		x	x	x	x		2		2				x			x	x
	Lobelia oahuensis	E	1			x		x	x			x	x			x		x	x	x	x		2		2	x			x				
*	*Neraudia angulata angulata*	E	58	<60		x		x	x	x		x						x	x	x	x	2,4	2,5,7	2,5	2				x		x		x
*	*Neraudia angulata dentata*	E	6	<50		x		x	x	x	x	x						x	x	x	x	2,4	2,3,7	3	2				x			x	x
*	*Nototrichium humile*	E	1330	1000-1600		x	x	x	x	x	x	x							x				1,2,3,4,5, 6,7,9	1,2,3,4, 5,7					x			x	x
	Peucedanum sandwicense	T	20	1000-5000		x		x	x	x		x						x														x	x
*	*Phyllostegia kaalaensis*	E	6	<50			x	x		x		x							x	x		1	9	7					x	x		x	x
*	*Plantago princeps princeps*	E	30	50-142		x		x	x			x						x	x	x	x		2,9	7	2				x				
*	*Pritchardia kaalae*	E	59	100-130		x		x	x	x		x	x					x	x	x		3	2,8	6	2	x			x	x	x		
*	*Sanicula mariversa*	E	75	<75		x		x	x			x						x	x	x	x	3	2		1,2				x				
	Schiedea hookeri	E	10	100-140		x		x	x			x						x	x	x	x		2		2						x	x	x
	Schiedea kaalae	E	3	130			x	x		x		x											9	7							x		
*	*Schiedea nuttallii nuttallii*	E	51	<100			x	x		x		x							x	x	x	1	1,9	1,7					x				
*	*Silene lanceolata*	E	40+	<2000		x		x	x			x						x	x	x	x		2		2				x				
	Spermolepis hawaiiensis	E	47+	1000-3000	x	x		x	x			x						x	x	x			2										
*	*Tetramolopium filiforme (2 varieties)*	E	1572	3300-3500	x	x		x	x			x						x	x	x			2		2				x				x
*	*Viola chamissoniana chamissoniana*	E	286	237		x		x	x			x						x	x	x	x		2		2				x			x	
	LISTED INVERTEBRATE ANIMALS																																
	Achatinella mustelina	E	00-2000			x	x	x	x	x		x	x	x				x	x	x	x		1,2,4,5,6, 9	1,2,4,5, 6,7	2	x					x		

E = endangered, T = threatened, PE = proposed endangered, C = candidate for proposal, SOC = species of concern

Appendix F - Makua Military ReservationThreats and Actions

Species of Special Consideration	Scientific Name	Federal status E=endangered	# in Action Area known by Army	Statewide Total	Main Military Threats				Non-military Threats											Mitigation actions (See key)										Species Co-location Sites for Mitigation				
					Fire Zone A	Fire Zone B	Fire Zone C	Alien species intro	Goats	Pigs	Cattle	Weeds	Rats	Euglandina rosea	Disease	Slugs	Black twig borer	Erosion	Propagate	Monitor known populations	Survey	Outplant	Ungulate control	Weed control	Erosion control	Rat Control	Slug Control	Insect control	Mitigation out of action area	Lower Kaala NAR	Makaleha forest	Honouliuli (TNCH)	BWS Makaha	Waianae Kai
	LISTED VERTEBRATE ANIMALS																																
	Paroreomyza maculata	E	1			x	x	x	x	x		x	x		x			x			x		1,2,4,5,6,7	1,2,4,5,6	2								
	Lasurius cinereus semotus	E	1			x	x	x	x	x		x						x			x		1,2,3,4,5,6,7	1,2,3,4,5,6	2								
	PROPOSED ENDANGERED ANIMAL																																
	Chaslempis sandwichensis gayi	PE				x	x	x	x	x	x	x	x		x			x		x	x		1,2,3,5,6,9	1,2,3,7	2	x							
	UNLISTED PLANTS																																
	Bobea timonioides	SOC	2	400-500		x		x	x	x		x									x		2,5	2									
	Capparis sandwichiana	SOC	2	?		x		x				x								x													
	Cyanea lanceolata calycina	SOC	200+	200+			x	x		x		x	x			x					x								x		x		
*	*Dissochondrus biflorus*	SOC	500+	1000s			x	x		x		x									x		9	7							x	x	
	Dubautia sherffiana	SOC	161	several 100		x		x	x	x		x						x			x		2,5		2					x	x	x	x
	Exocarpos gaudichaudii	SOC	1	several 100			x	x		x		x									x		9	7								x	
	Labordia kaalae	SOC	22	1000-2000		x	x	x	x	x		x						x		x			2,4,8,9	4,6,7	2							x	
	Lobelia yuccoides	SOC	5+	1000s			x	x		x		x	x			x					x		9	7								x	
	Melicope makahae	C	8	100-200		x		x	x	x		x								x			2,8	6									x
	Morinda trimera	SOC	1000+	<4000		x	x	x	x	x		x						x					1,2,5,6,9	1,2,6,7	2							x	
	Neraudia melastomifolia	SOC	17+	1000s		x	x	x	x	x	x	x						x		x			1,2,4,9	1,4,7	2					x		x	x
	Nesoluma polynesicum	SOC	5	<500		x		x	x	x		x						x		x			2,5	2	2								
	Nothocestrum latifolium	SOC	3	<300		x		x	x	x		x					x	x		x			2,5	2	2								
	Platydesma cornuta decurrens	SOC	152	few 100		x	x	x	x	x		x						x			x		2,8	6	2							x	x	x
	Pleomele forbesii	C	124	500		x	x	x	x	x	x	x						x			x		1,2,3,4,5,6,7,8	1,2,3,4,5,6						x		x	x	
	Pteralyxia macrocarpa	SOC	82+	<500		x	x	x	x	x		x						x			x		1,2,5,6,8,9	1,2,6,7						x	x	x	x	
	Schiedea mannii	SOC	10000+	10,000s	x	x	x	x	x			x						x					2		2								x	x
	Schiedea pubescens purpurescens	SOC	#	few 100		x		x	x	x		x						x			x		2,8	6	2							x		x
	Strongylodon ruber	SOC	20+	1000s		x		x	x	x		x						x			x		2,4	4	2							x		
	Tetraplasandra kavaiensis	SOC	3	1000s			x	x		x		x									x		9	7										
	UNLISTED INVERTEBRATE ANIMALS																																
	Amastra rubens	SOC				x	x	x	x	x		x	x	x				x			x		1,2,5	2	2									
	Cookeconcha sp	SOC					x	x		x		x	x	x									l	r										
	Laminella sanguinea	SOC					x	x		x		x	x	x																				
	Leptachatina sp.	SOC				x		x	x	x		x	x	x				x					2,5	2	2									
	Megalagrion nigrohamatum nigrolineatum	C					x	x		x		x	x	x																				
	Partulina dubia	SOC				x		x	x	x		x	x	x				x					2,5	2	2									
	Pleuropoma sandwichensis	SOC				x		x	x	x		x	x	x				x					2,5	2	2									
	UNLISTED VERTEBRATE ANIMALS																																
	Asio flammeus sandwichensis	C			x			x	x	x		x	x		x						x		2,5,8	2,6										

E = endangered, T = threatened, PE = proposed endangered, C = candidate for proposal, SOC = species of concern

Key to Appendix F – Makua Military Reservation Threats and Actions

Outplant

1. Establish experimental populations in Kahanahaiki exclosure, Makua (see Makua Mitigation map).
2. Establish experimental populations in Lower Makua Dry Forest. (*)
3. Establish experimental populations in the Ohikilolo ridge vicinity.
4. Establish experimental populations in Kaluakauila dry forest.

Ungulate Control

1. Maintain the Kahanahaiki exclosure as a pig free area.
2. Eradicate goats in Makua Valley through fencing and hunting. (*)
3. Assess ungulate situation in Kaluakauila and implement control accordingly.
4. Develop and implement ungulate control program for the Makua rim opposite Pahole NAR and western Makaleha (East Rim).
5. Develop and implement ungulate control program for Lower Makua dryland forest. (*)
6. Develop and implement ungulate control program outside the Kahanahaiki exclosure.
7. Develop and implement ungulate control program for C-ridge vicinity.
8. Eradicate pigs from forest patches on Ohikilolo if problem arises.
9. Assist NARs staff in ungulate control.

Weed Control

1. Kahanahaiki gulch exclosure and vicinity.
2. Lower Makua Valley dry forest. (*)
3. Kaluakauila gulch vicinity.
4. East rim vicinity.
5. Upper C-ridge vicinity.
6. Ohikilolo forest patches.
7. Assist NARs staff in weed control.

Erosion Control

1. Construct barriers to hold soil.
2. Thorough ungulate management.

Insect Control

x. Develop insecticide treatment for black twig borer and Chinese rose beetle. Support biological control research on these arthropod species.

(*) = *Contingent on restrictions on entering areas with unexploded ordnance.*

Table 2. Summary of General Mitigation.

THREAT	ARMY'S CURRENT ACTIONS	ADDITIONAL ACTIONS DESCRIBED IN THIS MITIGATION PLAN
Fire	See Standard Operating Procedures	**1)** Finalize and implement an approved fire management plan for Makua Action Area (MAA). **2)** Enforce additional restrictions on military training. **3)** Evaluate need to reconsult with the Service if a fire starts outside the fuel break road as a result of military training. (Once fire starts outside firebreak road, the Army must cease all military training to extinguish the fire) **4)** Research and implement the creation of a living firebreak beyond existing forest edge (or other acceptable means for curtailing the continued advancement of fires) **5)** Conduct or contract seed storage use and testing to determine how seeds can best be kept for genetic banking and propagation. **6)** Monitor native vegetation, including assessment of changes to current forest boundary.
Alien Plant Species Control and Prevention	See Biological Assessment	**1)** Address weed spread during briefings for new troops. **2)** Survey for introduction of new weeds at least annually. Sampling methods to be included in the implementation plan. Eradicate new weeds found. **3)** Prioritize alied species for eradication. Prioritization must be included in the implementation plan. **4)** Include methods and implementation of alien species control in the implementation plan. **5)** Include vegetation and weed control monitoring requirements in the implementation plan. **6)** Conduct alien plant control and monitoring in off-site mitigation areas.

THREAT	ARMY'S CURRENT ACTIONS	ADDITIONAL ACTIONS DESCRIBED IN THIS MITIGATION PLAN
Feral Ungulate Control	See Biological Assessment	**1)** Complete perimeter fence as determined by the implementation plan if it is determined that pigs are moving into Makua from adjacent areas. **2)** Remove goats and pigs from Makua as determined by the implementation plan. **3)** Consider completion of fencing of Kahanahaiki management unit if ungulate activity increases. **4)** Develop and implement monitoring methods for determining ungulate activity. **5)** Implement ungulate control and monitoring actions occurring in Makua also in the Pahola Natural Area Reserve. **6)** Control and monitor ungulates in monitored off-site mitigation areas.
Small Mammal Control	See Biological Assessment	**1)** Control and monitor small mammals within managment areas, off-site mitigation areas, and other areas specified in the implementation plan. **2)** Consider assisting in toxicant registration efforts for rodent control. **3)** Include management actions and monitoring for rodent control in the implementation plan. **4)** Control and monitor small mammals in off-site mitigation areas.
Invertebrate Control	See Biological Assessment	**1)** Monitor and control invertebrates within management areas, off-site mitigation areas, and other areas identified in the implementation plan. **2)** Support additional research into the impacts and control methods for the black twig borer, two-spotted leafhopper, slugs, and mosquitoes as much as possible. **3)** Include appropriate avenues/methods for research and control in the implementation plan. **4)** Implement recommendations contained in the Army report to RCUH for *Euglandina rosea* and for slug control. **5)** Control and monitor invertebrates in off-site mitigation areas.

Table 4: Additional Species-Specific Mitigation for Plants Likely to be Jeopardized by Military Training

						IN ACTION AREA								OUTSIDE ACTION AREA								REINTRODUCTION								
Species	# Individuals State-wide	# Individuals in Makua Action Area	# Populations/Occurrences State-wide	# Populations/Occurrences in Makua Action Area	% Individuals in Makua Action Area	Kahanahaiki	Ohikilolo	Kaluakauila	Lower Makua	Pahole NAR	Other*	# Populations to be Managed	# Population Credits	Waianae Kai	Makaha	Lower Kaala	Honouliuli	Makaleha	Lualualei	Maakua	# Populations to be Managed	# Population Credits	Waianae Kai	Makaha	Lower Kaala	Honouliuli	Makaleha	Lualualei Nanakuli	Find More Sites	# Populations to be Managed	# Population Credits	Total Population Credits Received
Alectryon macrococcus var. *macrococcus*	500	83	27	8	16	R	--	--	--	m	--	2	0.42	m	m	m	m	m	m	--	5	2.50	--	--	--	--	--	--	--	0	0.00	2.92
Alsinidendron obovatum	31	31	5	5	100	R	--	--	--	2m/R	--	3	0.84	--	--	--	--	--	--	--	0	0.00	--	--	--	R	--	R	R	7	2.33	3.17
Cenchrus agrimonioides var. *agrimonioides*	<100	41-71	7	3	75	2m/R	--	--	--	M	--	4	0.91	--	m	--	m	m	--	--	3	1.50	--	--	R	R	--	--	--	2	0.66	3.07
Chamaesyce herbstii	<100	60	4	2	87	R	--	--	--	2m	--	3	0.67	--	--	--	m	m	--	--	2	1.00	--	--	--	2R	2R	--	--	4	1.32	2.99
Ctenitis squamigera	100	4	10	1	4	R	--	--	--	R	--	2	0.34	m	--	m	--	m	--	--	3	1.50	--	--	2R	--	2R	--	--	4	1.32	3.16
Cyanea grimesiana ssp. *grimesiana*	< 50	5	15	3	10	R	--	--	--	3m	--	4	0.92	--	--	m	2m	--	--	--	3	1.50	--	--	R	R	--	--	--	2	0.66	3.08
Cyanea longiflora	120	100	3	1	80	R	--	--	--	2M	--	3	1.17	m	m	--	--	--	--	--	2	1.00	R	R	R	--	R	--	--	3	1.00	3.17
Cyanea superba ssp. *superba*	4	4	1	1	100	R	--	--	--	R	m(C)	3	0.59	--	--	--	--	--	--	--	0	0.00	R	R	R	--	--	--	R	8	2.64	3.23
Cyrtandra dentata	157-257	150-250	4	3	97	M	--	--	--	2M	--	3	1.50	--	--	--	m	--	--	--	1	0.50	--	R	R	R	--	--	R	3	1.00	3.00
Delissea subcordata	<80	40	18	2	50	m/R	--	--	--	2m	--	4	0.92	--	--	m	m	--	--	--	2	1.00	--	--	R	R	--	R	R	3	1.00	2.92
Dubautia herbstobatae	1025	1023	4	3	100	--	M	--	--	--	m(K)	2	0.75	2m	--	--	--	--	--	--	2	1.00	R	--	R	--	R	--	R	4	1.32	3.07
Flueggea neowawraea	112-158	10	30+	3	<10	m	--	--	m	m	--	3	0.75	--	m	m	m	m	m	--	5	2.50	--	--	--	--	--	--	--	0	0.00	3.25
Hedyotis degeneri var. *degeneri*	21	12	5	1	70	R	--	--	--	m	--	2	0.42	m	--	--	--	3m	--	--	4	2.00	--	--	R	--	R	--	--	2	0.66	3.08
Hedyotis parvula	220-235	150	4	2	65	--	2M	--	--	--	--	2	1.00	--	--	--	m	--	M	--	2	1.50	--	--	--	R	R	R	--	2	0.66	3.16
Hesperomannia arbuscula	50	13	5	1	25	R	--	--	--	m/R	--	3	0.59	m	m	--	m	--	--	--	3	1.50	--	--	R	R	--	R	--	3	1.00	3.09
Lipochaeta tenuifolia	2000	375-590	3	1	60	m	M	M	--	--	--	3	1.25	M	m	M	--	--	--	--	2	2.00	--	--	--	--	--	--	--	0	0.00	3.25
Neraudia angulata var. *angulata*	80	50+	5	2	60	--	--	R	m	--	--	2	0.42	m	--	--	2m	--	--	--	3	1.50	--	R	R	R	--	--	--	3	1.00	2.92
Neraudia angualta var. *dentata*	<40	6	8	3	15	--	--	R	R	R	--	3	0.51	m	m	--	--	--	3m	--	5	2.50	--	R	--	R	--	--	--	0	0.00	3.01
Nototrichium humile	1500	1320	7	3	90	M	--	M	M	--	--	3	1.50	M	--	--	--	--	m	--	2	1.50	--	--	--	--	--	--	--	0	0.00	3.00
Phyllostegia kaalaensis	<50	10+	6	1	20	R	--	--	--	m	--	2	0.42	m	--	m	3m	--	--	--	5	2.50	--	--	--	--	--	--	--	0	0.00	2.92
Plantago princeps var. *princeps*	175-242	17-30	6	2	20	--	--	--	m	m	M (S)	3	1.00	--	--	--	2m	--	M	--	3	2.00	--	--	--	R	R	--	--	0	0.00	3.00
Pritchardia kaalae	140	60+	5	1	43	--	M	--	--	--	--	1	0.50	m	--	2m	--	M	--	--	4	2.50	--	--	--	--	--	--	--	0	0.00	3.00
Sanicula mariversa	77	75	3	2	97	--	m	--	--	R	--	2	0.42	2m**	--	--	--	--	--	--	2	1.00	R	R	--	R	R	--	2R	6	1.66	3.08
Schiedea kaalae	<20	3	8	1	15	--	--	--	--	m	--	1	0.25	--	--	--	3m	--	--	m	4	2.00	--	--	--	--	--	--	2R	2	0.66	2.91

Table 4 (continued): Additional Species-Specific Mitigation for Plants Likely to be Jeopardized by Military Training

						IN ACTION AREA								OUTSIDE ACTION AREA								REINTRODUCTION								
Species	# Individuals State-wide	# Individuals in Makua Action Area	# Populations/Occurrences State-wide	# Populations/Occurrences in Makua Action Area	% Individuals in Makua Action Area	Kahanahaiki	Ohikilolo	Kaluakauila	Lower Makua	Pahole NAR	Other*	# Populations to be Managed	# Population Credits	Waianae Kai	Makaha	Lower Kaala	Honouliuli	Makaleha	Lualualei	Maakua	# Populations to be Managed	# Population Credits	Waianae Kai	Makaha	Lower Kaala	Honouliuli	Makaleha	Lualualei Nanakuli	Find More Sites	# Populations to be Managed	# Population Credits	Total Population Credits Received
Schiedea nuttallii	55-105	28	5	1	30-50	m	--	--	--	m	--	2	0.50	--	--	--	m	--	--	--	1	0.50	R	R	--	R	R	--	2R	6	2.00	3.00
Tetramolopium filiforme	1550	1539	5	3	100	m	M	--	M	--	--	3	1.25	m	--	--	--	--	m	--	2	1.00	--	--	--	--	--	--	2R	2	0.66	2.91
Viola chamissoniana var. *chamissoniana*	255-315	220-285	6	1	85	--	m	--	--	--	2m (S)	3	0.75	m	--	--	--	--	2m	--	3	1.50	--	R	--	R	R	--	--	3	0.66	2.91

M = manage existing stable population

m = manage and possibly augment existing unstable population

R = reintroduce population within historic range

-- no mitigation is recommended at this site

*Other management units/areas within Makua action area:

C - C-Ridge

K - Keaau

S - Schofield Military Reservation

**One population/occurrence is within Waianae Kai forest reserve and the other is on state land on Makua-Keaau Ridge