

FINAL

IMPLEMENTATION PLAN

MAKUA MILITARY RESERVATION ISLAND OF OAHU

SECTION 1: BACKGROUND AND METHODOLOGY

May 2003

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(Contract No. DACA83-96-D-0007, Delivery Order No. 0055)

Executive Summary

2 This document was prepared to guide conservation efforts that will result in the stabilization of
4 27 endangered plant taxa and an endangered species of Hawaiian tree snail that could be affected
6 by military training activities at Makua Military Reservation (MMR) in Hawaii. In 1998, the
8 U.S. Army (Army) initiated formal consultation under section 7 of the Endangered Species Act
10 (16 U.S.C. 1531 et seq.) with the U.S. Fish and Wildlife Service (USFWS) to determine if
12 routine military training at MMR would jeopardize the continued existence of 41 endangered
14 species. The Army is responsible for maintaining stability of each of these taxa, applying
16 additional management specified in this plan, to those taxa below stability. The consultation
18 used an action area (AA) (area potentially affected by military training) that extended beyond the
20 boundaries of MMR and was based on vegetation types, fire history, natural and human-made
22 barriers, and a consensus of where fire could be stopped by State, Federal, and Army fire-
24 fighting resources. Taxa for which either a significant portion of the populations occur within
26 the AA or for which no populations are stable, hereafter referred to as target taxa, were addressed
28 in the Army's proposed action of military training and conservation measures in such a way as to
30 avoid jeopardy.

32 In 1999, the USFWS issued a biological opinion (BO) concluding that the routine military
34 training and the conservation measures identified by the Army in its Biological Assessment (BA)
36 would not jeopardize the endangered species found within the AA. The conclusion of no
38 jeopardy was based on certain restrictions to military training, preparation and implementation of
40 a wildland fire management plan, implementation of management actions identified in the BA
42 for the 13 endangered species at stability and minimally impacted by Army training, and
44 preparation and implementation of a plan (Implementation Plan) for the additional 27 plant target
taxa and one snail target taxon. The Implementation Plan (IP) would identify additional
management actions beyond those the Army was already implementing or agreed to implement
in the BA to stabilize the 28 target taxa. During the preparation of the IP, the Army decided on
additional restrictions to routine military training, four additional taxa were found within the AA,
additional populations outside the AA were found for one taxon, and the Federal status of
another taxon changed. The Army reinitiated consultation and the USFWS provided a
supplement to the BO which determined that the additional four taxa will not be jeopardized by
Army training, resulting in a final number of 28 target taxa. When stabilization of all of the
target taxa is achieved, restrictions to routine military training may possibly be eliminated,
following reinitiation of consultation with the USFWS. In addition, there are other conditions
such as fires outside of the firebreak road, discovery of additional taxa, change in status of taxa,
etc., which would trigger reinitiating consultation under section 7 of the Endangered Species Act.

To stabilize the target taxa, each taxon must be maintained with sufficient numbers of
populations to ensure their long-term viability. Additionally, threats to the managed and
reproducing individuals in each population must be controlled, and each taxon must be
adequately represented in an *ex situ* (out of the wild) collection. Stabilization is only the first
step toward eventual recovery of these endangered species. Recovery of these taxa is beyond the
Army's responsibilities under the section 7 consultation process. Because the implementation of
this kind of taxon stabilization effort has never before been attempted in Hawaii, the Army

46 created an Implementation Team (IT) to assist the Army and its contractors in preparing the IP.
47 The IT is comprised of biologists representing the Army, USFWS, State of Hawaii, Honolulu
48 Board of Water Supply, The Nature Conservancy of Hawaii, Campbell Estate and endangered
taxon or ecosystem experts (see Chapter 3: Implementation Team).

50
51 The Makua IP provides taxon background summaries describing the biology and current status
52 of the target taxa, methodology and a conceptual framework for the required stabilization, the
specific actions required to stabilize each taxon and the habitat they depend upon, and
54 monitoring protocols to evaluate success of the management actions. The stabilization plan for
each target taxon outlines specific actions, including threat abatement and reintroductions into
56 appropriate, protected habitat. Threat abatement actions include control of feral ungulates,
selected weeds, predators such as small mammals, insect pests, and diseases. In addition to
58 taxon level management of target taxa *in situ* (in the wild), habitat level management, requiring a
broader geographic scope and control of threats affecting ecosystem processes, is also included
60 to support the development of stable populations of target taxa. Because of the widespread
distribution of the target taxa and the need for maintaining ecosystem processes, 31 management
62 units (MUs) are proposed in the Waianae and Koolau Mountains of Oahu and at sites on the
island of Kauai, where the most important wild populations of the target taxa occur. These areas
64 encompass the important habitat for *in situ* management and reintroduction efforts that will lead
to the stabilization of the target taxa. The proposed MUs occur on Army, Navy, State of Hawaii,
66 Honolulu Board of Water Supply, and private lands, and will require cooperation and
memoranda of agreement with the landowners prior to initiation of management actions at these
68 sites. This IP includes taxon actions and MU actions, as well as a timetable and budget for
implementation.

70
71 The anticipated outcome of the IP is the implementation of management actions in populations
72 and MUs to achieve stabilization of populations for each target taxon across its range. To assess
the success of the stabilization actions, the monitoring program in this IP will allow for an
74 assessment of both taxon and habitat status over time relative to achieving the IP goals. The IT
will conduct an annual assessment of the results of the management actions through a review of
76 the monitoring data to determine the Army's progress toward achieving stabilization of the target
taxa within a reasonable time frame. The assessment will also allow for modification of the IP
78 strategies as needed using an adaptive management approach.

80 The timeline for this IP is projected over 33 years, during which time all of the management
actions identified in the IP will be initiated, and in the process of implementation. There are
82 three phases of implementation, each approximately 10 years in duration, which result in
increasing levels of taxon and MU management over time. These phases are sequenced based on
84 specific criteria of rarity and risk described in this document. All populations and MUs will be at
full stabilization management by the third phase. The implementation of the IP is expected to
86 cost an average of approximately \$8,066,000 per year, for an estimated total of \$269,551,000
over 33 years. This figure is subject to change depending on timing of implementation of actions.
88 The complete implementation of the IP is estimated to require similar amounts of funding over at
least the next 33 years, and then lower funding for maintaining stable populations of the target
90 taxa for the duration of Army training in MMR.

92 The IP is subject to the availability of funds and nothing in this plan should be interpreted to
94 violate the Anti-deficiency Act. The Army intends to fund the program through its operating
96 funds each year. The IP requires the Army to continue as an active member of regional
98 conservation efforts in support of stabilization of the target taxa and the habitats they depend on.
100 By taking an active role to determine the best available practices and the highest priority threat
management needs, the Army's conservation efforts will be in the forefront of species
conservation in Hawaii. Successful implementation of the IP assures that the Army will be in
compliance with Endangered Species Act and still accomplish its training mission.

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1.0 Plan Overview

Organization of this plan

This Implementation Plan (IP) is arranged in four sections that reflect different aspects of the IP process:

Section 1: Background and Methodology

The first section provides a general overview and introduction to the target taxa and the proposed actions that are considered necessary to meet the objectives of the IP. It includes an executive summary, a discussion of the methods and approaches used by the Implementation Team (IT) to develop the recommended actions at taxon and habitat levels, and a summary of the background biological information for all of the target taxa. This document is meant to provide a compact summary of the approach and conclusions of the IT, and the goals and strategies of the IP.

Major highlights:

Executive Summary	Threats Assessment
Project History and Scope	Strategy for Stabilization
The Target Taxa	Management Units
The Implementation Team	Adaptive Management
The Action Area	Measures of Success
The Credit System	Conclusions
Population Units	Taxon Summaries

Section 2: Actions Section

This section is the most detailed section, and provides the major protocols for management of the target taxa, including the stabilization plans for each of the target taxa, a discussion of the management actions needed within management units (MUs); MU summary tables and monitoring protocols. It is designed to provide the implementers of the IP with the actions and timeframe for efforts over the short, intermediate, and long-term.

Major highlights:

Approach to *Achatinella mustelina* Stabilization
Achatinella mustelina Stabilization Plan
 Approach to Plant Stabilization
 Plant Stabilization Plans
 Management Unit Summaries
 Monitoring Protocols

Section 3: Appendices

The third section of the IP contains numerous supporting documents in a series of appendices that are referred to specifically in the first and second sections of the IP. This includes biological database reports, literature reviews, and guidelines for management actions such as propagule storage and collection.

Major highlights:

- 48 Hawaiian Spelling of Place Names
- Lyon Arboretum Seed Storage Summary
- 50 Phytosanitation Standards and Protocols
- HRPRG Propagule Collection Guidelines
- 52 Captive Propagation Protocols for *Achatinella mustelina*
- Priority Weeds for Selected Makua Management Units

54

Section 4: Cost and Staffing Estimates

56 The fourth section of the IP has been prepared primarily for the Army, and includes an overview
58 of estimated costs, a timeline for implementation of actions, and staffing requirements for the
implementation of the IP over the 33-year period.

60

Major highlights:

- 62 Cost Estimates Assumptions
- Implementation Timeline and Sequencing
- 64 Implementation Actions – Detailed Cost Estimates and Time Schedule
- Summary of Costs and Army Environmental Staff

66

Note on the use of Hawaiian diacritical marks in this plan

68 The Hawaiian language is heavily used in place names and common names of target taxa.
70 Hawaiian spelling makes use of special diacritical marks, including the glottal stop (‘) and
macron (a line over a vowel, signifying a long vowel) that are considered important in correct
72 spelling of Hawaiian words. While the importance of correct use of Hawaiian diacritical marks
is recognized, the complex interface between databases, spreadsheets and word processing
74 platforms within this document forced the simplification of spelling of Hawaiian words,
dropping the use of glottal stops and macrons. A list of the proper spelling of the major
76 Hawaiian place names used in this plan is provided in Section 3, Appendix 1.1: Spelling of
Hawaiian Place Names.

2.0 Introduction

Pertinent background and project scope

This document was prepared to guide conservation efforts that will result in the stabilization of 28 endangered plant taxa and an endangered species of Hawaiian tree snail that could be affected by military training activities at Makua Military Reservation (MMR) in Hawaii. In 1998, the U.S. Army (Army) initiated formal consultation under section 7 of the Endangered Species Act (16 U.S.C. 1531 et seq.) with the U.S. Fish and Wildlife Service (USFWS) to determine if routine military training at MMR would jeopardize the continued existence of 41 endangered species. The Army is responsible for maintaining stability of each of these taxa, and applying additional management specified in this plan to those taxa below stability. The consultation used an action area (AA) (area potentially affected by military training), that extended beyond the boundaries of MMR and was based on vegetation types, fire history, natural and human-made barriers, and a consensus of where fire could be stopped by State, Federal, and Army fire-fighting resources. Taxa for which either a significant portion of the populations occur within the AA or for which no populations are stable, hereafter referred to as target taxa, were addressed in the Army's proposed action of military training and conservation measures in such a way as to avoid jeopardy.

In 1999, the USFWS issued a Biological Opinion (BO) (USFWS 1999) concluding that the routine military training and the conservation measures identified by the Army in its Biological Assessment (BA) would not jeopardize the endangered species found within the AA. The conclusion of no jeopardy was based on certain restrictions to military training, preparation and implementation of a wildland fire management plan, implementation of management actions identified in the BA for the 13 endangered species at stability and minimally impacted by Army training, and preparation and implementation of a plan (Implementation Plan) for the additional 27 plant target taxa and one snail target taxon. The Implementation Plan (IP) would identify additional management actions beyond those the Army was already implementing or agreed to implement in the BA to stabilize the 28 target taxa. During the preparation of the IP, the Army decided on additional restrictions to routine military training, four additional taxa were found within the AA, additional populations outside the AA were found for one taxon, and the Federal status of another taxon changed. The Army reinitiated consultation and the USFWS provided a supplement to the BO (USFWS 2001) which determined that the additional four taxa will not be jeopardized by Army training, resulting in a final number of 28 target taxa. When stabilization of all of the target taxa is achieved, restrictions to routine military training may possibly be eliminated, following reinitiation of consultation with the USFWS.

To stabilize the target taxa each taxon must be maintained with sufficient numbers of populations to ensure their long-term viability. Additionally, threats to the managed and reproducing individuals in each population must be controlled, and each taxon must be adequately represented in *ex situ* (out of the wild) collections. Stabilization is only the first step toward eventual recovery of these endangered species. Recovery of these taxa is beyond the Army's responsibilities under the section 7 consultation. Because the implementation of this kind of taxon stabilization effort had never before been attempted in Hawaii, the Army created an Implementation Team (IT) to assist the Army and its contractors in preparing the IP. The IT is comprised of biologists representing the Army, USFWS, State of Hawaii, Honolulu Board of

48 Water Supply, The Nature Conservancy of Hawaii, Campbell Estate, and endangered taxon or
ecosystem experts (see Chapter 3: Implementation Team).

50 The Makua IP provides the basis for meeting the taxon stabilization requirements of the section 7
consultation. Successful implementation of the IP assures that the Army will be in compliance
52 with the Endangered Species Act and will still be able to accomplish its training mission. These
requirements are as follows:

- 54
- Identify priority taxa and areas within MMR and in off-site stabilization areas.
 - 56 • Determine an estimate of the minimum viable population for each taxon considered likely
to be jeopardized by Army activities.
 - 58 • Determine intermediate and final definitions of success for stabilization of each taxon.
 - Develop protocols to achieve the highest possible genetic representation that can be
60 collected for each of the target taxa.
 - Develop reintroduction and augmentation protocols which include the determination of
62 adequate number of individuals to reintroduce or augment to reach success, number of
populations, size or life stage distribution of the population, how to achieve the highest
64 number of individuals possible within a population, contamination issues, timing of
reintroduction and augmentation, and site selection.
 - 66 • Determine habitat management requirements (quality and quantity) for each taxon.
 - Identify priority incipient weeds and the areas to be surveyed within MMR and on off-
68 site stabilization areas.
 - Develop a method to monitor, integrate and evaluate data, and report results.
 - 70 • Develop a schedule for completion of implementation actions and a cost estimate for
implementation of each identified action.
 - 72 • Develop a scope of work for each of the implementation actions.

74 **Triggers for reinitiation of consultation**

The Army is required to reinitiate formal consultation with the USFWS if:

- 76
- The amount of incidental take is exceeded.
 - For the Makua consultation, take was set as loss of up to one tree or bush that is
78 known to harbor, or have harbored in the last 15 years, Oahu tree snails
(*Achatinella mustelina*), no more than one active Oahu elepaio (*Chasiempis*
80 *sandwichensis ibidis*) nest, or the abandonment of one active elepaio nest
(USFWS 1999);
 - New information reveals effects of the agency action that may affect listed taxa or critical
82 habitat in a manner or to an extent not considered in any previous biological opinions.
 - Previous biological opinions include the 1999 biological opinion and the
84 supplemental biological opinion in 2001. USFWS and the Army agree that if a
86 taxon within the AA currently not included in this plan decreases to such a level
that the Army's actions may potentially jeopardize the taxon (*i.e.*, the entire taxon
88 falls below stability levels throughout its range), the Army is required to reinitiate
consultation to include that taxon. Each year, the USFWS and the Army should
90 review the current status of non-target AA taxa throughout their range as part of
the IT review process. If either agency becomes aware of a change in the status

- 92 of the taxon (in or out of the AA), the agency will inform the IT and the other
agency.
- 94 ○ If a non-target AA taxon changes in status to below stability, the Army may
become responsible for its stabilization. The USFWS is responsible for tracking
96 the status of such taxon outside of the AA. If taxon already included in the IP
reach stability either through management actions or the location of additional
98 populations, the Army would not need to reinitiate consultation, since this is the
goal of the IP and measures are included in the IP to potentially reduce
100 management actions and monitor such a taxon to ensure it maintains stability.
- The agency action is subsequently modified in a manner that causes an effect to the listed
102 taxon or critical habitat not considered in the biological opinion.
 - Such modifications may include the use of new types of ammunition or new
104 training maneuvers that may have a high risk for causing fire, or
 - A new taxon is listed or critical habitat is designated that may be affected by the action.
 - For example, critical habitat will be proposed soon for several taxa within the
106 Makua AA. The Army is required to reinitiate consultation once the critical
108 habitat is proposed to ensure that its actions do not adversely modify critical
habitat for those endangered taxa within the AA which are proposed for
110 designation. The funding and implementation of this IP may preclude the need to
designate critical habitat within any of the MUs.

112 Other particular instances that would require the Army to reinitiate consultation are referred to
114 throughout the IP. In addition, the BO and supplement (USFWS 1999 and 2001) require that the
Army reinitiate consultation if a fire occurs outside the fire break road as a result of military
116 activities.

118 **Biological approach**

120 This IP has been developed strictly from a biological perspective. Although primarily taxon-
based, an emphasis on habitat restoration and ecosystem processes is recognized, focusing on 1)
122 the intrinsic value of *in situ* biological webs in designated sensitive/special areas, 2) building on
habitat restoration and threat removal/control, 3) stabilizing habitat and allowing for natural
124 recovery, and 4) utilizing augmentation and reintroduction of a taxon as needed. The decisions
on the specific management actions and the locations of these actions are based primarily on the
known biological needs of the target taxa, and are not compromised by other factors such as land
126 ownership, political jurisdiction, or public opinion. By using such an approach, the action
priorities in the IP are fully justified on biological grounds.

128 Related to this biological approach is the recognition that intensive management efforts at taxon
130 and habitat levels can have negative effects on the target taxa, other sensitive taxa, and native
ecosystems if not properly implemented. In addition to proposing actions beneficial to the target
132 taxa, the avoidance of negative affects of proposed actions ("do no harm") is an important
guiding principle. Following this principle, the IP incorporates protocols designed to minimize
134 negative effects of human activities in native ecosystems such as inadvertent introduction of
alien weeds, introduction of pathogens, trampling of vegetation, opening of trails, increased fire
136 risk, and genetic contamination via inappropriate outplantings. These protocols protect not only
the target taxa, but also other sensitive rare and endangered taxon known to occupy the proposed

138 management areas. Careful testing of techniques before large-scale implementation and
140 monitoring for the consequences of management actions also reflect this principle.

The IP identifies two types of actions: required and recommended. **Required actions** must be
142 conducted as described in the IP in order to meet stabilization requirements, unless modified
144 through the adaptive management process and approved by the IT and the USFWS. Some of the
146 required actions have several options from which the Army can choose in completing the
148 actions. Required guidelines or protocols are found in ***bold italics*** throughout Section 1.
150 Conversely, the Army will not be required to conduct **recommended actions**. However, the IT
152 has recommended these actions because they will most likely provide information that will give
the Army less costly and more efficient methods to achieve taxon stabilization. For example, the
IT may recommend researching plant reintroduction methods. This will add an extra step at the
onset of implementation, but may result in refined methods that require collection of fewer seeds,
propagation of fewer plants, or result in less impact to the reintroduction site due to outplanting
and therefore will cost less to implement.

154 **The target taxa**

All of the target taxa are federally endangered species endemic to the Hawaiian Islands (see
156 Table 2.1). The majority of the target taxa are endemic to Oahu, with the heart of their
distribution in the Waianae Mountains. All but eight are currently restricted to the Waianae
158 Mountains, and one taxon, *Alsinidendron obovatum*, is now only found in the AA. Only taxa
currently known from the Makua AA have been included as target taxa. Taxa that have been
160 recorded historically in the AA, but are currently not known to persist there have not been
considered for inclusion among the target taxa. For endangered plant taxa with two or more
162 varieties or subspecies, only those found in the Makua AA have been designated target taxa. For
instance, varieties of *Plantago princeps* other than var. *princeps* (the variety found in the Makua
164 AA) are not being dealt with, even though the whole species was listed as an endangered species.

166

168 **Table 2.1 Target taxa of the Makua Implementation Plan**

Scientific name	Hawaiian name	Current Range*
<i>Alectryon macrococcus</i> var. <i>macrococcus</i>	<i>mahoe, alaalahua</i>	W, KA, MO, WMA
<i>Alsinidendron obovatum</i>	-	W
<i>Cenchrus agrimonioides</i> var. <i>agrimonioides</i>	-	W, WMA, EMA
<i>Chamaesyce herbstii</i> ³	<i>akoko</i>	W
<i>Chamaesyce celastroides</i> var. <i>kaenana</i> ¹	<i>akoko</i>	W
<i>Cyanea grimesiana</i> subsp. <i>obatae</i> ^{2, 3}	<i>haha</i>	W
<i>Cyanea longiflora</i> ³	<i>haha</i>	W
<i>Cyanea superba</i> subsp. <i>superba</i>	<i>haha</i>	W
<i>Cyrtandra dentata</i>	<i>haiwale, kanawao keokeo</i>	W, K
<i>Delissea subcordata</i>	<i>haha</i>	W
<i>Dubautia herbstobatae</i>	<i>kupaoa</i>	W
<i>Flueggea neowawraea</i>	<i>mehamehame</i>	W, KA, EMA, HA
<i>Hedyotis degeneri</i> var. <i>degeneri</i>	<i>manono</i>	W
<i>Hedyotis parvula</i>	<i>manono</i>	W
<i>Hesperomannia arbuscula</i> ³	-	W, WMA
<i>Hibiscus brackenridgei</i> subsp. <i>mokuleianus</i> ¹	<i>mao hau hele</i>	W
<i>Lipochaeta tenuifolia</i>	<i>nehe</i>	W
<i>Neraudia angulata</i>	<i>maaloa, maoloa</i>	W
<i>Nototrichium humile</i>	<i>kului</i>	W
<i>Phyllostegia kaalaensis</i> ³	<i>kapana</i>	W
<i>Plantago princeps</i> var. <i>princeps</i>	<i>ale</i>	W, K
<i>Pritchardia kaalae</i>	<i>loulu</i>	W
<i>Sanicula mariversa</i>	-	W
<i>Schiedea kaalae</i> ³	-	W, K
<i>Schiedea nuttallii</i>	-	W, MO
<i>Tetramolopium filiforme</i>	-	W
<i>Viola chamissoniana</i> subsp. <i>chamissoniana</i>	<i>pamakani</i>	W
<i>Achatinella mustelina</i>	<i>pupu kaniioe, kahuli</i>	W

*Current Range abbreviations: W = Waianae, K=Koolau, KA = Kauai, MO = Molokai, WMA = West Maui, EMA = East Maui, HA = Hawaii

1 Addition to the list of target taxa as a result of IT surveys in the AA during the preparation of this plan.

2 Biological opinion identified this taxon as *Cyanea grimesiana* subsp. *grimesiana*, but further investigation determined it was *Cyanea grimesiana* subsp. *obatae*.

3 Indicates that the species is found within the AA but outside of MMR.

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3.0 Implementation Team

Because the implementation of this kind of taxon stabilization effort had never before been attempted in Hawaii, the U.S. Army (Army) created an Implementation Team (IT) to assist the Army and its contractors in preparing this Implementation Plan (IP). The IT is comprised of biologists representing the Army, U.S. Fish and Wildlife Service (USFWS), State of Hawaii, Honolulu Board of Water Supply, The Nature Conservancy of Hawaii (TNCH), The Estate of James Campbell, and endangered taxon and ecosystem experts. The IT convened a series of meetings in which information gathered in the process of developing the IP and was presented, reviewed, and incorporated into the requirements of the IP as described in Chapter 2.0: Introduction.

Table 3.1 Members of the Makua Implementation Team

Name Affiliation IT Subcommittees	Organization
Joel Lau IT Botanical Expert Botanist Reintroduction Subcommittee Database Subcommittee	Hawaii Natural Heritage Program Center for Conservation Research and Training University of Hawaii at Manoa 3050 Maile Way, Gilmore 409 Honolulu, HI 96822
Trae Menard IT TNCH Representative and Campbell Estate liaison Natural Resources Manager Snail Subcommittee Sanitation Subcommittee Monitoring Subcommittee Joan Yoshioka* Pauline Sato IT Alternates *Former TNCH Representative	The Nature Conservancy of Hawaii Oahu Program P.O. Box 971665 Waipahu, HI 96797
James D. Jacobi, Ph.D. IT Ecological Expert Botanist Monitoring Subcommittee Reintroduction Subcommittee Database Subcommittee	U.S. Geological Survey Pacific Islands Ecosystems Research Center Kilauea Field Station P.O. Box 44 Hawaii National Park, HI 96718
Michael G. Hadfield, Ph.D. IT Malacological Expert Professor, Zoology Department Snail Subcommittee	University of Hawaii Kewalo Marine Laboratory Pacific Biomedical Research Center 41 Ahui Street Honolulu, HI 96813

16

Name Affiliation IT Subcommittees	Organization
Edward Guerrant, Ph.D. IT Reintroduction Expert Conservation Director Reintroduction Subcommittee Sanitation Subcommittee	The Berry Botanic Garden 11505 SW Summerville Avenue Portland, Oregon 97219-8309
H. Kapua Kawelo IT Army Representative Biologist Reintroduction Subcommittee Monitoring Subcommittee Snail subcommittee Joby Rohrer IT Alternate	Directorate of Public Works, Environmental Division Bldg 104, Wheeler Army Airfield U.S. Army Garrison, Hawaii (APVG-GWV) Schofield Barracks, HI 96857-5013
Christina Crooker IT USFWS Representative Biologist Reintroduction Subcommittee Timeline Subcommittee Marie M. Bruegmann Monitoring subcommittee James Kwon Stephen Miller IT Alternates	U.S. Fish and Wildlife Service Pacific Islands Fish and Wildlife Office 300 Ala Moana Blvd, Rm. 3108 PO Box 50088 Honolulu, HI 96850
Brent Liesemeyer IT State Representative Biologist Talbert Takahama IT Alternate Snail subcommittee	Oahu Division of Forestry and Wildlife State Department of Land and Natural Resources 2135 Makiki Heights Drive Honolulu, HI 96822 Mailing Address: 1151 Punchbowl Street, Room 325 Honolulu, HI 96813
Amy Tsuneyoshi IT BWS Representative Sanitation Subcommittee	Board of Water Supply 630 South Beretania Street Honolulu, HI 96843

4.0 Geographic Scope of the Implementation Plan

2

Introduction

4

The Makua action area (AA) includes all of Makua Military Reservation (MMR) (*e.g.*, Makua Valley, Koiahi Gulch, Kahanahaiki Valley, *etc.*), as well as adjacent lands, including portions of Kuaokala Forest Reserve, Pahole Natural Area Reserve, Keaau Valley, and Kaluakauila Valley, that are considered at risk of damage or destruction from military activities originating from within the MMR (see Map 4.1).

8

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The geographic scope of the Implementation Plan (IP) includes the entire AA plus the portions of the natural geographic ranges of the target taxa considered necessary to achieve stability of these taxa. While the natural geographic range of these taxa is largely confined to the Waianae Mountains of the island of Oahu for the majority of target taxa, a few taxa are also found in the Koolau Mountains of Oahu and on Kauai. Management actions are therefore not limited to the Waianae Mountains or Oahu but include the island of Kauai as necessary for achieving stability for the taxa. All sites for the IP actions are specifically described and mapped in the IP.

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18 The Waianae region

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The Waianae Mountains comprise one of the richest botanical regions in the Hawaiian Islands, including about 10% of the state's rarest plant taxa (HINHP 1996). The arrival of humans, and the resulting introduction of alien species, wildfire, agricultural development, and settlement, has resulted in a loss of native vegetation in the majority of the region, especially below 2,000 feet in elevation. Although there are significant exceptions, the majority of rare and endangered taxa lie within or just outside of the zone of native-dominated vegetation (see Maps 4.2, 4.3, and 4.4). These remaining areas of the most intact native habitat form the majority of the arena for actions proposed in this plan. The map clearly demonstrates the strong correlation between remaining native-dominated vegetation and the remaining current occurrences of the target taxa. These current occurrences provide the potential sites for proposed *in situ* management and reintroductions for achieving stability.

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Ownership and management patterns in the Waianae Mountains

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There are many landowners in the Waianae Mountains. These include the U.S. Government (primarily U.S. Army (Army) and U.S. Navy (Navy) lands), the State of Hawaii (including Hawaiian Homes Lands, State Forest Reserves and State Natural Area Reserves), Honolulu City and County (Board of Water Supply), and private landowners including The Estate of James Campbell, Dole Food Co., Inc., and a number of other trusts, companies, and individuals. The major patterns of ownership and management are depicted in Map 4.5. The map includes the names of the owners as well as those of the lessees (if any), and also indicates the specific jurisdiction of the parcels (*e.g.*, state, federal, private, city and county, *etc.*). The State's game management area and public hunting areas are also depicted.

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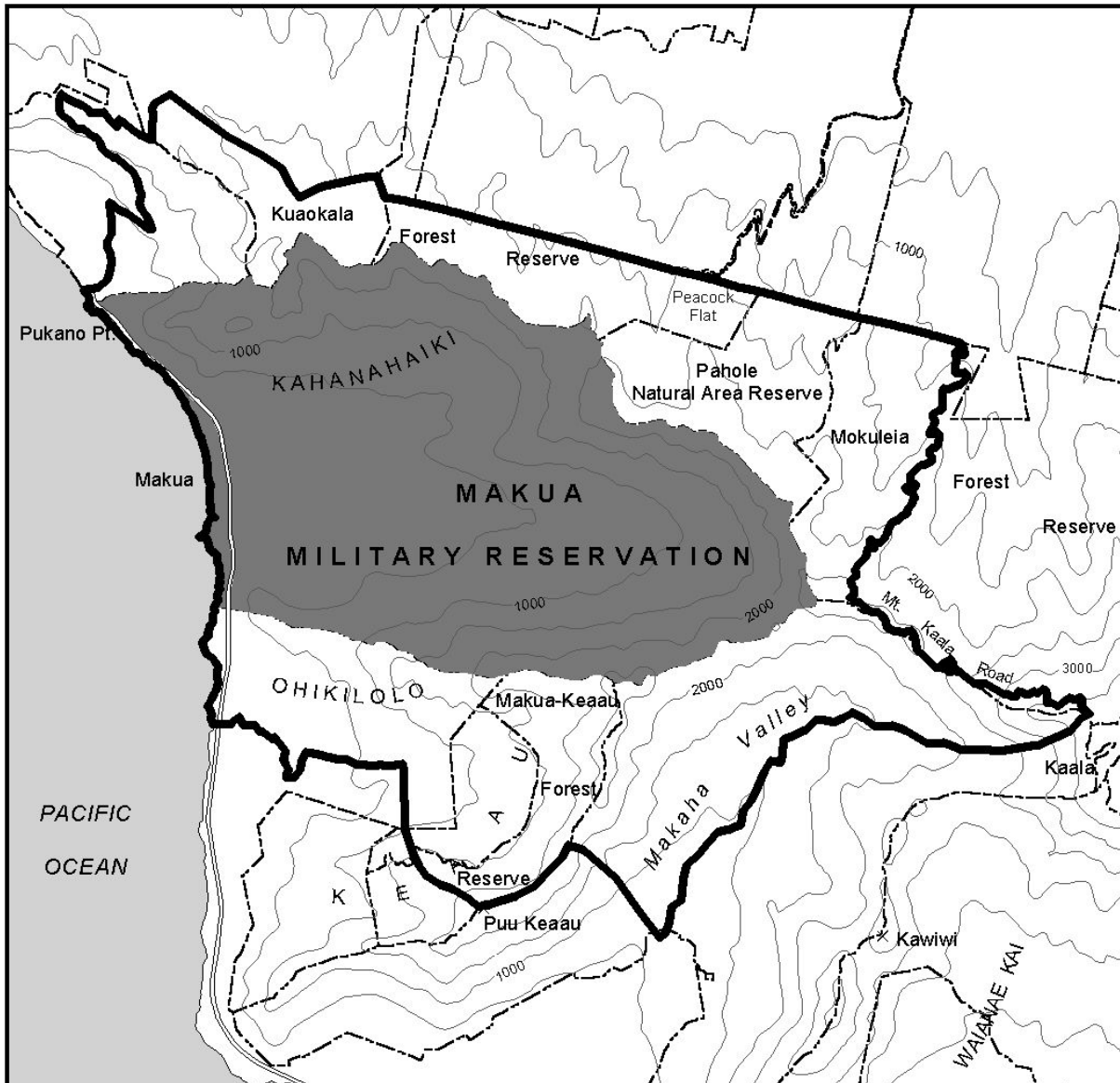
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A variety of native taxa and habitats exist in the Waianae region and management efforts are underway on many of these lands. For example, portions of the Waianae Mountains are designated as reserves of the State Natural Area Reserves System (NARS), where the land is managed primarily to protect and preserve native ecosystems and taxa. Pahole NAR, Mt. Kaala NAR, and Kaena Point NAR all have active programs of ungulate and weed management, native

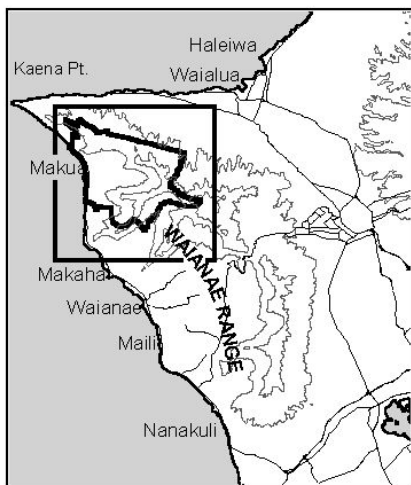
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48 vegetation restoration, native taxon reintroduction, and other protective management. State
Forest Reserves in the Waianae Mountains provide protective conservation zoning and programs
50 for public hunting. The Board of Water Supply lands in upper Makaha Valley are designated as
protected watershed with limited public access. A portion of the land holdings of the Estate of
52 James Campbell in the southern Waianae Mountains is managed by The Nature Conservancy of
Hawaii as the Honouliuli Preserve, and is dedicated to native taxon and ecosystem protection.
54 Active programs for rare plant and snail protection (including fencing, ungulate control, weed
control, and predator control) are underway, as well as some native vegetation restoration
56 projects. Portions of the Navy's holdings in Lualualei are managed by their environmental
program, which has mandates to protect endangered species on Naval facilities. The Army's
58 environmental program is engaged in a variety of active management programs in MMR and
Schofield Barracks Military Reservation, as well as in other selected areas of the Waianae
Mountains. These management programs include fencing for ungulate control, weed control,
60 snail predator control, rare plant reintroduction, and limited vegetation restoration. Through the
activities of these various landowners, significant taxon and habitat level management is already
62 underway, contributing to the protection of the Makua target taxa as well as other native taxa.



Map 4.1
Makua Action Area



-  Action Area Boundary
-  Makua Military Reservation
-  Ownership and/or Land Use Boundary
-  Major Road
-  Contour Interval Every 500 ft.



1 0 1 2 Miles

1 0 1 2 3 4 Kilometers

This map was designed to assist in planning and land management. Information contained in this map is generalized and should not be used for other than its specified purpose. For information contact the Environmental Division of the Directorate of Public Works, U.S. Army Garrison, Hawaii. Produced by the Hawaii Natural Heritage Program, 2003.

40 modifications discussed in Chapter 9.0: Strategy for Stabilization of Target Plant Taxa, and further clarified in Chapter 9.1: Setting Stabilization Targets.

42 Because biological populations are so difficult to define, the IT defined population units (PUs) as
44 manageable geographic units of a given plant taxon. The term PU does not presume that the
group of plants interacts genetically and ecologically, as would a true population, but more
accurately describes a grouping of plants that may or may not be a viable population. PUs are

46 defined according to geographic separation, the presence of other probable barriers to gene flow
48 (such as ridges and habitat discontinuities), and limited likelihood of susceptibility to any given
50 threat event. Based on the current literature on gene flow for plants, little gene flow occurs
52 between individuals separated by over 500 meters, particularly for those taxa in which pollen
54 from one individual must be transferred to another individual for fertilization to occur (Ellstrand
56 *et al.* 1989). To err on the side of caution, the IT doubled this distance, since we know so little
58 about the pollination mechanisms and gene flow of the target taxa. As a general guideline,
therefore, ***PU*s are comprised of one or more individuals separated by 1,000 meters from other
individuals of the same taxon, or less if other factors, such as barriers to dispersal or gene
flow, are also present.** Justifications describing the appropriate separating factors or potential
genetic affects on wild PUs are documented in each target taxon's stabilization plans (see
Section 2, Chapter 2: Stabilization Plans) for any PU that violates the 1,000 meter separation
guideline.

60 The IP evaluated nearly 1,000 current and historic occurrences of the target plant taxa
62 documented from the Waianae Mountains and elsewhere in the archipelago, using the Hawaii
64 Natural Heritage Program database, supplemented by information from recent field surveys. Of
66 these, the IP identified 387 PUs known to be extant in 1989 (ten years prior to the issuance of the
68 biological opinion). A 1989 cutoff date was chosen since it was believed that this represented
the most accurate assessment of management options for the target taxa. This differs from the
1970 cutoff date that was used to determine taxa to be considered in the U.S. Army's Biological
Assessment (U.S. Army 1999).

68 A PU is the fundamental geographic and demographic unit for the information contained in the
70 sections of the IP, including the plant taxon summaries, stabilization plans, and the management
72 unit summaries. As the U.S. Army implements components of the IP, which include genetic
74 studies and monitoring of management practices, and more is learned about the target taxa, the
information gathered may help refine our understanding of PUs for each taxon. Insights may be
76 gained on the effects of natural barriers (*e.g.*, major ridges) or discontinuities in habitat that
separate groups of individuals. The definition and application of the PU guidelines will be
78 reviewed as these data become available from the IP monitoring program. The IT recognizes
that local extirpations of PUs may occur. Guidelines for the management consequences for such
contingencies are discussed in Chapter 9.2: The Credit System for Plants.