2015 Status Report for the Makua and Oahu Implementation Plans

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*Cover photo *Sanicula mariversa* reintroduction, Ohikilolo Ridge, Waianae Mountains, Oahu.

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EXECUTIVE SUMMARY

The Oahu Army Natural Resources Program (OANRP) has 60 personnel on staff, comprised of support staff, an ecosystem restoration crew, an ungulate management crew, three resource management crews, and a nursery/seed bank crew. Most of these staff are employed via a Cooperative Agreement funded by the Army through the Pacific International Center for High Technology Research (PICHTR) and administered by the Research Corporation of the University of Hawaii-Pacific Cooperative Studies Unit (PCSU). Staff levels in Fiscal Year (FY) 2015 were higher than those in FY 2014. During this reporting period, OANRP hired one Ungulate Management Technician and two temporary employees to conduct fence maintenance and ungulate control projects. For FY 2015, OANRP received a total of $7,130,000 to implement Makua Implementation Plan projects and Tier 1 projects from the Oahu Implementation Plan. This included funding for new research initiatives, bat survey equipment, expanded rat control services, funding to partner with the U.S. Department of Agriculture on a pilot rat bait application project and fence materials to support a Waianae Mountains Watershed Partnership fencing initiative. In FY 2015, OANRP did not receive funding for OIP Tier 2 and Tier 3 projects as there was no training conducted that could impact the species at the Tier 2 and 3 levels, as specified in the 2003 Oahu Biological Opinion.

This status report (report) serves as the annual report for participating landowners, the U.S. Fish and Wildlife Service (USFWS), and the Implementation Team (IT) overseeing the Makua Implementation Plan (MIP) and Oahu Implementation Plan (OIP). The period covered in this report is October 1, 2014 to June 30, 2015 which is only a nine month reporting period. This reporting period shift was made so that this report will be submitted at the end of the current cooperative agreement that ends 30 Sept 2015. PCSU was awarded a new contract with two one-year options which commenced 1 July 2015. This report covers 9 months of Year 11 of the MIP and Year 8 of the OIP. Due to the abbreviated reporting period, this document will be somewhat abbreviated as compared to previous reports. Hawaiian diacriticals are not used in this document except in some appendices in order to simplify formatting. Please refer to Appendix ES-1, *Spelling of Hawaiian Names*.

OANRP completes thousands of actions each year to implement the MIP and OIP (IPs); the results of those myriad activities are summarized in this report. The report presents summary tables analyzing changes to population units of plants and snails over the last year and since the IPs were completed, as well as updates on new projects and technologies. More detailed information for all IP taxa is available via the program database supplied on CD (See Appendix ES-2 for a tutorial of how to use this database).

OANRP is reporting on the eleventh year of the MIP Addendum (Addendum completed in 2005, original finalized in 2003) and the eighth year of the OIP (finalized in 2008). The MIP Addendum emphasized management for stability of three Population Units (PUs) per plant taxon in the most intact habitat and 300 individuals of *Achatinella mustelina* in each Evolutionarily Significant Unit (ESU). The original Makua Biological Opinion (BO) in 2007 and amended BO in 2008, both issued by the USFWS, require that the Army provide threat control for all Oahu Elepaio (*Chasiempis ibidis*) pairs in the Makua Action Area, stabilize 28 plant taxa and *Achatinella mustelina*, and take significant precautions to control the threat and spread of fire as a result of the 2007 Waialua fire that destroyed individuals and habitat of *Hibiscus brackenridgei* subsp. *mokuleianus*. The OIP outlines stabilization measures for 23 additional plant taxa, the Oahu Elepaio, and six extant Koolau *Achatinella* species. Since the OIP was finalized, two additional species were added requiring stabilization, *Drosophila montgomeryi* and *Drosophila substenoptera*. Of the OIP plants, management activities are conducted with eleven taxa that are present in the Schofield Barracks West Range Action Area and in the Kahuku Training Area. In 2015, OANRP did not receive funding to support the remaining 12 OIP plant taxa and the six Koolau *Achatinella* species because of the lack of Army training impacts to these taxa in the Kawailoa Training Area.

The Army has contracted the Center for Environmental Management of Military lands based at Colorado State University to prepare an updated biological assessment for the Army to enter into formal consultation for Oahu training ranges (including Makua Military Reservation). This document will include an analysis of the potential impacts from Army training on the twenty plant taxa given federal status in August 2012. The decision was made recently to include Makua Military Reservation in this Biological Assesssment (BA), while in previous consultations, Oahu and Makua had been kept separate. This approach allows the Army to present a combined analysis of impacts to Oahu's endangered species. The draft BA is expected in December 2015 and a Biological Opinion from the USFWS is anticipated by the end of the 2016 calendar year. Management or stabilization requirements will be determined through the consultation process and outlined in the Biological Opinion to be issued upon completion of this process.

Of special interest are access restrictions experienced for Makua Military Reservation during this reporting period. An unexploded ordnance accident occurred within Makua in April 2015. During the investigation and while safety procedures are being reviewed, OANRP have not been able to access field sites within the valley. Naturally, on going projects for stabilization species are being negatively affected by this shut down. OANRP is working with Army Range Division and Safety to regain regular access before the 2015-5016 outplanting season. When access is regained, OANRP will need to spend extra time to catch up on protection measures. For example, OANRP have not cut/sprayed grass at the *Hibiscus brackenridgei* in Lower Ohikilolo since April and it is expected that multiple treatments will be required to reduce fuel to an acceptable level.

Infrastructure

The OANRP baseyard located on Schofield Barracks is complete. This baseyard includes three office buildings, one greenhouse, a seed storage facility, a workshop, an invasive species mitigation area, pesticide storage and gear storage areas. The outreach staff continue to maintain their office at the East Range baseyard because it is a convenient location to rendez-vous for volunteer trips.

Landowner/Agency Communications

OANRP continues to operate under a 20-year license agreement with Kamehameha Schools (KS) (expiring November 2030) and a license agreement with Hawaii Reserves, Inc. (expiring March 2017). The four-year license agreement with the Honolulu Board of Water Supply expired in November 2014; however; the Army and BWS real estate staff are actively working on a renewal. In addition, the Army is working to acquire a right of entry permit with Dole Food Company for *Hibiscus brackenridgei* subsp. *mokuleianus* surveys and monitoring. These parcels are being sold and this access will need to be negotiated with the new landowner. The Army also continues to work cooperatively under an MOU with the U.S. Navy for work in Lualualei Naval Magazine. Lastly, the Army is in the process of renewing an annual right of entry permit to protect Oahu Elepaio on Gill and Olson property at Palehua.

In July 2011, an MOU was signed between the Army and the State of Hawaii (State), Department of Land and Natural Resources (DLNR). Currently, the Army holds six State of Hawaii permits, including a Natural Area Reserves Special Use Permit, a Threatened and Endangered Plant Species Permit, an Invertebrate Permit, a Forest Reserve Access Permit, a Conservation District Use Permit, and a Protected Wildlife Permit. In the last year, the State and Army negotiated to extend the term for these permits from one year to three. The Army and the State are nearing finalization of a rental agreement for OANRP's use of the NIKE site mid-elevation greenhouse and associated facilities. A signed lease is expected before the end of this fiscal year.

OANRP continues to provide support for partner agencies including the Oahu Invasive Species Committee, Oahu Plant Extinction Prevention Program, Snail Extinction Prevention Program (SEPP) and

the Koolau and Waianae Mountains Watershed Partnerships. The Army is also an official member of the Koolau Mountains Watershed Partnership, the Waianae Mountains Watershed Partnership, the Coordinating Group on Alien Pest Species, the Hawaii Rare Plant Restoration Grouop, the Pacific Island Climate Change Cooperative and the Hawaii Conservation Alliance.

Management Unit (MU) Protection

During this reporting period, OANRP completed the northern section of the Helemano to Poamoho (1,700 m) MU fence. Also, OANRP contracted fence construction along the remaining perimeter of Makua Military Reservation along the northern rim. As of 30 June 2015, ~3,300 meters of this section from Kahanahaiki to Kaluakauila management units was complete. Construction on the final remaining ~1,000 m section of this perimeter fence began August 1st, after preparing a new risk assessment for the project. An unexploded ordnance accident in the valley temporarily halted access for all work in the valley. In addition, OANRP secured funding for and purchased fence materials for the Makaleha, Waianae Mountains Watershed Partnership fencing project. Construction of this fence is being funded by the State of Hawaii.

As reported last year, OANRP has transitioned ecosystem management focus to more intensive MU weed control and restoration. The OANRP fence construction program ended with the 2014 calendar year. In 2015, OANRP hired two ungulate management technicians to focus on fence monitoring and maintenance. For more details about OANRP ungulate control see Chapter 1.

In this 9-month reporting period, OANRP spent 4,654 hours controlling weeds across 325.9 ha. Incipient Control Area (ICA) efforts accounted for 254.6 ha of this total which his 75% of the total area over which weeds were controlled. Staff spent 1,537 hours on ICA management and conducted 333 visits to 148 ICAs. The ICA totals represent an increase from previous reporting periods even though this reporting period only covers 9 months. Some of this increase is due to aerial treatment of *Chromolaena odoratum* using helicopters. Weed Control Area (WCA) efforts covered 80.3 ha in 9 months which is an increase from last year's 90 ha in one year. This area increase is may be attributed to the new Ecosystem restoration crew's efforts in sweeping large sections of management units for single species targets such as *Grevillea robusta* and *Toona ciliata*. OANRP conducted control in WCAs for a total of 3,117 hours over 352 visits at 122 WCAs. See Chapter 1 for a comparison to last year's control figures. OANRP has completed a total of 21 Ecosystem Restoration Management Unit Plans (ERMUPs) for the highest priority and largest MUs. Due to the short reporting period, ERMUPs were not prepared to include in this report.

OANRP conducted road and landing zone surveys in order to detect and prevent the spread of any newly introduced invasive species. OANRP submitted 44 introduced plant samples to the Oahu Early Detection Program at Bishop Museum collected both during these surveys and during the course of regular work activities. Of these, one was a new state record, two were new naturalization records and one was a range extension. Highlights are covered in Chapter 1.

During this reporting period, the new central vehicle wash facility (CVWF) opened for use. This facility is staffed during regular business hours and will be staffed if units require access during off duty hours. The location of the CVWF is very convenient for use by units occupying Schofield Barracks West and South Ranges. Unfortunately, the Kahuku and East Range washracks were both out of commission for repairs on a few occasions during this reporting periods. More details about vehicle washracks is presented in Chapter 1.

Rodent Control Program

OANRP rat control operations continue to expand the use of the Goodnature® automatic traps to reduce labor expended rebaiting traps. Also, OANRP continue to test new baits in all traps to maximize the persistence and lengthen rebaiting intervals. In addition, the solicitation for rat control services includes expansion of rat control grids to include more traps per grid, to allow for year-round control and to add a new grid in Makaha. A contractor to conduct this work will be selected before the current contract ends in September. During this reporting period, OANRP also secured funding to partner with the U.S. Department of Agriculture, Wildlife Services to study the application of rodenticide to control rat population spikes. This trial will occur in the Kahanahaiki Mangement Unit and based on the results, OANRP will assess the potential application of this tool in other areas to control seasonal spikes. Lastly, included are summaries of two rat control technique research projects that were completed during the reporting period. For more details about the OANRP rodent control program see Chapter 6.

Vegetation Monitoring

During this reporting period, OANRP re-monitored priority MU level plant community health monitoring plots for the Kahanahaiki and Makaha MUs. This included installation of new plots in the Makaha Subunit II management unit. An analysis of both these data sets are included as Appendices 1-3 and 1-4, respectively, to this report. OANRP developed a new vegetation monitoring protocol, which utilizes pole-intercept methods, intended for smaller management units. This methodology will be applied at the Kamaili MU over the course of the next year. OANRP also analyzed *Clidemia hirta* weeding trial plots from the Opaeula Lower I MU and results are included as Appendix ES-3. This reporting period, OANRP continued to support a University of Hawaii research project which is comparing satellite imagery, aerial imagery and gigapan robotic technology (Gigapan) for collecting vegetation monitoring data (Appendix ES-4). OANRP continues to use Gigapan to monitor fountain grass and strawberry guava control efforts and has applied gigapan in partnership with the State of Hawaii to monitor *Angiopteris evecta*.

Fire

During this 9-month reporting period, no fires have occurred outside the Schofield Barracks firebreak road from training nor have any fires occurred at Makua Military Reservation. In May 2015, the Army conducted another successful prescribed burn at Schofield Barracks. The burn reduced fuel within the impact area as planned.

Rare Plant Conservation

The Executive Summary tables on the following pages for the MIP and OIP plant taxa include current status (with totals not including seedlings), last year's population numbers, and the number of plants in the original IPs for comparison for each population unit. Genetic storage and ungulate protection status is also summarized for each PU. The number of PUs that have reached numeric stabilization goals are included. Genetic storage of at least 50 seeds each from 50 individuals, or at least three clones each in propagation from 50 individuals, is required for each PU. If there are fewer than 50 founders for a PU, genetic storage is required from all available founders. For example, if there are at least 50 seeds from five individuals, or at least three clones in propagation from five individuals, then the "% Completed of Genetic Storage Requirement" listed in the tables is 10%. Genetic storage for reintroduced populations is not required because those populations originate from other populations with their own genetic storage requirement. PUs with population sizes of zero and a genetic storage requirement of "n/a (reintroduction)" denote reintroductions that are planned but have yet to be conducted. The number of seeds in genetic storage approximates the number of viable seeds initially received for stored collections.

Viability rates for most collections were estimated or calculated at the time of storage. For untested collections, seed viability was averaged from other collections within the same PU or taxon.

OANRP has expanded its slug control program every year since 2010 in protection of rare plants. We now protect 24 PU's from slugs. In 2014-2015, OANRP controlled slugs within eight Management Units (MUs) across an area equal to 4.26 acres, a 33% increase in area from the previous year (3.2 acres).

As of the end of this reporting period, 47 of 100 MIP PUs (47%) and 3 of 12 (42%) PUs for OIP Tier 1 plant species are at or above the stabilization goal for minimum number of mature plants. Due to the abbreviated reporting period, OANRP has not updated or prepared any new rare plant 5-year plans and instead presents a summary of rare plant management statistics and some critical updates for a select few priority taxa (Chapter 3). All data tables are included on the CDs distributed to IT members. During this reporting period, OANRP outplanted a grand total of 2,136 individuals of MIP and OIP taxa. Specifically, 1,491 individuals of seven Makua taxa, 462 individuals of three OIP taxa and 152 individuals of four taxa shared between both IPs were outplanted. In the last year, OANRP made 287 observations at in situ sites of IP taxa and 286 observations at outplanting sites.

Makua Implementation Plan - Executive Summary - Plants

# of Stable IP Population Units: 47 of 101

= Ungulate Threat to Taxon within Population Unit

No Shading = Absence of Ungulate threat to Taxon within Population Unit

Plant Taxon	Target # Matures	Population Unit Name	Total Current Mat.+Imm.	Total Current Mature	Total Current Immature	Total Current Seedling	# Plants In 2014	# Plant In Original Report	% Completed Genetic Storage Requirement	% of Plants Protected from Ungulates	PU Met Goal?	# PU Met Goal
Alectryon macrococcus var. macrococcus	50											
		Central Kaluaa to Central Waieli	8	3	5	0	9	53	0%	0%	No	
		Kahanahaiki to Keawapilau	2	1	1	0	5	8	0%	100%	No	
		Makaha	36	36	0	0	37	75	3%	100%	No	
		Makua	11	11	0	0	16	15	17%	100%	No	
		Alectryon macrococcus var. macrococcus Total:	57	51	6	0	67	151				0 of 4
Cenchrus agrimonioides var. agrimonioides	50											
		Central Ekahanui	257	168	89	0	257	20	76%	100%	Yes	
		Kahanahaiki and Pahole	380	319	61	79	465	276	22%	100%	Yes	
		Makaha and Waianae Kai	299	171	128	5	17	12	50%	97%	Yes	
		Cenchrus agrimonioides var. agrimonioides Total:	936	658	278	84	739	308				3 of 3
Cyanea grimesiana subsp. obatae	100											
		Kaluaa	150	128	22	1	164	0	100%	100%	Yes	
		North branch of South Ekahanui	149	83	66	0	165	5	100%	100%	No	
		Pahole to West Makaleha	111	75	36	0	116	46	58%	100%	No	
		Palikea (South Palawai)	144	108	36	1	147	63	65%	100%	Yes	
		Cyanea grimesiana subsp. obatae Total:	554	394	160	2	592	114				2 of 4
Cyanea longiflora	75											
		Kapuna to West Makaleha	272	28	244	2	141	66	48%	100%	No	
		Makaha and Waianae Kai	317	110	207	0	52	4	27%	100%	Yes	
		Pahole	162	58	104	21	131	114	100%	100%	No	
		Cyanea longiflora Total:	751	196	555	23	324	184				1 of 3
Cyanea superba subsp. superba	50											
		Kahanahaiki	257	58	199	113	304	152	100%	100%	Yes	
		Makaha	199	27	172	246	197	0	N/A	100%	No	
		Manuwai	142	0	142	0	173	0	N/A	100%	No	
		Pahole to Kapuna	166	95	71	4	200	170	N/A	100%	Yes	
		Cyanea superba subsp. superba Total:	764	180	584	363	874	322				2 of 4

Makua Implementation Plan - Executive Summary - Plants

# of Stable IP Population Units: 47 of 101

= Ungulate Threat to Taxon within Population Unit

No Shading = Absence of Ungulate threat to Taxon within Population Unit

Plant Taxon	Target # Matures	Population Unit Name	Total Current Mat.+Imm.	Total Current Mature	Total Current Immature	Total Current Seedling	# Plants In 2014	# Plant In Original Report	% Completed Genetic Storage Requirement	% of Plants Protected from Ungulates	PU Met Goal?	# PU Met Goal
Cyrtandra dentata	50											
		Kahanahaiki	113	37	76	94	123	97	48%	100%	No	
		Kawaiiki (Koolaus)	84	5	79	0	84	50	0%	0%	No	
		Opaeula (Koolaus)	130	23	107	0	125	26	2%	100%	No	
		Pahole to West Makaleha	1273	603	670	281	1273	300	100%	96%	Yes	
		Cyrtandra dentata Total:	1600	668	932	375	1605	473				1 of 4
Delissea waianaeensis	100											
		Ekahanui	219	196	23	0	195	58	86%	100%	Yes	
		Kahanahaiki to Keawapilau	259	240	19	0	280	34	72%	100%	Yes	
		Kaluaa	739	650	89	6	720	44	70%	100%	Yes	
		Manuwai	132	88	44	0	197	0	N/A	100%	No	
		Delissea waianaeensis Total:	1349	1174	175	6	1392	136				3 of 4
Dubautia herbstobatae	50											
		Makaha	29	28	1	0	29	0	48%	0%	No	
		Ohikilolo Makai	91	89	2	0	91	700	0%	100%	Yes	
		Ohikilolo Mauka	424	415	9	0	424	1300	0%	100%	Yes	
		Dubautia herbstobatae Total:	544	532	12	0	544	2000				2 of 3
Euphorbia celastroides var. kaenana	25											
		East of Alau	23	21	2	0	23	26	71%	0%	No	
		Kaena	1475	579	896	0	1475	300	100%	0%	Yes	
		Makua	85	85	0	0	127	40	100%	100%	Yes	
		Puaakanoa	166	150	16	2	181	157	56%	0%	Yes	
		Euphorbia celastroides var. kaenana Total:	1749	835	914	2	1806	523				3 of 4
Euphorbia herbstii	25											
		Kaluaa	0	0	0	0	0	0	N/A	100%	No	
		Kapuna to Pahole	108	56	52	0	92	170	28%	100%	Yes	
		Manuwai	0	0	0	0	0	0	N/A	100%	No	
		Euphorbia herbstii Total:	108	56	52	0	92	170				1 of 3

Makua Implementation Plan - Executive Summary - Plants

# of Stable IP Population Units: 47 of 101

= Ungulate Threat to Taxon within Population Unit

No Shading = Absence of Ungulate threat to Taxon within Population Unit

Plant Taxon	Target # Matures	Population Unit Name	Total Current Mat.+Imm.	Total Current Mature	Total Current Immature	Total Current Seedling	# Plants In 2014	# Plant In Original Report	% Completed Genetic Storage Requirement	% of Plants Protected from Ungulates	PU Met Goal?	# PU Met Goal
Flueggea neowawraea	50											
		Kahanahaiki to Kapuna	129	6	123	0	127	32	29%	100%	No	
		Makaha	65	10	55	0	61	4	45%	40%	No	
		Manuwai	35	0	35	0	29	0	N/A	100%	No	
		Ohikilolo	1	1	0	0	1	3	100%	100%	No	
		Flueggea neowawraea Total:	230	17	213	0	218	39				0 of 4
Gouania vitifolia	50											
		Keaau	55	55	0	0	55	0	62%	0%	Yes	
		Makaha (Future Introduction)	0	0	0	0	0	0	N/A	100%	No	
		Manuwai (Future Introduction)	0	0	0	0	0	0	N/A	100%	No	
		Gouania vitifolia Total:	55	55	0	0	55	0				1 of 3
Hesperomannia oahuensis	75											
		Haleauau	1	1	0	0	1	0	0%	100%	No	
		Makaha	46	3	43	0	27	13	0%	100%	No	
		Pahole NAR	42	4	38	0	50	8	N/A	100%	No	
		Pualii	73	6	67	0	65	0	N/A	100%	No	
		Hesperomannia oahuensis Total:	162	14	148	0	143	21				0 of 4
Hibiscus brackenridgei subsp. mokulelanus	50											
		Haili to Kawaiu	8	5	3	2	8	4	81%	0%	No	
		Keaau	16	0	16	0	27	0	27%	100%	No	
		Makua	88	80	8	0	99	7	69%	100%	Yes	
		Manuwai	170	160	10	0	198	0	N/A	100%	Yes	
		Hibiscus brackenridgei subsp. mokulelanus Total:	282	245	37	2	332	11				2 of 4
Kadua degeneri subsp. degeneri	50											
		Alaiheihe and Manuwai	148	78	70	2	158	60	65%	95%	Yes	
		Central Makaleha and West Branch of East Makaleha	36	23	13	8	36	47	60%	0%	No	
		Kahanahaiki to Pahole	278	147	131	23	278	161	100%	100%	Yes	
		Outplanting site to be determined	0	0	0	0	0	0	N/A		No	
		Kadua degeneri subsp. degeneri Total:	462	248	214	33	472	268				2 of 4

Makua Implementation Plan - Executive Summary - Plants

# of Stable IP Population Units: 47 of 101

= Ungulate Threat to Taxon within Population Unit

No Shading = Absence of Ungulate threat to Taxon within Population Unit

Plant Taxon	Target # Matures	Population Unit Name	Total Current Mat.+Imm.	Total Current Mature	Total Current Immature	Total Current Seedling	# Plants In 2014	# Plant In Original Report	% Completed Genetic Storage Requirement	% of Plants Protected from Ungulates	PU Met Goal?	# PU Met Goal
Kadua parvula	50											
		Halona	121	93	28	19	121	64	100%	0%	Yes	
		Ohikilolo	257	100	157	5	257	66	100%	100%	Yes	
		To be determined (Ekahanui?)	0	0	0	0	0	0	N/A		No	
		Kadua parvula Total:	378	193	185	24	378	130				2 of 3
Melanthera tenuifolia	50											
		Kamaileunu and Waianae Kai	1061	815	246	274	1061	880	0%	0%	Yes	
		Mt. Kaala NAR	125	121	4	0	70	250	0%	100%	Yes	
		Ohikilolo	1117	1109	8	0	1117	2009	12%	100%	Yes	
		Melanthera tenuifolia Total:	2303	2045	258	274	2248	3139				3 of 3
Neraudia angulata	100											
		Kaluakauila	134	65	69	0	134	0	N/A	100%	No	
		Makua	126	120	6	0	126	29	42%	100%	Yes	
		Manuwai	199	115	84	0	88	12	50%	100%	Yes	
		Waianae Kai Mauka	16	13	3	0	19	46	56%	100%	No	
		Neraudia angulata Total:	475	313	162	0	367	87				2 of 4
Nototrichium humile	25											
		Kaluakauila	208	160	48	0	159	200	2%	100%	Yes	
		Makua (south side)	53	50	3	0	53	138	0%	100%	Yes	
		Manuwai	115	115	0	0	119	0	N/A	100%	Yes	
		Waianae Kai	270	216	54	0	270	200	4%	88%	Yes	
		Nototrichium humile Total:	646	541	105	0	601	538				4 of 4
Phyllostegia kaalaensis	50											
		Keawapilau to Kapuna	0	0	0	0	0	0	100%	100%	No	
		Makaha	0	0	0	0	1	0	N/A	100%	No	
		Manuwai	0	0	0	0	5	0	N/A	100%	No	
		Pahole	0	0	0	0	0	10	100%	100%	No	
		Phyllostegia kaalaensis Total:	0	0	0	0	6	10				0 of 4
Plantago princeps var. princeps	50											
		Ekahanui	239	48	191	0	204	33	84%	100%	No	
		Halona	11	10	1	0	11	50	100%	0%	No	
		North Mohiakea	51	39	12	0	51	30	38%	100%	No	
		Ohikilolo	0	0	0	0	0	14	71%	100%	No	
		Plantago princeps var. princeps Total:	301	97	204	0	266	127				0 of 4

Makua Implementation Plan - Executive Summary - Plants

# of Stable IP Population Units: 47 of 101

= Ungulate Threat to Taxon within Population Unit

No Shading = Absence of Ungulate threat to Taxon within Population Unit

Plant Taxon	Target # Matures	Population Unit Name	Total Current Mat.+Imm.	Total Current Mature	Total Current Immature	Total Current Seedling	# Plants In 2014	# Plant In Original Report	% Completed Genetic Storage Requirement	% of Plants Protected from Ungulates	PU Met Goal?	# PU Met Goal
Pritchardia kaalae	25											
		Makaleha to Manuwai	135	122	13	0	136	141	2%	2%	Yes	
		Ohikilolo	1675	85	1590	0	1675	473	0%	100%	Yes	
		Ohikilolo East and West Makaleha	334	4	330	0	334	75	N/A	100%	No	
		Pritchardia kaalae Total:	2144	211	1933	0	2145	689				2 of 3
Sanicula mariversa	100											
		Kamaileunu	413	5	408	135	361	26	100%	100%	No	
		Keaau	43	0	43	0	43	141	60%	100%	No	
		Ohikilolo	216	0	216	200	30	162	36%	100%	No	
		Sanicula mariversa Total:	672	5	667	335	434	329				0 of 3
Schiedea kaalae	50											
		Kaluaa and Waieli	171	166	5	0	206	55	100%	100%	Yes	
		Maakua (Koolaus)	10	10	0	0	10	4	40%	0%	No	
		Pahole	228	83	145	47	132	3	100%	100%	Yes	
		South Ekahanui	428	160	268	12	428	85	74%	100%	Yes	
		Schiedea kaalae Total:	837	419	418	59	776	147				3 of 4
Schiedea nuttallii	50											
		Kahanahaiki to Pahole	220	108	112	58	226	65	95%	100%	Yes	
		Kapuna-Keawapilau Ridge	74	74	0	0	113	4	100%	100%	Yes	
		Makaha	111	68	43	0	57	0	N/A	100%	Yes	
		Schiedea nuttallii Total:	405	250	155	58	396	69				3 of 3
Schiedea obovata	100											
		Kahanahaiki to Pahole	1311	283	1028	210	1961	90	100%	100%	Yes	
		Keawapilau to West Makaleha	584	58	526	67	1419	36	100%	95%	No	
		Makaha	198	146	52	13	226	0	N/A	100%	Yes	
		Schiedea obovata Total:	2093	487	1606	290	3606	126				2 of 3
Tetramolopium filiforme	50											
		Kalena	117	24	93	0	117	0	6%	100%	No	
		Ohikilolo	3858	2394	1464	20	3858	2500	14%	100%	Yes	
		Puhawai	30	21	9	2	85	12	80%	0%	No	
		Waianae Kai	20	20	0	0	38	22	0%	0%	No	
		Tetramolopium filiforme Total:	4025	2459	1566	22	4098	2534				1 of 4

Oahu Implementation Plan - Executive Summary - Plants

# of Stable IP Population Units: 12 of 31

= Ungulate Threat to Taxon within Population Unit

No Shading = Absence of Ungulate threat to Taxon within Population Unit

Plant Taxon	Target # Matures	Population Unit Name	Total Current Mat.+Imm.	Total Current Mature	Total Current Immature	Total Current Seedling	# Plants In 2014	# Plant In Original Report	% Completed Genetic Storage Requirement	% of Plants Protected from Ungulates	PU Met Goal?	# PU Met Goal
Abutilon sandwicense	50											
		Ekahanui and Huliwai	164	46	118	5	146	44	18%	100%	No	
		Kaawa to Puulu	91	32	59	0	105	124	0%	59%	No	
		Kahanahaiki	78	72	6	0	29	0	100%	100%	Yes	
		Makaha Makai	225	92	133	0	120	100	100%	75%	Yes	
		Abutilon sandwicense Total:	558	242	316	5	400	268				2 of 4
Cyanea acuminata	50											
		Helemano-Punaluu Summit Ridge to North Kaukonahua	272	130	142	0	375	72	8%	0%	Yes	
		Kaluanui and Maakua	249	123	126	50	221	0	0%	0%	Yes	
		Makaleha to Mohiakea	216	151	65	0	228	118	2%	97%	Yes	
		Cyanea acuminata Total:	737	404	333	50	824	190				3 of 3
Cyanea koolauensis	50											
		Kaipapau, Koloa and Kawainui	119	106	13	0	125	76	0%	84%	Yes	
		Opaeula to Helemano	27	23	4	0	24	13	0%	48%	No	
		Poamoho	39	21	18	0	36	12	0%	0%	No	
		Cyanea koolauensis Total:	185	150	35	0	185	101				1 of 3
Eugenia koolauensis	50											
		Kaunala	59	20	39	27	62	141	18%	95%	No	
		Oio	7	5	2	0	12	74	24%	100%	No	
		Pahipahialua	28	22	6	141	28	291	35%	100%	No	
		Eugenia koolauensis Total:	94	47	47	168	102	506				0 of 3
Gardenia mannii	50											
		Haleauau	69	69	0	0	2	2	50%	100%	Yes	
		Helemano and Poamoho	17	17	0	0	8	18	12%	0%	No	
		Lower Peahinaia	10	9	1	0	10	46	10%	67%	No	
		Gardenia mannii Total:	96	95	1	0	20	66				1 of 3
Hesperomannia swezeyi	25											
		Kamananui to Kaluanui	246	134	112	45	246	99	0%	4%	Yes	
		Kaukonahua	109	55	54	2	128	127	0%	0%	Yes	
		Lower Opaeula	39	18	21	0	27	24	0%	0%	No	
		Hesperomannia swezeyi Total:	394	207	187	47	401	250				2 of 3

Oahu Implementation Plan - Executive Summary - Plants

# of Stable IP Population Units: 12 of 31

= Ungulate Threat to Taxon within Population Unit

No Shading = Absence of Ungulate threat to Taxon within Population Unit

Plant Taxon	Target # Matures	Population Unit Name	Total Current Mat.+Imm.	Total Current Mature	Total Current Immature	Total Current Seedling	# Plants In 2014	# Plant In Original Report	% Completed Genetic Storage Requirement	% of Plants Protected from Ungulates	PU Met Goal?	# PU Met Goal
Labordia cyrtandrae	50											
		East Makaleha to North Mohiakea	335	295	40	0	340	100	18%	88%	Yes	
		Koloa	81	33	48	0	123	0	N/A	100%	No	
		Labordia cyrtandrae Total:	416	328	88	0	463	100				1 of 2
Phyllostegia hirsuta	100											
		Haleauau to Mohiakea	147	71	76	0	132	18	67%	100%	No	
		Koloa	220	97	123	1	129	0	55%	98%	No	
		Puu Palikea	241	114	127	0	204	0	N/A	100%	Yes	
		Phyllostegia hirsuta Total:	608	282	326	1	465	18				1 of 3
Phyllostegia mollis	100											
		Ekahanui	12	11	1	0	76	35	100%	100%	No	
		Kaluaa	130	88	42	0	191	49	100%	100%	No	
		Pualii	11	11	0	0	33	0	100%	100%	No	
		Phyllostegia mollis Total:	153	110	43	0	300	84				0 of 3
Schiedea trinervis	50											
		Kalena to East Makaleha	647	296	351	377	622	376	100%	89%	Yes	
		Schiedea trinervis Total:	647	296	351	377	622	376				1 of 1
Stenogyne kanehoana	100											
		Haleauau	129	0	129	0	0	1	100%		No	
		Kaluaa	204	26	178	0	222	79	100%	100%	No	
		Makaha	130	0	130	0	156	0	N/A	100%	No	
		Stenogyne kanehoana Total:	463	26	437	0	378	80				0 of 3

Rare Snail Conservation

During this reporting period, OANRP continued to maintain the Kahanahaiki and Puu Hapapa predator exclosures and cooperate with SEPP to maintain the Puu Palikea exclosure. SEPP took over the management of the Poamoho predator exclosure in preparation for their Koolau *Achatinella* reintroductions. OANRP and partners continue to monitor population trends for *Achatinella mustelina* within the Kahanahaiki and Puu Hapapa predator exclosures using timed count monitoring. During this reporting period, OANRP's ecosystem restoration program planted *Achatinella* host plant taxa to increase vegetation cover within the Puu Hapapa predator exclosure, a total of 62 host plants for *Achatinella* were outplanted.

At the request of the U.S. Fish and Wildlife Service, OANRP prepared a Tree Snail Monitoring Overview to provide history and background and justification for the OANRP tree snail monitoring strategy. This overview is meant to build off of the monitoring plans presented in the 2014 *Achatinella mustelina* management plan from last year's annual report. The monitoring strategy has been reviewed and commented on by USFWS staff through the years and the current plan includes resulting changes. If the USFWS has suggestions or recommendations regarding this strategy, OANRP look forward to discussing these and amending the monitoring strategy as appropriate.

Table 4 below presents the status summary for the Waianae *A. mustelina* in the MIP. There is no OIP snail table as all Koolau snail taxa are Tier 2 or 3. The goal is to achieve 300 total snails across all age classes in each ESU. Populations of *A. mustelina* in the MIP have been genetically assigned to one of six ESUs. Up from last year, 6 of the 8 managed field populations have over 300 snails. The ESU-A snail numbers went up substantially likely due to more intensive surveying in order to translocate snails into the Kahanahaiki exclosure. This increase is a reflection of the cryptic nature of tree snails, there are regularly more in a population than can be counted during any one monitoring event.

Table 4. Makua Implementation Plan –Executive Summary – Snails

Achatinella mustelina Evolutionary Significant Unit (ESU)	Population	2014 Snails				# Snails in 2014	# Snails in 2003 MIP	# of Snails at University of Hawaii Lab	% of Snails in Population Protected from Ungulates	% of Snails in Population Protected from from Rats	Is Population at Goal?	Overall Populations at Goal for Species
		# Adult	# Sub-adult	# Juvenile	Total 2015							
ESU A	Kahanahaiki/ Pahole	171	110	55	336	179	105	3	100%	100%	Yes	*6 of 8*
ESU B	B1: Ohikilolo	266	132	61	459	457	300	0	100%	100%	Yes	
	B2: East Makaleha	235	61	8	304	307	40	11	0%	100%	Yes	
ESU C	Lower Kaala NAR/ Schofield Barracks West Range	235	128	29	392	392	50	9	100%	100%	Yes	
ESU D	D1: North Kaluaa to Schofield Barracks South Range	294	188	49	531	380	86	0	100%	100%	Yes	
	D2: Makaha	155	52	6	213	210	17	1	100%	100%	No	
ESU E	Ekahanui	140	43	9	192	171	12	11	100%	95%	No	
ESU F	Puu Palikea	264	121	73	458	430	40	0	93%	100%	Yes	
Totals					**2,885**	**2,526**	**650**	**36**				***6 of 8***

Rare Vertebrate Management

In 2015, OANRP controlled rats to protect 98 pairs of Oahu Elepaio (*Chasiempis ibidis*). The BO requires the protection of 75 pairs, therefore, OANRP met this requirement. The documented fledgings from managed pairs this year numbered 50 which is down from last year's number. Weather may be the cause of a less productive breeding season this year. This may be the result of numerous high wind events during the nesting season. The number of rats caught was higher at all managed Elepaio sites than in 2014. Based on data from other rodent control projects where tracking tunnels are employed, rat populations spiked in 2015 which may be one explanation for the increase in rats captured. At some sites, such as Schofield, OANRP asked our rat control contractor to reset traps twice during the one week/month of access. Therefore, the increases in rats caught at Schofield must be looked at using rats caught per trap night to determine what this increase can be attributed to. In addition, at Palehua, OANRP converted rat control from a territory based system to trapping in a grid design so the spike in captures here could be due to trap relocation and distributional change rather than rat population increases. OANRP installed automatic traps in Schofield for the 2015 breeding season to compensate for access limitations. OANRP will continue to adapt rodent control approaches in order to maximize protection. The total required access dates were met during the calendar year but were not distributed ideally for Elepaio management. For more information, see the Rare Vertebrate Management Chapter 4.

Over the past year, nene geese (*Branta sandvicensis*) were not observed once in July at Wheeler Army Airfield. The male nene bird died during the past year, therefore, only the family of three, mom and her two offspring were observed. OANRP will continue to track nene visitation to Wheeler. Construction site staff and Airfield operations staff provide timely observation data. For more information, see the Rare Vertebrate Management Chapter 4.

Acoustic monitoring for the Hawaiian hoary bat was expanded this year to include the majority of Army installations on Oahu. A total of 30 detection stations are being monitored for one year by U.S. Geological Survey staff and OANRP. In early September 2015, an official Garrison policy was signed that formalizes a tree cutting moratorium during the bat pupping season each year. This new policy is included as Appendix 4-2. During this reporting period (the month of June), prior to this policy being signed, OANRP was tasked to survey trees for roosting bats that required cutting, pruning or denutting because of safety issues. OANRP conducted five bat surveys to clear trees for removal or pruning, spent 18 of hours was spent by OANRP conducting these surveys. Forty-one trees were surveyed and zero roosting bats were found. OANRP expect that during the next pupping season, emergency tree removal and trimming requests will be drastically reduced. For more information, see the Rare Vertebrate Management Chapter 4.

Insect Mangement

During this reporting period, OANRP focused efforts on regular monitoring of known *Drosophila* populations designated in last year's report at 'manage for stability'. This monitoring allows OANRP to track fluctuations and attempt to determine abundance patterns. The number of *Drosophila* observed at baits differed dramatically by month and site, and results are summarized in Chapter 5. Additionally, 75 plants of various native species were planted into Palikea for habitat restoration of the *Drosophila* site. Also, 50 *Urera glabra* were planted at each of four selected *Drosophila montgomeryi* sites. Surveys of suitable hosts continue at training ranges to obtain a thorough picture of endangered *Drosophila* distribution at Army training ranges for use in the upcoming BA.

In anticipation of the likely listing of Hawaiian *Hylaeus* bee taxa as endangered within the next few years, OANRP supported its entomologist's involvement in a pilot reintroduction of *H. anthracinus*. Many of

the techniques involved in conducting this project may be applied to listed Oahu *Hylaeus* which may become the Army's responsibility to stabilize. Appendix ES-5 is a summary of the first large reintroduction effort with *Hylaeus* in Hawaii. Lastly, Appendix ES-6 is a discussion of *Megalagrion xanthomelas*, which was recently rediscovered on the grounds of Tripler Army Medical Center.

OANRP was also involved in a cooperative effort during this reporting period to locate a translocation site for *Megalagrion xanthomelas* from Tripler Army Medical Center (TAMC). It is anticipated that this taxon will be listed as an endangered species by Fall of 2016. The intent is to conduct a transloction before it is proposed endangered, Fall 2015, and bureaucratic procesess become more onerous. The State of Hawaii has taken the lead on researching species' biology, gathering information and pursuing permission for conducting another trial translocation. The Army is an active participant in these efforts. For a summary of these efforts see Chapter 5.

OANRP is a cooperator in control and detection efforts for coconut rhinoceros beetle (CRB) and the little fire ant (LFA) on Oahu. There are no known breeding population of CRB on Army controlled lands and the LFA has not been detected during OANRP surveillance of new plantings and Army plant holding facilities. The Army has established an official Garrison policy for preventing the LFA from establishing at Army controlled lands. This policy requires that landscaping plants be sourced from LFA free nurseries and that the responsibility for eradication of LFA, if introduced, is with contractors. The new policy is included as Appendix 7-1. This financial hook will hopefully prevent contractors from using contaminated nurseries as plant sources. For more information on these efforts review Chapter 7.

Research

During this reporting period, OANRP funded numerous research projects related to management of MIP and OIP taxa and in house research projects continue. The OANRP Research Specialist conducted a project in support of the upcoming Sluggo© special local needs permit renewal. This research involved quantifying the effect of slug control on the survivial of the endangered plants, *Delissea waianaensis* and *Cyanea superba* ssp. *superba*. Though not statistically significant, higher numbers of *D. waianaensis* seedlings and greater survival of *C. superba* ssp. *superba* were found in the slug control plots. The results of this project are presented in Chapter 7. In addition, the Research Specialist tested three herbicides on large patches of *Blechnum appendiculatum* to identify the most suitable control options. These research results are presented in Chapter 1.

For tree snail management, OANRP continued to fund the captive *Achatinella* propagation program at the University of Hawaii (UH) Tree Snail Laboratory (Lab). Results of this work are included in Appendix ES-7. Also included in Appendix ES-7 are results of reptile and amphibian predator studies conducted in Dr. Brendan Holland's laboratory. In addition, OANRP funded a molecular systematic assessment of *Achatinella mustelina* diet using snail feces and host plant leaves. A summary of research results obtained during this reporting period are included as Appendix ES-8A. Also included as Appendix ES-8B is a draft manuscript summarizing snail feeding preference studies and their relevance to *Achatinella* captive rearing. Lastly, related to tree snails, OANRP funded genetics work to elucidate climate associated adaptations and to relate this information to management of wild field populations. A summary of this work is presented in Appendix ES-9.

In support of the rare plant program, OANRP are also funding a population viability analysis for three IP rare plant taxa using demographic modeling. The project proposal for this work and a summary of work conducted during this reporting period are included as Appendix ES-10. OANRP also conducted a preliminary in-house trial to assess germination rates of seeds from senesced versus fresh *Cyanea superba* subsp. *superba* fruit. The results of this trial have interesting implications on the importance of fruit

dispersal for this taxon and are included as Appendix ES-11. In addition, OANRP funded the National Center for Genetic Resource Preservation to conduct research with dessication-sensitive seeds of IP taxa. Lastly, OANRP continue to conduct ground-breaking in-house research on pollination biology, fruit collection, seed viability, germination and storage.

Research funded by OANRP in support of the Ecosystem Management Program included the work of Dr. Paul Krushelnycky, who is studying the impacts of rodents on native arthropods. His research is conducted at two sites within the Waianae Mountains where OANRP maintains large-scale snap trap rat control grids. He published a paper based on the arthropod monitoring conducted in Kahanahaiki and Palikea it can be found at http://manoa.hawaii.edu/hpicesu/DPW/PEC-2015/2015.pdf. A report on this project can be found at Appendix ES-12. In addition, OANRP funded research to determine the importance of mycorrhizal fungi on the successful outplanting of native plants within management units. This research will be continued in the coming year in a trial of pot-bound plants ground in media containing various mixes of soil microbes. A summary of this year's research results are included as Appendix ES-13.

OANRP also funded research regarding the affect of an invasive ant *Solenopsis papuana* on native arthropods. This research will provide insight as to the significance of this particular ant taxon as a limiting factor for endangered *Drosophila*. An update on this project is include as Appendix ES-14.

TABLE OF CONTENTS

All appendices are included in electronic format on a CD enclosed with this document. Also, they can be found online through the PCSU website at http://manoa.hawaii.edu/hpicesu/dpw_mit.htm.

CHAPTER 1: ECOSYSTEM MANAGEMENT

Notable projects from the 2014-2015 reporting year are discussed in the Project Highlights section of this chapter. This reporting year covers nine months, from October 1, 2014 through June 30, 2015.

Threat control efforts are summarized for each Management Unit (MU) or non-MU land division. Ungulate control, outreach program, and weed control data is presented with minimal discussion. For full explanations of project prioritization and field techniques, please refer to the 2007 Status Report for the Makua and Oahu Implementation Plans (MIP and OIP; http://manoa.hawaii.edu/hpicesu/DPW/2007_YER/default.htm).

1.1 UNGULATE CONTROL PROGRAM

The Oahu Army Natural Resources Program (OANRP) has ended the fence construction phase of its management program and focusing more energy on ecosystem management; redirecting the focus from construction to managing the existing fence units. OANRP has transferred management of some Manage for Stability (MFS) populations in the MIP into these completed fences rather than building additional enclosures. Since Army training has not been shown to directly impact the Tier 2 or 3 species on Dillingham Military Reservation, Kahuku Training Area, Kawailoa Training Area or Schofield Barracks Military Reservation, the program is focusing its work on the OIP Tier 1 species that are impacted by training. This significantly reduces the number of fences required for management from the 2003 Oahu Biological Opinion. The fences not being built are listed in the table below.

Makua Implementation Plan MU fences	Oahu Implementation Plan MU fences
East Makaleha	Kawaiiki I/II
Kamaileunu/ Waianae Kai	Kawailoa
Alaiheihe and Kaimuhole	Poamoho Lower
	Poamoho Upper
	Opaeula Lower II
	South Kaukonahua II
	Kaipapau
	Manana
	North Kaukonahua
	Waiawa I
	Waiawa II
	Kahana
	Kaukonahua-Punaluu

As a result of the refocus of efforts, as of December 31, 2014, OANRP no longer staffs an in-house fencing crew. Rather, OANRP will focus on working within partnerships to contract fence construction projects together (i.e. Native Ecosystem Protection and Management (NEPM) Program Partnerships). These opportunistic partnerships will allow all parties to share the costs rather than one program absorbing all of it. OANRP has developed two ungulate management technician positions whose management focus will be fence monitoring/maintenance and ungulate control work. One position has been filled, but we are still looking for a qualified interested person to fill the second.

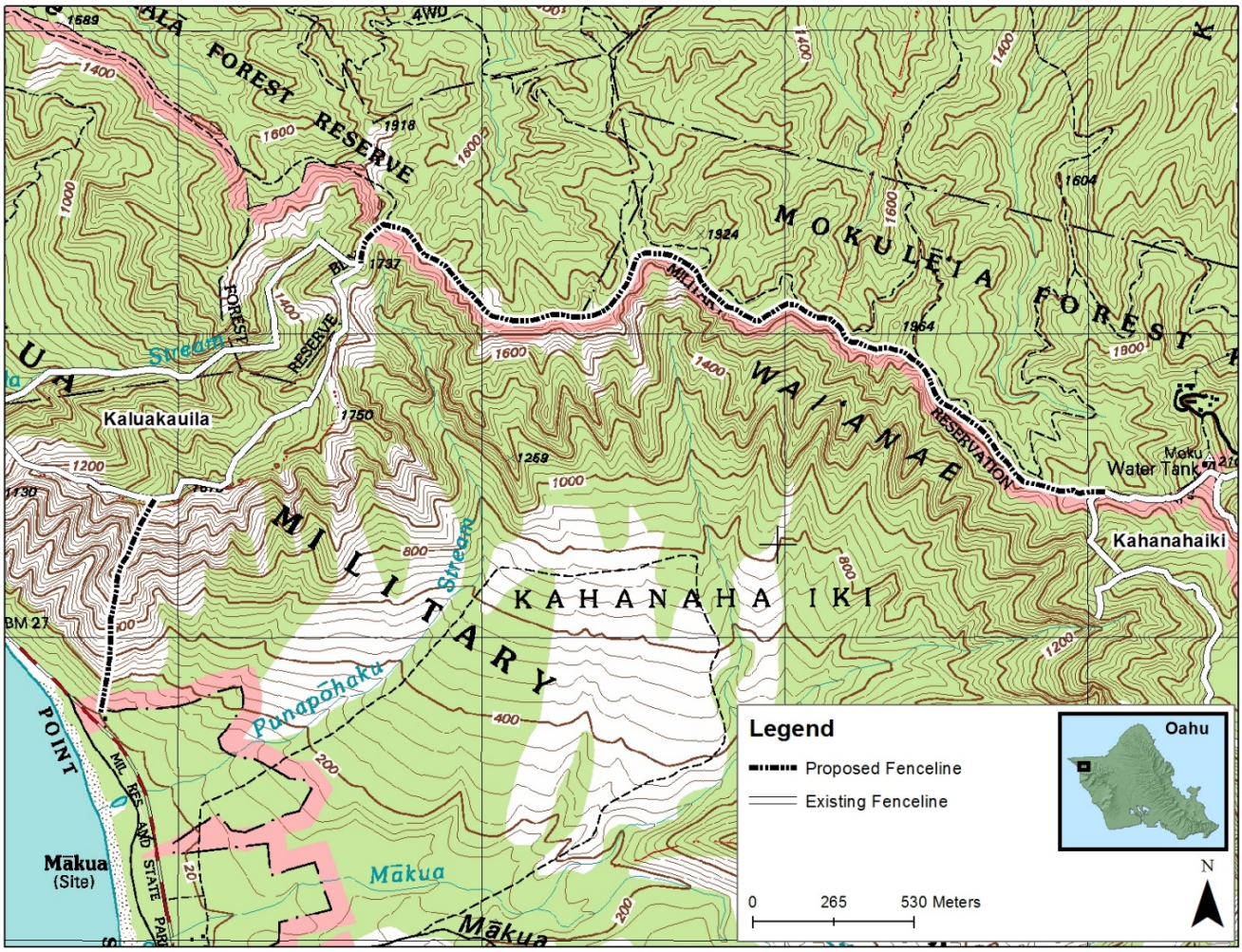


Figure 1.1 Map of fence construction in Northern Waianae's

Summary

- The final project for the OANRP in-house fence crew was to complete the north line of Poamoho (1500m). This section of fence connects to the larger Poamoho Unit (about 640 acres) that the DOFAW Natural Area Reserve System constructed. They were able to finish that project before their last day. They also scoped the strategic section of fence at Ekahanui and determined that the original determination that pigs could not pass through was correct.

- OANRP contracted out the construction of the northern Makua rim fence (Figure 1.1). The contractor completed the section between Kahanahaiki and Kaluakauila (3323 m). In April 2015 there was an accident in Makua where a grass cutting contractor was injured by detonation of UnExploded Ordnance. This resulted in the training area being shut down while an investigation was completed and mitigation measures could be determined so that accidents such as this may be avoided. As of 1 August fence construction was able to begin anew to complete the final section that runs from Kaluakauila to Farrington Highway (1000 m). All totaled, about 4,000 meters of new fencing was built during the reporting year. With the completion of this final section of fencing, all of Makua will be fenced. This will complete the terms and conditions laid out in the 2007 Makua Biological Opinion, ". Construction

of an ungulate-proof fence encircling the Makua Military Reservation installation boundary will be completed within three years of the data of completion of this Biological Opinion"

- OANRP is proposing to finish the Northern rim of Makua Valley, replace about 200 m of skirting and 400 m of fencing on the Opaeula/Helemano line and the lowest 2000 m of fencing along the Ohikilolo ridge in Makua by the end of the next reporting period.

- Opaeula Lower I and Makaha Subunit II had pigs breach the perimeter fences. At Opaeula Lower I the fence was reinforced with a mix of skirting and fickle wire, a type of plastic coated chicken wire. Four small pigs were removed using a combination of snares and conibear traps. In Makaha, one pig was able to squeeze into the fence. OANRP first tried to push the animal out a hole in the fence but to no avail. Finally, WMWP came in with a few dogs and removed it very quickly.

- Pig eradication efforts continued in Lihue MU. To date, a total of 537 pigs have been removed. Sign in all portions of the unit has been dramatically reduced but sign is still visible in a few areas. It seems as though the few remaining animals have become snare shy, making it that much more difficult to capture them. Efforts are focused on increasing coverage in areas minimally covered and making sure all snares are well set. OANRP is also running live traps and conibear traps along the firebreak road as an alternative to snaring exclusively. Access is limited so can only run those traps during the range maintenance week available each month.

OIP/MIP Management Unit Status

The MU status table below shows the current status of all proposed and completed fence units by MU. Shaded boxes identify where ungulate management or compliance documentations and authorizations are needed. The table identifies whether or not the fence is complete, ungulate free, identifies how many acres are protected versus how many were proposed in the Implementation plan, and the year the fence was or is expected for completion. Fences for which a Conservation District Use Permit (CDUP), Cultural 106, MOU, ROE or RA, or a License agreement has been acquired are checked in the appropriate box. The number of Manage for Stability Population Units (MFS) protected is also identified for each fence. For the sake of simplicity, this number also contains the number of Manage Reintroduction for Stability PU's. The MFS PU's are divided by taxa P (Plants), I (Invertebrates) and V (Vertebrates) The table also contains notes which give the highlights and status from each fence and lists the current threats to each fence unit.

MIP Management Unit Status

Management Unit	Management Unit Fence	Fenced	Ung Free	Acreage Current/ Proposed	Year Complete or Propose	CDUP	106	MOU/ ROE/ RA	Lic. Agr.	# MFS PUs					Notes	Current Threats
										MIP		OIP				
										P	I	P	I	V		
ARMY LEASED AND OWNED LANDS																
Kahanahaiki	Kahanahaiki I	Yes	Yes	64/64	1998					9	1	1			Complete and ungulate free	None
	Kahanahaiki II	Yes	Yes	30/30	2013		X								Fence is complete and ungulate free	None
Kaluakauila	Kaluakauila	Yes	Yes	104/104	2002					5					Complete. Fence is in need of some repair but still pig-free.	None
Opaeula Lower	Opaeula Lower	Yes	Yes	26/26	2011	X	X		X	1		1	1		Fence is complete and ungulate free.	None
Ohikilolo	Ohikilolo	Partial	No	3/574	2002 2014		X			14	1				Ohikilolo ridge fence is complete. Six PU fences are also complete and ungulate free. Since July 2006, 20 goats have been able to breach the fence,a couple may still be inside but OANRP have not observed them since they were seen originally. The Northern Makua rim section is almost complete, completing the 2007 BO terms and conditions.	Pig/Goat
Ohikilolo Lower	Ohikilolo Lower	Yes	Yes	70/70	2000					3					This strategic fence is complete. A portion of the fence was repaired after rock-falls.	None
Puu Kumakalii	Puu Kumakalii	No	-	-	-	-	-	-	-	3					None needed but is partially included within the Lihue fence. Any potential goat issues will be dealt with as they arise.	None
STATE OF HAWAII DEPARTMENT OF LAND AND NATURAL RESOURCES																
East Makaleha	East Makaleha	No	No	0/231	Cancelled	X	X			2	1		1		High priority fenceline for WMWP. OANRP may construct PU sized fences for PUs that could not be managed within existing MU fences.	Pigs and Goats
	West of East Makaleha	No	No	0/3	TBD	X									A PU fence has been proposed but is being deferred for now. A partnership fencing effort with the Snail Extinction Prevention Program may be a possibility. Permission from Oahu Branch required.	
Ekahanui	Ekahanui I	Yes	Yes	44/44	2001	X				6	1	2		1	Completed by TNCH and ungulate free.	None
	Ekahanui II	Yes	Yes	165/159	2009	X	X								Complete and ungulate free. The completed fence is 3% larger than the original proposed MU fence	None
Haili to Kealia	Haili to Kealia	No	-	-	-	X	-	-	-	1					As per DOFAW staff 'no fence needed'	None
Kaena	Kaena	Partial	-	-	-	X	-	-	-	1					There is a predator proof fence installed by State but it only protects a few of the EupCelKae plants	None
Kaluaa/Waieli	Kaluaa/Waieli I	Yes	Yes	110/99	1999	X		X		6	1	2	1		Completed by TNCH. The completed fence is 9% larger than the original proposed MU fence.	None
	Kaluaa/Waieli II	Yes	Yes	25/17	2006	X		X							Completed by TNCH. The completed fence is 7% larger than the original proposed MU fence.	None
	Kaluaa/Waieli III	Yes	Yes	43/11	2010	X	X	X							Complete and ungulate free. The completed fence is 3% larger than the original proposed MU fence	None
Keaau	Keaau II	Yes	Yes	8/33	2014	X	X	X		2					Complete and ungulate free. DLNR requested OANRP reduce the size of original proposed MU fence.	None

Management Unit	Management Unit Fence	Fenced	Ung Free	Acreage Current/ Proposed	Year Complete or Propose	CDUP	106	MOU/ ROE/ RA	Lic. Agr.	# MFS PUs					Notes	Current Threats
										MIP		OIP				
										P	I	P	I	V		
	Keaau III	No	No	4/33	2015	X	X	X							Fence being constructed by OPEP with assistance from WMWP and OANRP.	None
Keaau/Makaha	Keaau/Makaha	Yes	Yes	1/3	2009	X	X			1					Complete and ungulate free. The completed fence is smaller than the original proposed due to the terrain limitations.	None
Manuwai	Manuwai I	Yes	Yes	166/166	2011	X	X	X		3	1		1		Complete and ungulate free. Closed strategic section out of concern for possible ungulate breach.	None
Napepeiauolelo	Napepeiauolelo	Yes	Yes	1/1	2009	X	X	X		0					Complete and ungulate free	None
Pahole	Pahole	Yes	Yes	215/215	1998	X				14	1				Complete and ungulate free	None
Palikea	Palikea I	Yes	Yes	23/21	2008	X		X		1	1	1	2		Complete and ungulate free.	None
Kapuna Upper	Kapuna I/II	Yes	Yes	32/182	2007	X		X		13	1				Complete and ungulate free.	None
	Kapuna III	Yes	Yes	56/182	2007	X		X							Complete and ungulate free.	None
	Kapuna IV	Yes	Yes	342/224	2007	X		X							Complete and NAR staff believes it is ungulate free.	None
Waianae Kai	Slot Gulch	Yes	Yes	9/9	2010	X	X	X		1					Complete and ungulate free.	None
	Gouvit	Yes	Yes	1/1	2008	X		X		1					Complete and ungulate free	None
	NerAng Mauka	Yes	Yes	1/1	2011	X	X	X							Complete. Fence is continuously damaged by rock falls. OANRP is assessed the cost/benefit to maintaining management at this site and decided to move management to Kamaili unit.	None
West Makaleha	West Makaleha	Yes	No	7/11	2001 2016	X	X	X		5					The *Schiedea obovata* and *Cyanea grimesiana* subsp. *obatae* PU fences are complete and pig free. OANRP has proposed to extend *C. grimesiana out to include more Cyrtandra dentate* MFS plants in 2016.	None
BOARD OF WATER SUPPLY																
Kamaileunu	Kamaileunu	Yes	Yes	5/2	2008	X	X		X	1			1		Both of the *Sanicula mariversa* PU fences at Kamaileunu and Kawiwi are completed and ungulate free.	None
	Kamaileunu/ Waianae Kai	No	No	0/1	Cancelled	X			X	4		1			This fence will not be constructed due to the terrain and safety concerns for staff. DLNR is still working on a goat management plan that will include aerial shooting to reduce the population here.	Pigs and Goats
Makaha	Makaha I	Yes	Yes	85/96	2007					8	1				Complete and ungulate free.	None
	Makaha II	Yes	Yes	66/66	2013	X	X		X	5		1			Complete and ungulate free	None
DOLE FOOD COMPANY, INC.																
Alaiheihe and Kaimuhole	Alaiheihe and Kaimuhole	No	No	0/100	Canceled	X				1	0	1			Landowner is unwilling to allow fences built so this fence will not be constructed.	

OIP Management Unit Status

Management Unit	Management Unit Fence	Fenced	Ung Free	Acreage Current/ Proposed	Year Complete or Propose	CDUP	106	MOU/ ROE/ RA	Lic. Agr.	# MFS PUs					Notes	Current Threats
										MIP		OIP				
										P	I	P	I	V		
ARMY LEASED AND MANAGED LANDS																
Kaala-Army	Kaala	Partial	No	183/183	2008		X					4	1		Strategic fences complete. Three pigs were caught in 2014, the first since 2010. A line has been scoped for the Waianae Kai side and 106 surveys complete. OANRP is pursuing construction of this fence.	Pig
Kaunala	Kaunala	Yes	Yes	5/5	2006		X					1			Complete and ungulate free.	None
Kawaiiki I/II	Kawaiiki I/II	No	No	0/11	Cancelled	X			X						There are no tier 1 taxa therefore it will not be built until the Army trains in a way that may impact Tier 2 and 3 taxa.	
Kawailoa	Kawailoa	No	No	0/7	Cancelled	X	X		X			1			Army training does not impact this tier 1 species	
Lihue	Lihue	Yes	No	1800/980	2012		X			3	1	6			Completed. Encompasses six PU fences and original three proposed units. A total of 537 pigs have been removed. There are very few pigs left in unit.	Pig
Poamoho	Poamoho Lower	No	No	0/156	Cancelled	X	X		X			1			Species management be relocated to Poamoho NAR fence.	
	Poamoho Upper	No	No	0/60	Cancelled	X	X		X						There are no tier 1 taxa therefore it will not be built until the Army trains in a way that may impact Tier 2 and 3 taxa.	
Opaeula Lower II	Opaeula Lower II	No	No	0/24	Cancelled	X			X						Army training does not impact this tier 1 species	
Oio	Oio	Yes	Yes	4/4	2006	X						1			Complete and ungulate free.	None
Opaeula / Helemano	Opaeula / Helemano	Yes	Yes	273/273	2001/ 2007							1			Complete. Contractors are working on completing necessary repairs	None
Pahipahialua	Pahipahialua	Yes	Yes	2/2	2006	X						1			Complete and ungulate free.	None
South Kaukonahua	South Kaukonahua I	No	No	0/95	TBD		X					1			Postponed pending completion of Section 7 consultation in 2015. The Tier 1 taxa *Hesperomannia swezeyi* occurs within this MU.	Pig
	South Kaukonahua II	No	No	0/.5	Cancelled		X								There are no tier 1 taxa therefore it will not be built until the Army trains in a way that may impact Tier 2 and 3 taxa.	
STATE OF HAWAII DEPARTMENT OF LAND AND NATURAL RESOURCES																
Huliwai	Huliwai	Yes	Yes	.3/1	2014	X		X				1			Complete and ungulate free.	None
Ekahanui	Ekahanui III	Yes	Yes	8/8	2010	X	X					1			Complete and ungulate free.	None
Kaipapau	Kaipapau	No	No	0/273	Canceled	X						2			OANRP has shifted PU efforts from Kaipapau to other existing MUs.	Pig
Manana	Manana	No	No	0/19	Cancelled	X	X								OANRP is managing *Labordia cyrtandrae* within the Koloa MU as the wild plant found at Manana died.	Pig

Management Unit	Management Unit Fence	Fenced	Ung Free	Acreage Current/ Proposed	Year Complete or Propose	CDUP	106	MOU/ ROE/ RA	Lic. Agr.	# MFS PUs					Notes	Current Threats
										MIP		OIP				
										P	I	P	I	V		
Manuwai	Manuwai II	Yes	Yes	138/138	2011	X	X			10	1	1	1		Complete and ungulate free. The Lihue and Manuwai II unit share a strategic boundary and the ungulate free status is subject to pig traffic that although not highly probable, is possible could breach the unit	Pig
North Kaukonahua	North Kaukonahua	No	No	0/31	Cancelled	X	X	X				1			OANRP is partnering with the State to build a larger unit encompassing large amounts of suitable habitat.	Pig
Poamoho	Poamoho Lower II	Yes	No	5/5	2014	X	X	X				1			OANRP is partnering with the State to build a larger unit encompassing this unit. OANRP is almost completed with construction of the North line.	Pig
	Poamoho Pond	Yes	No	18/18	2014	X	X	X							Included in the Poamoho Natural Area Reserve fence	Pig
	Kaukonahua-Punaluu	No	No	0/2	Cancelled	X	X	X							There are no tier 1 taxa therefore it will not be built until the Army trains in a way that may impact Tier 2 and 3 taxa.	Pig
Wailupe	Wailupe	No	No	0/22	Cancelled	X									There are no tier 1 taxa therefore it will not be built until the Army trains in a way that may impact Tier 2 and 3 taxa.	Pig
Waimano	Waimano	Yes	Yes	4/4	2011	X	X								Complete and ungulate free. Transferred management of fence over to OPEP.	None
North Pualii	North Pualii	Yes	Yes	20/20	2006	X				1		1	1		Completed by TNCH and ungulate free.	None
	BOARD OF WATER SUPPLY															
Kamaili	Kamaili	Yes	Yes	9/7	2014	X	X		X	1		1			Complete and ungulate free.	None
	HAWAII RESERVES INC.															
Koloa	Koloa	Yes	Yes	177/160	2012	X	X		X			4			Complete and ungulate free.	None
	KAMEHAMEHA SCHOOLS															
Waiawa	Waiawa I	No	No	0/136	Cancelled	X			X						Army training does not impact these tier 1, 2 and 3 taxa.	Pig
	Waiawa II	No	No	0/136	Cancelled	X			X						Army training does not impact these tier 1, 2 and 3 taxa	Pig
STATE OF HAWAII DEPARTMENT OF TRANSPORTATION																
North Halawa	North Halawa	Partial	No	.5/4	2010	X									Completed a small PU sized fence. Transferred management of fence over to OPEP.	Pig
KUALOA RANCH INC.																
Kahana	Kahana	Yes	No	1/23	2010	X									Small PU fences were built around individual Schkaa plants in gulch. Larger unit will not be built until the Army trains in a way that may impact Tier 2 and 3 taxa.	None
U. S. FISH AND WILDLIFE SERVICE																
Kipapa	Kipapa	No	No	120/4	2015	X									U.S. Fish and Wildlife Service is building a 120 acre unit at this moment.	Pig

1.2 ENVIRONMENTAL OUTREACH

The OANRP outreach program is tasked with:

- conducting outreach to the military (including troops, their families and civilian contractors);
- conducting outreach to local communities about natural resource management;
- educating local communities and students about Hawaii's natural resources and careers in natural resource management;
- managing an active volunteer program which assists staff in meeting IP goals, particularly by conducting field actions.

Highlights from the 2015 reporting year are discussed below. See Appendix 1-1 for photos and examples of outreach materials and articles.

Volunteers

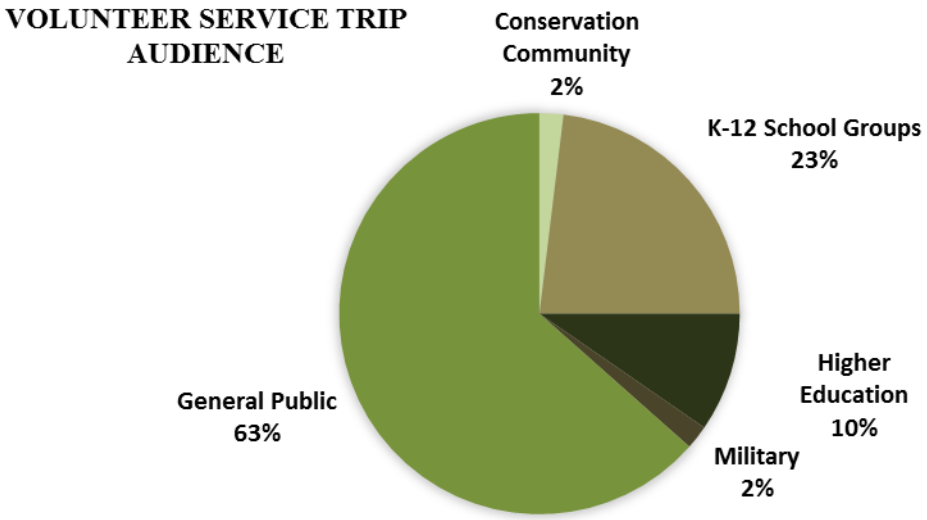
During the reporting period the outreach program continued to coordinate and lead an average of six volunteer trips each month and successfully met volunteer weeding goals. Additional projects at the two OANRP baseyards continue to receive support from a few of the program's most dedicated volunteers.

The table below compares volunteer participation with OANRP for this year with that of previous years, distinguishing between volunteer efforts spent in the field and around the OANRP baseyards. For 2015, only nine months of the year's data have been included, while previous years included 12 months. This reporting period also excludes volunteer hours from the Hawaii Youth Conservation Corps summer program, which will be included in the report for 2016.

Report Year	Total Volunteer Hours for Field Days*	Total Volunteer Hours at Work Site**	Total Volunteer Trips	Total Baseyard Volunteer Hours***
2015	3,013.5	824	52	333.25
2014	4,421.5	1,133.75	78	490.75
2013	3,767.5	957	69	569.5
2012	4,302.5	1,261.5	78	602.5
2011	4,194	1,231	76	618
2010	3,415	1,299	58	885

***** *Includes driving time to and from trailhead, safety briefing, hiking time to and from work site, and gear cleaning time at end of day*
*** Includes actual time spent weeding, planting or monitoring*
****Includes propagule processing, nursery maintenance, gear preparation, outreach support and maintenance of interpretive native gardens.*

The general public are the primary participants in the volunteer program and include members of the community with no affiliation, but also special interest groups, such as hula halau. School groups also make up a large portion of the volunteer program audience. The figure below depicts the variety of audiences that participated in OANRP volunteer trips during this reporting year.



Outreach staff expanded their weeding efforts by developing additional volunteer projects at appropriate locations within the Palikea, West Makaleha, and Pualii MUs.

The greatest volunteer effort continues to focus on controlling a variety of incipient and invasive weeds at the Kaala MU. A large portion of volunteer time this reporting year has also been spent within the Palikea and Kahanahaiki MUs.

The table below summarizes volunteer service trips by location.

Volunteer service for reporting period 2015

Management Unit	Projects	Management Actions
Kahanahaiki	Invasive weed control	6
	Trail maintenance	1
	Incipient weed control	1
	Revegetation projects	2
Kaala	*Sphagnum* moss control	6
	Other incipient weed control	9
	Invasive weed control	5
	Revegetation projects	3
Makaha I	Invasive weed control	4
	Waianae High School Field Day	1
Palikea	Incipient weed control	5
	Invasive weed control	7
West Makaleha	Invasive weed control	2
Kaluaa	Invasive weed control	6
Pualii	Invasive weed control	3

The following list highlights additional volunteer coordination conducted by OANRP outreach staff.

- Maintained a volunteer database of 1,893 total volunteers and communicated regularly with active volunteers;
- Coordinated volunteer opportunities with OANRP field teams for individuals seeking careers in conservation
- Facilitated an Eagle Scout Project with Troop 24, which included the design and construction of a volunteer glove drying rack, bench, interpretive garden improvement and educational signage. The Scouts completed the project on March 28 and volunteered a collective total of 110 hours.

Internships and Temporary Staff

Outreach staff developed internships at OANRP and with cooperating agencies. Outreach staff coordinated the first day of orientation and various trainings for all interns. Field teams coordinated subsequent orientation days in the field.

Internship opportunities provide valuable natural resource management training for the next generation of conservationists and give participants the opportunity to experience terrestrial field work. Bulleted points below highlight outreach staff efforts with the interns and temporary staff.

- Evaluated and scored 36 applicants, interviewed seven applicants and awarded five individuals with three-month, paid OANRP summer internships. Interns were placed with field and horticulture crews to gain valuable career skills and experience in the field of natural resource management.
- Evaluated, scored and interviewed one applicant, and awarded that individual with a three-month, Pacific Internship Program for Exploring Science (PIPES) internship with OANRP. Intern was tasked with conducting specialized weed control projects under the Ecosystem Restoration Program.

- Hosted a 10-month AmeriCorps intern with OANRP. The intern worked with each of the three natural resource field crews and participated in projects with program specialists.

See Appendix 1-1 for photos of interns and temporary staff.

Educational Materials

Outreach staff developed new educational materials in various media focused on natural resource issues specific to MIP and OIP species and their habitats. These contributions are summarized by category in the bulleted list below.

- Outreach Exhibits and Activities:
  - Predator Tracking Game
    - PURPOSE: Inform K-12 students about presence of introduced predators in Hawaii and how OANRP monitors and controls predator activity in MUs
  - Prevent Extinction Color-in Button
    - PURPOSE: Engage K-12 students in conversations about endangered species, specifically Oahu elepaio, mao hau hele (the state flower, *Hibiscus brackenridgei*) and kahuli tree snails.
- Brochures & Flyers:
  - Hawaiian Hoary Bat Brochure
    - PURPOSE: Inform general public about the endangered Hawaiian hoary bat (*Lasiurus cinereus semotus*) and OANRP's management efforts in MUs
- Presentations:
  - Officer-in-Charge/Range-Safety-Officer USAG-HI Range Safety Briefing
    - PURPOSE: Revised Natural Resource Section of the OIC/RSO Range Brief to enable staff from Range Division-Hawaii to give presentation
- Other:
  - Nene Goose Observation Form
    - PURPOSE: To provide USAG-HI (contractors, civilians, enlisted personnel) a means to report Nene geese observations on Oahu to OANRP staff
  - Cover design for OANRP Helicopter Safety and Management Plan

Troop Education

Outreach staff conducted presentations for Army troops, contractors and other active duty military personnel, highlighting the relationship between training activities and natural resources on Army training lands. Additionally, staff developed a new Range Brief Presentation for Range Safety Officers to give at bimonthly Range Briefs, reducing the presentation load on OANRP staff.

Event	**Description**	**Number of presentations**	**Number of People Served**
Range Brief Presentation: "Environmental Requirements"	A 20-minute brief on natural resource considerations on training lands.	9	509

Environmental Compliance Officer (ECO) training presentation: "Protecting Natural Resources"	A one-hour presentation for the ECO training courses held at Schofield Barracks.	6	169
Training Area Presentation: "Protecting Natural Resources in Makua"	A 15-minute presentation on natural resource considerations at Makua Military Reservation (MMR).	3	218
Total number of people served:			**896**

Outreach Events

Outreach staff disseminated information on natural resources specific to Army training lands at local schools, community events and conferences. These activities are summarized in the table below. See Appendix 1-1 for photos.

- Total number of outreach activities = 22
- Total number of people served (approximated) = 3,214

Outreach activities for FY 2015

Event	Estimated # of People Served	Audience
Volunteer Appreciation Hike	4	general public
Hawaii Invasive Species Awareness Week Kickoff Event	10	
Hawaii Agriculture and Environmental Awareness Day	100	
Leeward Community College STEM Class	25	higher education
Windward Community College Botany Class Presentation	12	
University of Hawaii Natural Resource and Environmental Management Presentation	40	
Windward Community College Environmental Science Class Presentation	8	
Hawaii Pacific University Natural Resource Management Class Presentation	14	
Windward Community College Botany Class Presentation	18	
University of Hawaii Geography Club Nursery Tour	3	
University of Hawaii Natural Resource and Environmental Management Presentation	20	
Nonacademic careers in Ecology, Evolution and Conservation Biology: Q&A with State and Federal biologists	45	
Kupu Environmental Fair	150	
Leilehua High School Career Day Presentation	42	K-12

Spot the ant, Stop the ant: Information on two new pests affecting Hawaii, the Coconut Rhinoceros Beetle and the Little Fire Ant	500	military
Nene Brief at Wheeler Army Air Field	10	
Applause for Paws (USAG-HI Pet Awareness Event)	200	
Schofield Fun Fest	800	
Schofield Earth Day	500	
Fort Shafter Earth Day Festival	500	
Hale Kula Elementary "Build a Forest" presentation*	105	
Hale Kula Field Trip to OANRP Baseyard*	100	
Wheeler Intermediate School Career Fair*	63	
Hawaii Botanical Forum Field Trip	10	Conservation community
Total Number of People Served	**3,214**	

**denotes K-12 audience, in addition to being military*

Contributions to Conferences/Workshops

OANRP staff contribute to outreach by presenting research findings at various conferences throughout the Pacific. This reporting year, one staff presented at the 2015 Pacific Biosecurity conference and four staff presented at the first annual Hawaii Botanical Forum. These and other presentations are listed in the table below. Other conferences fell outside of the reporting period for 2015 and will be included in the 2016 report.

Presentation Title	Format	Author/leader name(s)	Venue	Date
The Distribution of *Solenopsis papuana* in the Waianae & Koolau mountains*	Poster presentation	Ogura-Yamada, C.S. and P.D. Krushelnycky	Pacific Biosecurity: Protecting What Matters Most	1-Apr-15
Sierola (Hymenoptera: Bethylidae) and the evolution of hyperdiverse lineages in Hawaii	Oral presentation	Magnacca, Karl N.		1-Apr-15
Ecology of some of the less-celebrated invasive ants in Hawaiian forests*	Oral presentation	Krushelnycky, Paul D.		1-Apr-15
Considerations for in situ harvesting of fruits of rare plants	Oral presentation	Weisenberger, Lauren	Hawaii Botanical Forum	9-Oct-14
Propagule selection for ex situ storage strategies of rare plants	Oral presentation	Keir, Matthew		9-Oct-14
Rare Taxa Management: Habitat Restoration and Weed Control Issues	Oral presentation	Beachy, Jane		9-Oct-14
Monitoring Protocols and Hawaii Rare Plant Restoration Group Monitoring Forms	Oral presentation	Kawelo, Kapua		9-Oct-14

**Denotes OANRP-funded research from other organizations*

Public Relations and Publications

Wrote articles, press releases, bulletins and scholarly journal articles; provided coordination and accurate information to the local, state, regional, and national media and agencies (see Appendix 1-1 for examples). The table below is a summary of all media and publications relating to OANRP management in 2015.

Media coverage and publications in FY 2015

Title	Author	Publication	Date	Format
Volunteers Help Protect Makua Endangered Plants	Kimberly Welch	Hawaii Army Weekly (http://www.hawaiiarmyweekly.com/2014/10/04/volunteers-help-protect-makua-endangered-plants/)	04-Oct-2014	News article
Remants of populations provide effective source material for reintroduction of an endangered Hawaiian plant, *Schiedea kaalae* (Caryophyllaceae)	Weisenberger, L.†, S.G. Weller and A.K. Sakai	American Journal of Botany 101(11): 1954-1962	24-Oct-14	Scholarly journal article
Youth 'build' a forest, environmental awareness	Celeste Hanley	Hawaii Army Weekly (http://www.hawaiiarmyweekly.com/2015/02/26/youth-build-a-forest-environmental-awareness/)	26-Feb-15	News article
Notes on native and alien Hymenoptera and Diptera (Insecta) from the Hawaiian Islands	Karl Magnacca	Bishop Museum Occasional Papers	11-May-15	Scholarly journal article
Post works to oust pesky coconut rhinoceros beetle	Stephanie Joe	Hawaii Army Weekly (http://www.hawaiiarmyweekly.com/2015/05/14/post-works-to-oust-pesky-coconut-rhinoceros-beetle/)	14-May-15	News article

†*Denotes OANRP staff for co-authored articles*

Ecosystem Management Program Bulletin

During this reporting period, the outreach staff edited, produced and distributed the Ecosystem Management Program (EMP) Bulletin, a newsletter highlighting achievements made by the Army Environmental Division's Conservation Branch on Oahu and Hawaii islands.

- Volume 60, Issue 2 – Arthropods
- Volume 60, Issue 3 – Research

The EMP is posted online at http://manoa.hawaii.edu/hpicesu/dpw_emb.htm and at www.issuu.com/oanrp. It is also distributed to a comprehensive list of state, non-profit federal and educational institutions and OANRP volunteers. Articles from this publication are frequently picked up by other Army publications. A hard copy of the bulletin is also provided to the University of Hawaii at Manoa Hamilton Library.

Volunteer Recognition

Several volunteers will be eligible to receive the President's Volunteer Service Award for FY2015 at the end of September 2015, when we report their service hours to the Corporation for National and Community Service. Volunteers who were eligible to receive President's Volunteer Service Award in FY2014 were honored with an 'elepaio interpretive hike at Palehua with OANRP's avian specialist on March 31.

See Appendix 1-1 for photos and samples of outreach materials and articles.

1.3 WEED CONTROL PROGRAM

MIP/OIP Goals

The stated MIP/OIP goals for weed control are:

- Within 2m of rare taxa: 0% alien vegetation cover
- Within 50m of rare taxa: 25% or less alien vegetation cover
- Throughout the remainder of the MU: 50% or less alien vegetation cover

Given the wide variety of habitat types, vegetation types, and weed levels encompassed in the MUs, these IP objectives should be treated as guidelines and adapted to each MU as management begins. Please see the 2010-2011 MIP and OIP Annual Report for a discussion of adaptive changes to these goals. The Ecosystem Restoration Management Unit Plans (ERMUPs) for each MU detail specific goals and monitoring expectations for each MU.

Weed Control Effort Summary

OANRP weed control efforts are divided into three primary categories: incipient control efforts, broad ecosystem control efforts, and early detection surveys. Weed control efforts are discussed for each category separately.

This year, OANRP spent 4,654 hours controlling weeds across 325.9 ha. These figures include both incipient and ecosystem control efforts by staff and volunteers but do not include survey efforts or travel time. The table below lists efforts for the previous five reporting cycles. Note that all other reporting periods were 12 months in length, while only nine months are discussed in this year's report.

Report Year	Effort (hrs)	Area (ha)
2014-2015 (9 months)	4,654	325.9
2013-2014	7,600	286.5
2012-2013	6,967.6	267.7
2011-2012	5,860	275.7
2010-2011	5,778	259

Complementing control efforts, OANRP staff conducted early detection surveys on all primary training range roads and military landing zones (LZs), some MU access roads, and all secondary training range roads in KTA, SBE, MMR, and SBW.

Incipient Control Areas

Incipient control efforts are tracked in Incipient Control Areas (ICAs). Each ICA is drawn to include one incipient taxon; the goal of control is eradication of the taxon from the ICA. ICAs are primarily drawn in or near MUs. Those not located within or adjacent to an MU were selected for control either because they occur in an Army training range (for example, *Cenchrus setaceus* in MMR) or are particularly invasive (*Morella faya* in Kaluaa). Many ICAs are very small and can be checked in an hour or less, and in some MUs multiple small ICAs can be checked in one day. In contrast, a few ICAs, like those for *Sphagnum palustre* in Kaala or *Chromolaena odorata* in Kahuku, are quite large and require days to sweep completely. Typically, ICAs are swept repeatedly until eradication has been achieved and staff is reasonably confident there is no remaining seed bank. In the absence of data regarding seed longevity, staff does not consider a site eradicated until ten years after the last sighting. The goal of ICA efforts is to achieve local eradication of the target species. OANRP currently controls about 61 taxa in 235 ICAs, and considers eradication to have been achieved at 9 ICAs.

Of the total 325.9 ha swept, ICA efforts covered 245.6 ha. Staff spent 1,537 hours on ICA management and conducted 333 visits to 148 ICAs. This is the greatest area managed for incipient weeds in a reporting period to date, despite the fact that this period is three months shorter than previous years; see table below. This increase is due to additional focus on conducting sweeps and control for several priority taxa, including *Chromolaena odorata*, *Schizachyrium condensatum*, and *Erythrina poeppigiana*. This year, ICA work accounted for 75% of the total area controlled and 33% of total effort. This makes sense, as incipient control generally requires less time per acre than habitat restoration weed control.

Report Year	# ICAs	Visits	Effort (hrs)	Area (ha)
2014-2015 (9 months)	147	333	1,537	245.6
2013-2014	157	389	1,753.6	196.41
2012-2013	152	311	1,369.2	184.34
2011-2012	115	260	1,661	219.27
2010-2011	130	281	665.5	164

While the goals for all ICAs are the same, the rate of visitation required to achieve local eradication varies widely. Some ICAs, such as those for *Ehrharta stipoides*, must be visited at least quarterly, as this cryptic grass grows and matures very quickly. In contrast, for *Angiopteris evecta* ICAs, once initial knockdown is complete, ICAs need only be swept once every year or two, as individuals are slow to mature. In general, ICA efforts are considered successful if visits are frequent enough to detect and control plants before they mature and there is a downward trend in total numbers of plants found per visit.

Although not included in this document, specific reports that identify dates of last mature and non-mature plants found, overall effort spent, and population trend graphs are available for each ICA. These reports may be generated in the OANRP database (supplied on CD) and are recommended for review by the IT.

While the majority of ICAs require minimal amounts of effort to monitor, some require significant investment of resources. Volunteers contribute significantly to ICA control efforts at Kaala and Palikea, which enables OANRP to divert staff time to more challenging taxa and/or work sites. A good example of this is *Sphagnum palustre*, which is highly invasive, but is not located in direct proximity to IP taxa. Volunteer time allows staff to focus on *Hedychium gardnerianum*, which directly threatens rare plants and their habitat, while maintaining focus on less immediate threats, including *S. palustre*, *Juncus effusus*, and *Crocosmia crocosmiiflora*.

The ten MUs where most ICA effort was spent are highlighted in the table below. Note that effort hours do not include travel or trip preparation, or time spent surveying outside of known ICA boundaries to define infestation areas.

2015 ICA Effort in MUs

MU	# of Taxa	Taxa List	# of Visits	Effort (hrs)	Comments
KTA No MU	6	*Acacia mangium* *Cenchrus setaceus* *Chromolaena odorata* *Melochia umbellata* *Miscanthus floridulus* *Rhodomyrtus tomentosa*	66	505.95	As predicted, the majority of ICA effort was spent at KTA this year. KTA hosts several ecosystem-altering weeds, including the largest population of *Chromolaena* in the State. As one of the most heavily used Ranges, KTA is a high priority incipient control area. *Chromolaena* control accounts for almost 90% of time spent at KTA. Hours recorded here do not include hours spent by OISC, which are included in Appendix 1-2.
SBE No MU	8	*Buddleja madagascariensis* *Cenchrus setaceus* *Chromolaena odorata* *Heterotheca grandiflora* *Rhodomyrtus tomentosa* *Schizachyrium condensatum* *Smilax bona-nox* *Vitex trifolia*	44	270.8	Most of the effort at SBE this year was used towards surveys and control of *Schizachyrium*. Much of the Range has been surveyed, and it appears that this grass sticks to its preferred open habitat, including heavily used LZs. Control efforts are complicated by LZ maintenance (mowing). The biggest find this year was a small population of 15 *Chromolaena*, discovered while conducting *Schizachyrium* surveys. This appears to be an isolated population, and no plants have been seen since February 2015.
Kaala Army	6	*Anthoxanthum odoratum* *Crocosmia* x *crocosmiiflora* *Festuca arundinacea* *Juncus effusus* *Pterolepis glomerata* *Setaria palmifolia* *Sphagnum palustre*	30	216	Staff work with volunteers to control most of the *Crocosmia*, *Juncus*,and *Sphagnum* ICAs. *Sphagnum* control efforts in particular have been very successful, and fewer trips are needed to cover the same amount of area. Unfortunately, several new ICAs (*Sphagnum*, *Pterolepis*, *Juncus*) were found on the transect trail this year; it is likely these were spread by staff or hikers.

MU	# of Taxa	Taxa List	# of Visits	Effort (hrs)	Comments
Lihue	1	*Erythrina poeppigiana*	5	110.5	The temporary ecosystem restoration crew conducted buffer surveys around this infestation, delimiting the boundaries of the ICA. In addition, crews cleared understory weeds to allow for easier detection of young *Erythrina*. Mature trees continue to be challenging to kill, and require multiple treatments.
Kaala NAR	5	*Crocosmia* x *crocosmiifolia* *Diplazium esculentum* *Juncus effusus* *Pterolepis glomerata* *Sphagnum palustre*	21	88.8	Staff assisted NEPM staff with treatment of *Sphagnum* both along the boardwalk, and in the core of the infestation. Control efforts of *Pterolepis* at the shelter have been successful thus far, with no plants found last year. Volunteers continue to assist with control efforts of *Crocosmia* and *Juncus*.
SBW No MU	1	*Chromolaena odorata*	16	72.5	Control of *Chromolaena* at SBW is a high priority. A combination of ground and aerial treatment was used to cover a large portion of the infestation. Fortunately no new outlier sites were found this year.
Ohikilolo Lower	1	*Cenchrus setaceus*	6	72.2	This year a combination of ground control and aerial sprays were conducted at the *Cenchrus* infestation. Control efforts were hampered by the closure of MMR following a safety incident on the Range. Aerial operations were able to continue, but ground operations have been halted until the Range is reopened.
Palikea	2	*Crocosmia* x *crocosmiiflora* *Dicliptera chinensis*	10	51.6	The majority of time was spent on *Crocosmia* control, and utilized volunteer labor. One new *Dicliptera* location was discovered this year.
Kahanahaiki	7	*Angiopteris evecta* *Dicliptera chinensis* *Ehrharta stipoides* *Elephantopus mollis* *Pterolepis glomerata* *Rubus argutus* *Triumfetta semitriloba*	32	40.73	Control work on *Ehrharta* continues to be the focus at Kahanahaiki, and additional new locations were discovered this year. Seed studies suggest that this taxon does not form a persistent seed bank, suggesting that intensive control may pay off in successful eradication. *Elephantopus* was found for the first time here. A common trailside weed elsewhere on Oahu, staff hope to eradicate it from Kahanahaiki.
Kaluaa and Waieli	8	*Angiopteris evecta* *Arthrostemma ciliatum* *Casuarina equisetifolia* *Clusia rosea*	18	38.15	These numbers include ICA control in both Kaluaa and Waieli MU and Kaluaa No MU. Efforts have been successful at suppressing some ICAs, with no plants found this year at ICAs for

MU	# of Taxa	Taxa List	# of Visits	Effort (hrs)	Comments
		Dovyalis hebecarpa			*Arthrostemma, Casuarina, Clusia,* and *Dovyalis.*
		Ehrharta stipoides			
		Morella faya			
		Solanum capsicoides			

The table below highlights the taxa which required the most control effort in the past year.

ICA Target Taxa

Taxa	2015 Effort (hours)	2014 Effort (hours)	Comments
Chromolaena odorata	524.6	418.6	*Chromolaena* continues to be OANRP's top ICA priority. Staff efforts include treatments of hotspots, large sweeps, and aerial spraying; see discussion section 1.8 below. OANRP continued to contract OISC to conduct work across half of the KTA infestation; see Appendix 1-2 for OISC's progress report.
Schizachyrium condensatum	190.95	108	SBE remains the only location on Oahu with *Schizachyrium*. Efforts to fully delimit the boundaries of the infestation continued this year. Areas of likely habitat were identified using GIS imagery and systematically surveyed. Fortunately, few plants were found outside of the known infestation areas, although one new ICA was identified in August 2015. Control efforts are ongoing. Coordination with range maintenance staff will be critical to preventing further spread of this grass.
Sphagnum palustre	186.4	327.75	Due to the success of previous control efforts, there is much less *Sphagnum* on the Army side of the Kaala boardwalk than ever before. Volunteer efforts continue in a narrow, 3m buffer along the boardwalk, and focus on detailed searches for scattered *Sphagnum* florets. Staff began conducting complementary control in the portions of the infestation off the boardwalk, which are difficult to sweep thoroughly with volunteers. In addition, staff spent 63.75 hours conducting *Sphagnum* control in the Kaala NAR.
Crocosmia x *crocosmiiflora*	115.75	167.95	Volunteers conduct the majority of *Crocosmia* control at both Kaala and Palikea. Most effort is spent at Kaala, where *Crocosmia* forms dense, localized banks. Corms are removed by hand. While this is effective on small populations, such as those at Palikea, it is not effective on the large patches at Kaala. A trial of chemical control methods was designed this year, and will be installed in the coming months.
Erythrina poeppigiana	110.5	8.5	With a HPWRA score of 12 (high), this taxon has the potential to become a major threat. It recruits easily, with hundreds of immature plants seen in the field. Staff notes that it grows quickly, and large mature can be difficult to kill. This taxon is known from two locations on OANRP managed lands, both on Schofield Barracks. All effort was spent this year at the site in the Lihue MU, described in the table above. Control work has yet to start on the other site, located between the edge of the training range and a cantonment road. A work order was submitted to DPW to remove the one large mature tree; completion is pending.

Taxa	2015 Effort (hours)	2014 Effort (hours)	Comments
Cenchrus setaceus	75.05	107.05	ICAs for this fire-prone grass are located in DMR, KTA, SBE, and MMR. *Cenchrus* is a high priority taxon due to its association with fire and potential for negative impact to training ranges. ICAs located at DMR, KTA, and SBE were likely dispersed to these areas via military training. No plants have been seen at three ICAs (DMR, one each at KTA and SBE) for several years, and they have been classified as eradicated. Previous studies by the OANRP seed lab suggest seeds do not persist in the soil for longer than a year and half. The majority of effort (72.2 hours) this year was spent on the MMR infestation at Ohikilolo Lower MU. Aerial sprays and ground sweeps were conducted.
Rhodomyrtus tomentosa	64.13	77.05	*Rhodomyrtus* is known from several OANRP managed areas, including SBE, KTA, and Pahole. At Pahole, no plants have been seen since the initial discovery of this site in 2013. At KTA, no plants have been seen since initial discovery in 2005, although follow-up monitoring efforts occasionally were conducted in an area just south of the known plant site. One additional follow-up visit, targeting the known plant site, will be conducted before declaring the KTA infestation extirpated. The largest infestation is at SBE, which accounts for 62 person hours of control effort. The size of the infestation is the greatest challenge; systematic sweeps must be implemented to make real progress towards eradication. Control efforts thus far have mostly targeted known hotspots.
Melochia umbellata	59.5	91.75	This species, incipient to KTA has been controlled by OANRP since 2002. Last year, staff discovered *Melochia* sprinkled across several kilometers of Kaunala gulch. This discouraging find was somewhat mitigated by later surveys, which indicated that the plants appeared to be clustered into hotspots in the gulch bottom. OANRP strategy currently is to keep plants off roadways, minimizing potential for human-aided spread, and to treat hotspots. One *Melochia* ICA was declared eradication, as no plants had been seen at it for ten years.
Juncus effusus	33.9	41.85	Volunteers conduct the majority of control on this species, which staff only know from Kaala. Since the seeds are long-lived, control will need to continue for years to come.
Pterolepis glomerata	34.45	23.30	This taxon is only a target in the Waianae Mountains, where it is a control priority in Kaala, Manuwai, Makaleha, Pahole, and Makaha. New sites were found this year at Kaala and Manuwai. It is suspected *Pterolepis* seeds persist in the soil for many years, requiring constant vigilance to prevent spread and achieve eradication.
Ehrharta stipoides	24.3	28.5	*Ehrharta* continues to spread, with new locations discovered this year at Ekahanui, Kahanahaiki, Ohikilolo, and Pahole, despite efforts to improve sanitation practices. It is likely that *Ehrharta* is much more widespread across the Waianae Mts than originally thought. It thrives in the shade, forming dense mats. Preventing establishments of this taxon in MUs remains a priority. While difficult to ID, the lack of a persistent seed bank suggests this species is locally eradicable. Almost 15 hours alone were spent on control efforts in Kahanahaiki. If intensive efforts at Kahanahaiki pay off in the form of successful eradications, similar efforts may be replicated at other MUs.
Angiopteris evecta	20.67	52.55	This taxon is relatively widespread, but has been targeted for eradication in select MUs. Initial control is complete at all known sites, and the current strategy of annual maintenance checks appears to be effective.

Taxa	2015 Effort (hours)	2014 Effort (hours)	Comments
Morella faya	16	15	While widespread in the southern Waianae Mts. around Palikea, *Morella* is a high priority for control anywhere else on the island. No plants were found at ICAs in Makaha or Waieli. One mature plant was found at the ICA just outside of Kaluaa and Waieli, site of a former *Morella* plantation.

Weed Control Areas

Ecosystem control efforts are tracked in Weed Control Areas (WCAs). WCAs generally track all control efforts which are not single-species based. Note that WCAs are not necessarily drawn to encompass all of a MU, although in some MUs, like Makaha and Manuwai, the entire MU has been divided into WCAs. Each WCA is prioritized and goals are set based on a variety of factors including: presence of MIP/OIP rare taxa, potential for future rare taxa reintroductions, and integrity of native forest, invasive species presence, and fire threat. Different WCAs have different goals; some simply track trail and fenceline vegetation maintenance. The goals and priorities for weeding in a particular WCA are detailed in the appropriate ERMUP. For some low-priority WCAs, no control may be planned for many years. WCAs drawn outside of MUs typically provide a way of tracking weed control effort at genetic storage rare plant sites or along access trails and roads. OANRP does not necessarily plan to control 100% of the acreage in a WCA every year. Some WCAs are not intended to be visited annually, particularly those in sensitive habitats. Others, like the ones in Ohikilolo Lower which facilitate fuel break maintenance, are monitored quarterly and are swept in their entirety. Visitation rates and goals are further elucidated in the ERMUPs. Via the ERMUPs, staff hopes to more accurately show how priorities are set for different WCAs over a multi-year time period. See the 2009 Status Update for the MIP and OIP, Appendix 1-2, for information on control techniques.

This year, WCA efforts covered 80.3 ha. Staff spent 3,117 hours over 352 visits at 122 WCAs. WCA work accounted for 25% of the total area controlled and 67% of total effort. Much WCA control involves intensively working in small areas around rare taxa locations, and thus requires higher inputs of time per acre than for ICA management. The table below compares this report year's efforts to previous report years. Note that only nine months are covered this year, but that previous years cover twelve months each. Area data from 2008 through 2011 was not collected as accurately as current practices and is not presented for comparison.

Report Year	Effort	Visits	Area (ha)
2014-2015 (9 months)	3,117 hours	352	80.4
2013-2014	5,846 hours	526	90
2012-2013	5,620 hours	532	83.4
2011-2012	4,199 hours	443	57
2010-2011	5,123 hours	409	
2009-2010	3,256 hours	353	
2008-2009	2,652 hours	267	

As MU vegetation monitoring results have come in, many of the long-term IP goals across MUs have not yet been met (the IP covers 20 years). However, MU monitoring results may not capture smaller scale responses to weed control effort and various techniques. Staff therefore recognize the importance of also having meaningful short term goals and measures of success paired with effort data (staff time, cost) for various weed control strategies. OANRP should be able to use this information to prioritize projects, strategies, and to progress towards long-term ecosystem restoration goals in order to better balance alien plant control efforts with time needed to control other threats to rare taxa.

In the OANRP database, specific reports can be generated which detail the amount of time spent in each WCA, the weeds controlled, the techniques used, and the rare taxa managed. These database reports, as well as the ERMUPs, provide a more detailed look into each MU and each WCA, and are recommended to the IT/USFWS for review. It can be difficult to compare effort spent between WCAs/MUs and to judge whether the effort spent was sufficient. Since goals for each site vary, estimating the effort needed for each WCA is very challenging. Staff continues to work towards creating meaningful estimates of effort needed per WCA for select sites in the coming year.

The MUs where the most effort was spent this reporting year are summarized in the table below. Most of these MUs are large, host multiple rare IP taxa, contain large swaths of native forest, and are easily accessible. The primary exception is Ohikilolo Lower, home to two rare IP taxa, and currently closed to management until MMR is reopened following a serious safety incident. Maintaining the fuel reduction areas around the rare taxa is a high priority and requires consistent, large inputs of time. Volunteer weeding efforts contributed a large amount of time to the Kaluaa and Waieli, Makaha, Kahanahaiki, Palikea, West Makaleha, and Pualii North MUs. At Kaluaa and Waieli, Makaha, Kahanahaiki, and Manuwai staff conducted targeted sweeps for specific canopy weeds, treating them with low dose herbicide methods (i.e., incision point application) or conventional girdle/herbicide techniques. Understory weeds are not targeted on such sweeps, allowing staff to cover large acreages, and contributing to the high area/person hours spent at these MUs. At Kaala and Lihue, staff target *Hedychium gardnerianum* in native-dominated forest. These targeted sweeps account for most of the acreages swept at these MUs.

IP Management Unit	Area Weeded (ha)	# Visits	Effort (person hours)	Targeted Canopy or Single Taxa Sweeps	Volunteer Projects?
Kaluaa and Waieli	14.63	48	603.00	*Grevillea robusta, Toona ciliata*	Yes
Makaha I and II	6.11	42	337.75	*Grevillea robusta, Toona ciliata*	Yes
Kahanahaiki	2.71	38	302.67	*Grevillea robusta*	Yes
Palikea	1.29	33	281.30	-	Yes
Kaala Army	5.43	22	280.50	*Hedychium gardnerianum*	
Ohikilolo Lower	3.66	13	148.00	-	
Manuwai	10.14	9	144.00	*Grevillea robusta, Toona ciliata, Schefflera actinophylla, Spathodea campanulata*	
Pahole	2.59	21	126.00	-	
West Makaleha	0.59	11	125.25	-	Yes
Kapuna Upper	1.29	22	104.84	-	
Ekahanui	1.79	12	99.25	-	
Koloa	0.82	8	94.50	-	
Lihue	3.02	12	93.50	*Hedychium gardnerianum*	
Pualii North	0.30	6	79.75	-	Yes

Control efforts are summarized in the MU WCA Weed Control Summary table below. The table lists all MUs where WCA control was conducted in the past year. Data from the 2014 report is included for reference, although the two reporting periods cover different amounts of time, as described above. This year's data is shaded and in bold. For each year, the total actual area weeded is reported; for example, if one rare plant site of one acre was swept on three separate occasions, the area weeded is reported as one

acre, not three acres. The number of separate weeding trips is recorded as number of visits, and the effort is recorded in person hours spent weeding (travel and set-up time is not included).

MU WCA Weed Control Summary, 2013/10/01 through 2014/09/30

Management Unit						2014 Report Year			Comments
	MU area (ha)	Total WCA area (ha)	**Area weeded (ha)**	**# Visits**	**Effort (person hours)**	Area weeded (ha)	# Visits	Effort (person hours)	
Aimuu No MU	N/A	0.22	**0.04** *(369 m²)*	**1**	**2**	0	0	0	One trip was spent controlling weeds around the remaining, struggling *Eugenia koolauensis* at this site.
Alaiheihe No MU	N/A	9.99	**9.22**	**1**	**9**	2.46	2	3.5	This region includes the Lower Kaala NAR access road. Staff sprayed weeds along the road, and monitored an *Ehrharta stipoides* site at the end of the road.
East Makaleha No MU	N/A	1.21	**0**	**0**	**0**	0.03 *(257 m²)*	1	1	Last year, weed control was conducted in this area to facilitate ICA work. No similar effort was needed this year.
Ekahanui	87.5	77.91	**1.79**	**12**	**99.25**	1.48	28	119.25	Control efforts focused around rare species sites, particularly reintroduction zones. Low staffing levels on the Ekahanui crew contributed to the decline in effort this year.
Ekahanui No MU	N/A	10.09	**0**	**0**	**0**	0.01 *(117 m²)*	1	1	Limited weed control is conducted outside the MU.
Haili to Kealia No MU	N/A	0.82	**0.03** *(296 m²)*	**1**	**1**	0.70	1	1.5	This region encompasses the Kuaokala access road. Staff controlled *Sphaeropteris cooperii* along the road, and will continue to do so opportunistically.
Helemano	60.63	61.86	**0.91**	**2**	**2**	0.49	5	24.5	Helemano is a low priority MU due to the small number of Tier 1 taxa. This, combined with challenging access due to weather led to limited weed control effort in 2015. Staff targeted *Setaria palmifolia* along the fenceline.
Huliwai	0.91	0.20	**0**	**0**	**0**	0.13	1	4	This MU is centered around an *Abutilon sandwicensis* population. Low staffing resulted in no weed control at this site this year.
Huliwai No MU	N/A	9.43	**0**	**0**	**0**	0.41	1	6	Last year, staff conducted one IPA treatment in this area this year, targeting *Grevillea robusta*. No control was performed this year.

Management Unit						2014 Report Year			Comments
	MU area (ha)	Total WCA area (ha)	**Area weeded (ha)**	**# Visits**	**Effort (person hours)**	Area weeded (ha)	# Visits	Effort (person hours)	
Kaala Army	49.02	51.19	**5.43**	**22**	**280.5**	6.55	33	570	*Hedychium gardnerianum* continues to be the primary weed target at Kaala. Staff focused efforts on the lower slopes of Kaala, just above the cliffs ringing the summit. In addition, staff conducting buffer sweeps for *Sphagnum* also treated *Hedychium* along the boardwalk.
Kaala NAR	20.03	4.30	**0**	**0**	**0**	0.01 *(101 m²)*	1	0.25	No WCA work was conducted in the NAR this year.
Kaena	10.06	3.06	**0**	**0**	**0**	0.92	4	18	Typically, staff continue to focus weed control efforts around *Euphorbia celastroides* var. *kaenana*. Past control efforts were successful in controlling all woody weeds, so additional efforts here were given low priority in the face of severely reduced staffing on the crew assigned to Kaena.
Kaena East of Alau	14.51	0.89	**0**	**0**	**0**	0.27	3	47	Generally, weed control efforts focus on reducing fuel loads around a small population of *E. celastroides* var. *kaenana*. Low staffing levels on the crew assigned to Kaena resulted in no weed control performed this year.
Kahanahaiki	37.7	41.49	**2.71**	**38**	**302.67**	7.22	62	896.9	An exceptionally large amount of area and time were spent at Kahanahaiki last year. This year, efforts focused around rare taxa, on the chipper restoration site, and on two new gulch restoration sites. In addition, targeted sweeps were conducted to remove remaining *Grevillea robusta* from the canopy.
Kaleleiki	0.12	0.80	**0**	**0**	**0**	0.03 *(338 m²)*	1	2	The *E. koolauensis* population protected in this MU has been heavily impacted by the *Puccinia* rust. Weed control efforts are a low priority until a plan for *Eugenia* is developed.

Management Unit						2014 Report Year			Comments
	MU area (ha)	Total WCA area (ha)	**Area weeded (ha)**	**# Visits**	**Effort (person hours)**	Area weeded (ha)	# Visits	Effort (person hours)	
Kaluaa and Waieli	80.97	82.91	**14.63**	**48**	**603**	6.37	42	436.25	The large increase in area and time spent at Kaluaa are due to additional targeted canopy sweeps (IPA), and increased staff effort around rare taxa sites and the Hapapa snail enclosure.
Kaluaa No MU	N/A	14.23	**1.33**	**4**	**13**	6.45	6	48.5	Limited effort is spent outside of the fenced enclosure. Trail and road maintenance account for the time spent in this area.
Kaluakauila	42.73	9.64	**2.24**	**3**	**31**	1.73	12	102	Control efforts focused on grass control and *L. leucocephala* control around rare taxa. The ridgeline fuelbreak was maintained.
Kamaili	2.57	4.04	**0.17**	**5**	**30**	0.14	4	24	Last year two fences were completed in Kamaili. This year, vegetation monitoring was conducted, and once analysis is complete, weed control efforts will begin. Thus far, efforts have been limited to LZ clearing and habitat improvement around rare taxa.
Kapuna Upper	172.35	179.20	**1.29**	**22**	**104.84**	1.00	22	82	Control efforts continue to focus around rare taxa and reintroductions, particularly preparing rare taxa outplanting sites.
Kaunala	1.98	2.24	**0.06** *(553 m²)*	**1**	**20**	0.09 *(863 m²)*	2	28.5	Weed control efforts in this MU were limited due to the poor condition of the remaining *E. koolauensis*. Until an effective strategy to combat *Puccinia* rust is created, OANRP is hesitant to commit resources to habitat restoration.
Keaau and Makaha	1.19	0.18	**0**	**0**	**0**	0.02 *(238 m²)*	2	3	Minimal effort is needed around this *Sanicula mariversa* site.
Koko Crater No MU	N/A	0.28	**0.23**	**2**	**15.5**	0	0	0	Weed control was conducted around a new living collection site for *Hibiscus brackenridgii* ssp. *mokuleianus* at Koko Crater Botanical Garden

Management Unit						2014 Report Year			Comments
	MU area (ha)	Total WCA area (ha)	**Area weeded (ha)**	**# Visits**	**Effort (person hours)**	Area weeded (ha)	# Visits	Effort (person hours)	
Koloa	71.54	73.16	**0.82**	**8**	**94.5**	1.51	11	154.9	*Psidium cattleianum* is the dominant weed at this MU. Staff continued efforts to systematically control it in the southern end of the exclosure, close to the summit. Efforts also focused around an IP taxa outplanting.
KTA No MU	N/A	1.31	**0.01** *(96 m²)*	**1**	**1**	0	0	0	Minimal weeding was conducted at a *Eugenia koolauensis* site in conjunction with monitoring the remaining *Eugenia*.
Lihue	710.23	714.98	**3.02**	**12**	**93.5**	9.28	17	310.5	Last year, a lot of effort was spent in Lihue controlling *H. gardnerianum*, and maintaining the road, fence, and trail. This year, efforts were focused on habitat improvement around rare taxa, as well as continued *H. gardnerianum* massacres.
Makaha I	34.2	34.32	**5.8**	**34**	**271.75**	2.70	31	406.5	While area swept almost doubled this year, effort did not. The increase in area is primarily due to large scale sweeps for *G. robusta* and *T. ciliata*. Other control efforts at Makaha I continue to focus around rare taxa sites and native forest patches in the mauka portion of the MU and select *Coffea arabica* patches. Volunteer trips supplement staff efforts here.
Makaha II	26.69	7.19	**0.31**	**8**	**66**	0.29	7	94	Work at Makaha II focused on rare taxa habitat improvement around both wild and reintroduced plants.
Manuwai	122.49	127.43	**10.14**	**9**	**144**	8.18	19	184.5	Effort at Manuwai was split between large landscape sweeps for canopy weeds and focused control around rare taxa sites.
MMR No MU	N/A	21.18	**0.35**	**1**	**5**	1.33	8	132.1	This year, fencing was completed along the Kuaokala road, connecting Kahanahaiki and Kaluakauila. Grass was controlled along the line to facilitate fence checks.
Moanalua No MU	N/A	5.66	**3.31**	**1**	**24**	0	0	0	Grass clearing was conducted along the four wheel drive Moanalua access road.

Management Unit						2014 Report Year			Comments
	MU area (ha)	Total WCA area (ha)	**Area weeded (ha)**	**# Visits**	**Effort (person hours)**	Area weeded (ha)	# Visits	Effort (person hours)	
Nanakuli No MU	N/A	4.00	**0.04** *(381 m²)*	**1**	**3**	0	0	0	This is the Halona ridgeline, between the Palikea and Palikea IV MUs. Staff improved the LZ on this ridge, clearing away some weedy trees.
Ohikilolo	272.79	147.40	**0.04** *(432 m²)*	**3**	**15.5**	6.04	25	295	Efforts at Ohikilolo were severely limited this year. MMR was closed in April due to a safety incident, and has not yet reopened. Work in the Lower Makua portion of the MU is low priority; no trips were conducted while the Range was open. All effort in the Ohikilolo Ridge portion of the MU was targeted around rare taxa sites, particularly a new *Sanicula mariversa* outplanting. In addition, low staffing contributed to the lack of time spent at Ohikilolo Ridge.
Ohikilolo Lower	28.75	4.46	**3.66**	**13**	**148**	4.13	18	218	Maintaining fuel breaks around the rare taxa here continues to be labor-intensive. An experimental outplanting of *Scaevola taccada* was conducted in hopes of creating a green fuelbreak. The closure of MMR hampered monitoring of the trial, although the *Scaevola* are still alive. The range closure also has prevented crews from conducting weed control since April.
Oio	1.33	1.39	**0.09** *(908 m²)*	**1**	**16**	0	0	0	Due to the poor health of the *E. koolauensis* population at this site, no large scale weeding is planned for this site.
Opaeula Lower I	10.15	6.80	**0.27**	**3**	**6.5**	0.36	12	177.5	Last year, weed control efforts in this MU focused on *C. hirta* control at reintroduction sites and across the flat bowl in the center of the MU. This year, follow-up grass control was conducted, as well as minimal woody understory control. The decline in effort can be attributed to low staffing for the crew assigned to this area. Plots examining the optimal interval between weeding events to minimize *C. hirta* recruitment were completed this year. Results will be incorporated in the strategy for the MU.

Management Unit						2014 Report Year			Comments
	MU area (ha)	Total WCA area (ha)	**Area weeded (ha)**	**# Visits**	**Effort (person hours)**	Area weeded (ha)	# Visits	Effort (person hours)	
Pahipahialua	0.6	0.80	**0.03** *(346 m²)*	**1**	**15**	0.23	6	71	Due to the poor prognosis of *E. koolauensis* due to *Puccinia* rust damage, efforts at this MU are limited.
Pahole	88.02	31.50	**2.59**	**21**	**126**	3.80	39	548.25	Weed control effort at Pahole is targeted primarily around rare taxa locations. Last year, an exceptional amount of time was spent at Pahole. The decrease this year can be attributed in part to lower staffing on the crew assigned to Pahole.
Pahole No MU	N/A	11.25	**5.58**	**6**	**36.5**	4.95	4	26.5	Staff continues to control weeds along the Pahole road, around the Nike greenhouse, and at the Nike LZ.
Palawai No MU	N/A	1.43	**0.02** *(215 m²)*	**1**	**0.5**	0.21	3	12	This area immediately abuts the Palikea MU. Control efforts targeted *Sphaeropteris cooperi*. There is a large source population here, and control efforts prevent ingress into the MU.
Palikea	9.95	10.84	**1.29**	**33**	**281.3**	3.22	45	486.5	Control efforts this year included control around rare taxa sites, grass control along trails and fences, and maintenance around the snail enclosure. Additionally, a restoration project was developed; *S. terebinthifolius* was cleared and a variety of native species, including hosts for *Drosophila* were planted. A volunteer work site was also developed outside the old TNC fence.
Poamoho No MU	N/A	94.67	**0**	**0**	**0**	4.60	1	18	Last year, staff controlled weeds along the Poamoho road.
Puaakanoa	10.7	1.07	**0**	**0**	**0**	0.27	4	40	Fire is a major threat to the MU. Weed control efforts were hampered by the closure of MMR.
Pualii North	7.99	4.52	**0.30**	**6**	**79.75**	0.27	4	10.25	Staff focused control efforts around rare taxa sites and reintroductions, including a new site, which was planted with *Drosophila* host trees. Much of the increase in effort here comes from a new volunteer project.

Management Unit						2014 Report Year			Comments
	MU area (ha)	Total WCA area (ha)	**Area weeded (ha)**	**# Visits**	**Effort (person hours)**	Area weeded (ha)	# Visits	Effort (person hours)	
Puu Kumakalii	5.65	6.12	**0.27**	**1**	**1**	0	0	0	A large infestation of *Ehrharta stipoides* was scoped along the ridgeline. No control has been performed yet.
SBE No MU	N/A	4.16	**0.04** *(439 m²)*	**1**	**4**	0.05 *(547 m²)*	2	1.5	Weeds were cleared at the sediment disposal site, to keep it open for future use by DPW.
SBW No MU	N/A	2.03	**1.28**	**9**	**20.75**	1.34	12	23.5	Control efforts focus on maintaining weed free areas at the West Baseyard, to reduce the potential for staff to act as weed vectors.
Waianae Kai	3.66	1.14	**0.15**	**2**	**5.5**	0.05 *(465 m²)*	2	15	Control efforts focused around rare taxa locations and keeping the fenceline clear of weeds.
Waianae Kai Neraudia Mauka	0.53	2.59	**0.13**	**1**	**6**	0.14	6	29	Control efforts were conducted around rare taxa. Due to the difficulty of maintaining this fence, this MU may not be maintained in future.
Waimanalo to Kaaikukai No MU	N/A	1.28	**0.04** *(390 m²)*	**1**	**12.5**	0	0	0	This area encompasses the Palikea access trail. Last year, one volunteer trip was conducted at a native forest patch midway along the trail.
West Makaleha	38.04	1.49	**0.59**	**11**	**125.25**	0.51	14	174.5	This MU has two widely separated WCAs. No work was needed at the more remote site for years, but on a rare plant monitoring visit this year, staff noted major ingress of understory weeds and performed control. The majority of effort was spent at the other site, nicknamed 3-Points. Control here is targeted around rare taxa sites, along the fence, and a large patch of *Psidium cattleianum*. Volunteers provide much of the labor for the fenceline and *P. cattleianum* work.
West Makaleha No MU	N/A	0.51	**0.12**	**1**	**0.5**	0.09 *(932 m²)*	1	1	Control is conducted as needed to maintain the access trail. Grasses were controlled along the trail this year.
TOTAL	N/A	2,193.22	**80.36**	**352**	**3,117**	90.05	526	5,846	This reporting year covers 9 months, while 2014 covers 12 months.

1.4 INTER-AGENCY INVASIVE PLANT COLLABORATION

Invasive species management can be incredibly daunting, as the number of weeds rarely diminishes and new species discoveries add to an ever-mounting list of challenges. Collaboration is critical in achieving progress. OANRP supports, and is supported, by a variety of partner agencies in addressing weed control issues. They include, but are not limited to:

- Board of Water Supply (BWS)
- College of Human Resources and Tropical Agriculture (CTAHR). OANRP has worked closely with Dr. James Leary of CTAHR in research on novel weed control techniques.
- Koolau Mountains Watershed Partnership (KMWP)
- Oahu Early Detection (OED). Plant samples submitted to the Bishop Museum Herbarium are identified by Museum and OED staff. Interesting finds are discussed in section 1.7.
- Oahu Invasive Species Committee (OISC). OANRP serves on the OISC steering committee. In the past year, joint projects have included *Cenchrus setaceus* and *Chromolaena odorata* control efforts. The OANRP Ecosystem Restoration Program Manager is currently serving as the OISC Chair.
- Puu Ohulehule Conservancy
- State of Hawaii, Dept. of Land and Natural Resources (DLNR), Natural Area Reserve System (NARS), Forest Reserves (FS), and Native Ecosystems Protection and Management (NEPM)
- Waianae Mountains Watershed Partnership (WMWP)
- Waimea Valley

This year, OANRP participated in a second Weed Workshop, hosted by Waimea Valley and sponsored by KMWP. In addition, OANRP also participated in the first Oahu Weed Working Group Meeting, organized by NEPM. These two complementary events both focus on information, data, and technique sharing among agencies conducting active weed control management work.

1.5 VEGETATION MONITORING

Vegetation monitoring was conducted at the Kahanahaiki and Makaha MUs this year. These studies are described and analyzed in Appendix 1-3 (Vegetation Monitoring at Kahanahaiki, 2015) and 1-4, (Vegetation Monitoring at Makaha Subunits I and II, 2014). The results of these studies are being incorporated into the latest draft of the ecosystem restoration plans and will be used to modify weed control plans for these MUs. Vegetation monitoring was also conducted across the Kaluaa and Waieli MUs at the end of this report year. Results are being analyzed and will be presented next year.

1.6 INVASIVE SPECIES SPREAD PREVENTION ON TRAINING RANGES

The Army's potential to move weeds from one training area to another has been amply demonstrated. This year, OANRP continued to coordinate with Range Division, DPW, and contractors to increase the Army's awareness of alien weed threats and improve sanitation-related protocols, practices, and policies.

Wash Rack Status

- The Central Vehicle Wash Facility (CVW) opened for use in March 2015. This facility is open daily, and is conveniently located on Schofield Barracks. While units are supposed to schedule the CVW, DPW and others can drop in to use it during regular operation hours, 0800-1600.

Using the CVW, located 5 minutes from the OANRP baseyard

- OANRP, DPW Cultural Resources, and OISC staff attended a short orientation on running the KTA Wash Rack. This orientation means that staff do not need to schedule the wash rack via Range Facility Management Support System (RFMSS), but may simply show up at Range, check out the facility key, and wash vehicles. This reduces the need for Range Control staff to oversee washing operations and allows field crews to work more efficiently.

Receiving orientation to the KTA Wash Rack from Mr. Joe Lee of the Range Division.

- Both the KTA and SBE Wash Racks had mechanical issues, and were not fully operational for part of the year. The SBE Wash Rack was shut down for repairs November 2014, and did not come fully online until March 2015. In May, it was determined that additional repairs are needed to a different portion of the system; these repairs have not been completed and the facility is not fully operational at this time. The KTA Wash Rack was partially operational for most of the year. It was shut down briefly in March for repairs.
- A large, 5,000 soldier training event occurred in March 2015 at KTA. Range staff ensured that planning was done ahead of time to ensure that all vehicles could be washed upon departing the range, as required by policy. Repairs were completed on the KTA Wash Rack and Range staff prepared to keep the wash rack open for several days to accommodate all vehicles. In addition, the SBE Wash Rack was manned on the weekend to accommodate additional vehicles from the training event (normally open only week days), and the CVW also was scheduled for more detailed washing.
- The table below summarizes availability and usage of wash racks during the report year:

Facility	Days Available	Days Scheduled	Days Utilized	Notes
CVW Facility	52	4	1	The CVW opened in March, which accounts in part for the low number of days available. Scheduling the facility in advance is not required. It is unclear if 'days utilized' is tracked via the Range Scheduling office, but the low number shown here doesn't reflect staff observations of activity at the facility.
KTA Wash Rack	273	103	68	Units are required to wash vehicles upon departure from the training range. Last year, KTA was available for use 365 days, was scheduled for use 56 days, and actually utilized 45 days. This year's numbers are an improvement.
SBE Wash Rack	232	102	84	Last year, SBE was available for use 365 days, was scheduled for use 237 days, and actually utilized 199 days. Mechanical problems account for this year's decline. Fortunately, the CVW is now a back-up facility for SBE.

Landing Zones

- Staff reviewed a request to develop a new LZ located near Canon Dam on SBE. There are no sensitive taxa or incipient invasive species near this location. When the LZ is created, it will be added to the annual survey list.
- Staff reviewed the JOTC Land Expansion meeting notes, which discussed 5-10 LZs on the eastern end of Poamoho which are not currently in good repair and cannot be used for training. These LZs may be cleared in future; if so, staff will monitor them annually. No sensitive taxa or incipient invasive taxa are near these sites.
- After observing unauthorized landings on Non-Stop and Hammer LZs last year, staff pursued the issue with Range Scheduling. Investigation revealed that several LZs (Non-Stop, Hammer, Bryan's) were in fact located on private land. All of these LZs were removed from the RFMSS scheduling system. While this may not prevent all landings, it is now clear that these sites are not official training LZs.

Soil/Fill Inspections

- Over the past couple of years, staff noted *Heterotheca grandiflora*, a weed new to Oahu, growing out of sand and sand bags on SBE. Eventually, staff were able to track down the original stockpile of sand located at Area X on Schofield Barracks and conduct a survey there. No *H. grandiflora* or any other concerning incipient invasive species were found at the site. This stockpile site will be monitored periodically to inspect new shipments of sand and gravel.
- Staff reviewed a request to use soil stockpiled on SBS for repair work at SBE. No incipient invasive weeds are know from the soil stockpiles.
- Integrated Training Area Management (ITAM) requested review of a proposal to use soil from the Fort Shafter Flood Mitigation Project for repair work on SBE and SBS. The Federal Biologist conducted a survey of the Fort Shafter site, and no incipient weeds were found. However, there is *Santalum album* (non-native relative to Hawaiian *Santalum*, or Iliahi) found nearby. If the proposal is approved by DPW, fill sites will be monitored for *S. album*.

KTA

- Staff reviewed a Record of Environmental Consideratoin (REC) for vegetation clearing at Radar Hill in KTA. A site visit was conducted with the requesting unit, and all native trees were flagged to avoid accidental removal. A weed control trial is located nearby, but will not be impacted by the clearing.
- In response to concerns from Range Control about heavy impacts from motocross use to X-Strip LZ and the rampant trespassing by motocross riders onto KTA (beyond the boundaries of the designated motocross park), the State is pursuing a variety of actions to curb impacts. These include education, signage, and building a fence around X-Strip LZ.
- In May 2015, ITAM staff reported finding 2.47 miles of unauthorized trails constructed in the D-1 range on the far eastern side of KTA. This area directly abuts private land. The trails appeared to have been made with a small bulldozer, and do not overlap with any trails managed for training by ITAM. The Army may pursue an official investigation into the matter. These trails are concerning for OANRP as they represent another vector/pathway for the spread of *C. odorata*. The dozer trails were surveyed in August.

SBE and SBW

- A REC for removal of *Falcataria molucana* along the California Avenue entrance to SBE, and creation of a gravel parking area at the site was reviewed and approved. This area will be surveyed annually as part of regular SBE road surveys.
- OANRP began coordinating with Range Control and range maintenance contractor General Dynamics Information Technology (GDIT) regarding the presence of *Schizachryium condensatum* on LZs and other actively used maneuver areas on SBE. GDIT regulars mows these open grassy fields, preferred habitat for *S. condensatum*. OANRP reiterated the need to wash all equipment, including mowers and other vehicles, whenever they depart off SBE. A follow-up meeting will be scheduled in the coming year to try to coordinate OANRP surveys around the mowing schedule, and encourage GDIT to assist with control efforts.
- New signs were installed in July at a portion of the SBW *C. odorata* infestation. Staff had observed soldiers training in part of the infestation, in an area not open to training. Metal signs

were placed on the edge of the site, stating that the area was closed to training, and that there are invasive plants in the area.

1.7 WEED SURVEY UPDATES: NEW FINDS

Every year, new alien taxa are detected during directed surveys and incidentally during regular work. During directed surveys, lists of weeds are compiled, and staff considers distribution and invasive potential to determine whether control is warranted. Unknown species are collected and delivered to Oahu Early Detection (OED) and Bishop Museum. Support from these organizations facilitates the prompt identification of unknown species, and aids in determining whether control work is necessary. OANRP supports OED and Bishop Museum financially for identification services. The Hawaii Pacific Weed Risk Assessment (HPWRA) also provides a valuable indicator of invasive potential.

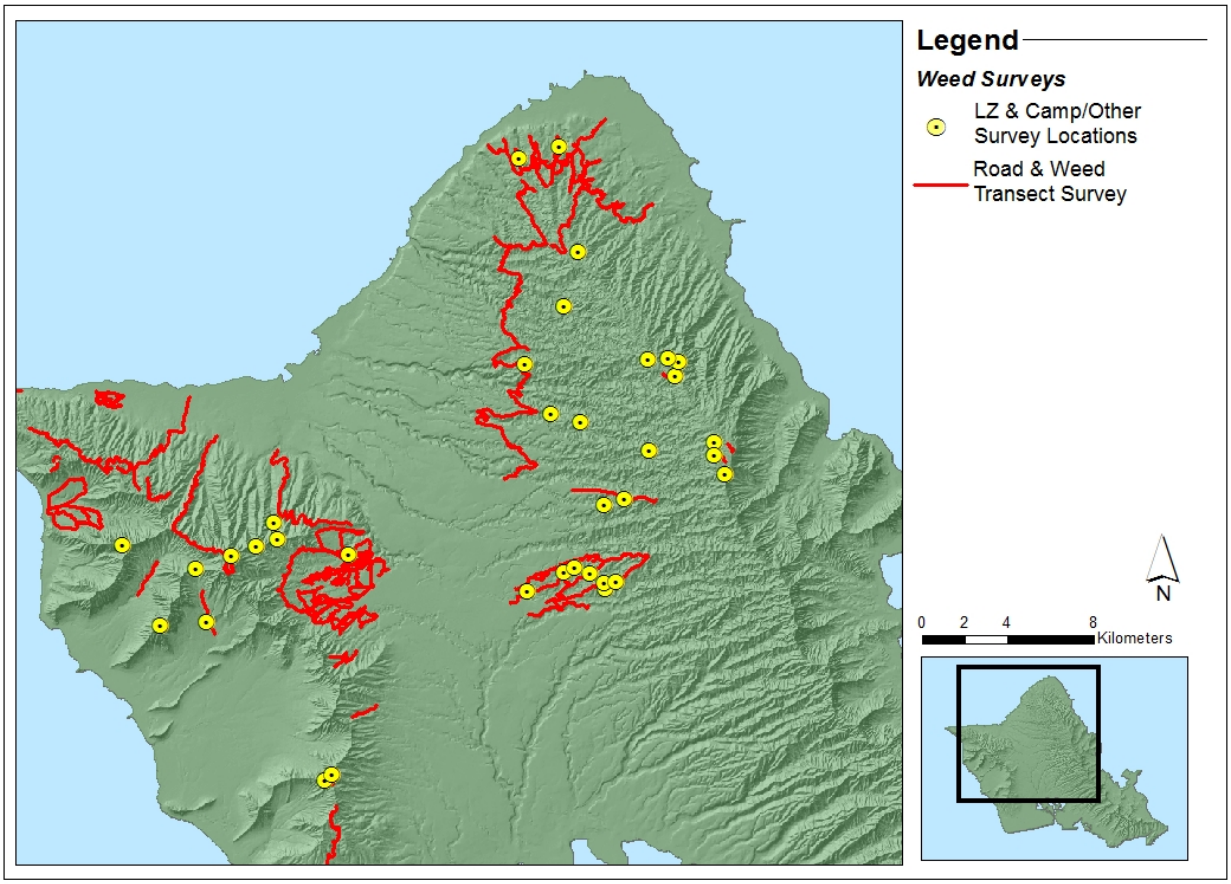
During the reporting period, staff surveyed nearly 350 km of roads and surveyed Landing Zones (LZs) on and off Army Training Ranges. Staff also surveyed at sites and along trails that are potential locations of introduction. Two surveys of this kind were newly added this year: the SBE washrack sediment disposal site, and a storage site for sand and gravel used for training range repairs across Schofield.

This year efforts continued to identify landing zones definitively in use by the Army. Range scheduling reports were used to identify LZs that did not have any reported Army use over the past several years. As it is possible that some landings were unreported, scheduled surveys were only discontinued for those LZs which had both no reported landings and that were identified as overgrown and impossible for Army helicopters to land. However, OANRP will monitor Army LZ use reports, and will stay abreast of LZ improvements to retired LZs, or construction of new LZs so that they may be surveyed in the future.

Summary of Surveys Conducted

Survey Type	Description	# Surveys Conducted this Year
Road Survey	All drivable roads on Army Training Ranges surveyed; Access roads to OANRP Management Units surveyed annually or every other year.	21 road surveys
LZ Survey	All actively used Army LZs surveyed once per year. OANRP LZs surveyed if used within a quarter.	42 surveys on 32 LZs (13 Army LZs, 19 OANRP LZs)
Transect Survey	Surveys conducted annually along access trails to OANRP MUs, and along selected MU fencelines and transects inside MUs.	16 surveys along 15 transects
Camp/Other Survey	Surveys conducted at OANRP campsites and other potential locations of introduction such as washrack sediment disposal sites.	2 surveys

Map of Surveys Conducted in 2015



Survey data are tracked in the OANRP database, and each year the list of new finds on each of those surveys is reviewed. The significant finds from those surveys, incidental observations during regular work, and noteworthy species submitted to Bishop Museum for identification are summarized below.

Summary of Alien Taxa Survey Results

Survey Type	Survey Code	Significant Alien Taxa Seen	Discussion
Road	RS-Kaala-01	*Verbesina encelioides*	Locations of previous observations of this taxa along the Kaala Rd were controlled. Control of this species will continue where seen above the Ranch Gate (2nd gate).
Road	RS-KLOA-01 (Poamoho)	*Vigna hosei*	OED notes that this species was introduced as an agricultural cover crop and was naturalized in surrounding pineapple fields. This observation extends known location. No control planned.
Road	RS-KLOA-08 (Drum Rd)	*Angiopteris evecta*	This invasive fern is widespread across the Koolaus, however only now observed along Drum Road. No control planned.

Survey Type	Survey Code	Significant Alien Taxa Seen	Discussion
Road	RS-KTA-07	*Leptospermum scoparium*	*L. scoparium* is known from several locales in the Northern Koolaus, several of which are in KTA. This find was new to this particular section of Road in KTA. Continued spread of this taxon will be monitored.
Road	RS-KTA-10	*Cleome gynandra*	This ornamental plant is considered widespread by Bishop Museum however no records occur from KTA. No control is planned.
Road	RS-Makaha-01	*Elephantopus mollis*	*E. mollis* is currently controlled as an ICA where it occurs in Management Units (one to date). Its proximity to the Makaha MU will be monitored.
Road	RS-Pahole-01	*Heliocarpus popayanensis*	*H. popayanensis* is not known from any locations in this vicinity. This observation may indicate spread from Central Waianae populations. Control along the Pahole Road will be discussed with State NARs staff, and this species will be targeted if found inside OANRP MUs.
Road	RS-Pahole-01	*Passiflora suberosa*	Known to have high densities in the Southern Waianaes, this taxa appears to be spreading in the Northern Waianaes. OANRP are noting greater frequency during vegetation surveys in Management Units and on more directed surveys. It is controlled during regular weed sweeps in MUs.
Road	RS-SBE-01	*Hyptis capitata*	Bishop records indicate this species is uncommon on Oahu. This observation may indicate further spread. No control planned.
Road	RS-SBE-01	*Cestrum nocturnum*	Part of this survey occurs adjacent to residential gardens. This ornamental may have been noted from a residential fence. It is known to naturalize as observed on Tantalus and would be a target for potential control if found naturalizing in more interior locations of the range. Monitor for now.
Road	RS-SBS-01 & RS-SBS-02 RS-WaiKai	*Dovyalis hebecarpa*	This species was known from the greater South Range area. It was a target on the OED survey list at one point in time. OANRP will continue to monitor any further spread across the range, however control is only currently conducted in Management Units.
Road	RS-SBS-01	*Petrorhagia velutina*	*P. velutina* was collected in 2010 from SBW and was a new island record. This is an expansion from that first detection No control planned.
Road	RS-SBS-02	*Oenothera kunthiana*	This species is a Primrose first collected by OANRP at the Kolekole Quarry in 2008. It was again observed shortly after on an LZ in 2009, and now is documented from SBS. No control planned.
Road	RS-SBW-04	*Tetragonia tetragonioides*	Interesting location occurrence as this species is usually found naturalized in coastal areas or locations where likely planted. No control planned.
Camp/ Other	OS-SBW-03 (Sand pile staging area)	*Albizia adianthifolia*	This taxa was a New State Record when collected in 2011 from Schofield Barracks and is now observed naturalizing across Schofield Barracks. Locations of occurrences will be documented and control of outlier plants on range will be discussed.

Survey Type	Survey Code	Significant Alien Taxa Seen	Discussion
Transect	WT-Kaluaa-01	*Pimenta dioca*	OANRP staff know of locations of this taxon in North Ekahanui and Huliwai Gulches, as well as in Lihue. It is not known from inside the Kaluaa and Waieli fence, however this location on the access trail to the MU will be documented and monitored to prevent further spread into the MU.
Transect	WT-Kaluaa-03	*Drymaria cordata var. pacifica*	This species ran rampant in the Hapapa Snail enclosure after alien canopy removal and heavy staff presence while conducting snail management in the last few years. This new find may represent staff spread of this on to the access trail. No control is planned, however if large patches form along the trail, control should be considered to prevent further spread along additional trails.
Transect	WT-MMR-02	*Vigna sp.*	This year OED staff helped identify several *Vigna* species that were collected from various surveys. Effort should be made during the next survey to collect a sample of this observed *Vigna* so that it can be identified to species.
Transect	WT-Palikea-01	*Crocosmia* X *crocosmiiflora, Cryptomeria japonica, Morella faya, Urochloa maxima*	*C.crocosmiiflora* is controlled inside the Palikea MU as an ICA, and is also controlled along this transect trail at regular intervals to prevent spread along the trail. It is not surprising that plants are observed even with regular control as plants reproduce vegetatively and complete control of 'clumps' via the preferred hand removal technique is not 100% successful, but does inhibit further spread. A large stand of *C. japonica* also occurs inside the MU and is targeted for gradual removal, and a known stand outside the MU that runs along this transect is not targeted for control. *M. faya* is only known as naturalized in this region of the Waianaes. Control efforts inside the Palikea MU are expected to increase this year using the IPA control method. *U. maxima* carries fire well and should be kept off of trails and fencelines.
LZ	LZ-HON-133 (Halona Ridge)	*Morella faya*	As mentioned in previous row, spread of *M. faya* to new areas should be avoided.
LZ	LZ-KLOA-018 (Black)	*Vigna luteola*	Another species of this genus was found on Poamoho Rd this year; both possibly agricultural introductions. No control planned.
LZ	LZ-KTA-016 (X-Strip)	*Paspalum cf. notatum*	This species was submitted to OED for identification and came back with a tentative id of *P. notatum*, a species known as naturalized on other islands, but not yet Oahu. Collection of fertile material will be important in correctly identifying this rhizomatous species.
LZ	LZ-MAK-143 (Burn Site)	*Nephrolepis brownii*	This LZ was the site of a fire in October 2007 and *N. brownii* (a fern) has likely taken advantage of the disturbed area created post fire. It forms dense understory clumps and spreads rapidly; control will be discussed.

Survey Type	Survey Code	Significant Alien Taxa Seen	Discussion
LZ	LZ-SBW-057 (Nalu's)	*Begonia foliosa*	This species occurs in abundance in the gulches at and below Mt. Kaala. This find documents a distant spread from known occurances (over 2 kilometers away from the summit of Kaala). Further spread of this taxa will be monitored, especially paying attention to any documentation of spread into Manuwai MU.
LZ	LZ-WAIKAIFR-110 (North of Puu Kepauula)	*Petrorhagia velutina*	Collected as a New Island Record in 2010 from SBW, observed at SBS this year, and now observed in the Waianae Kai Forest Reserve. No control planned.
Incidental	None (SBE)	*Chromolaena odorata*	Several immature individuals were noted while conducting surveys at SBE for another incipient weed species. This observation documents further spread of this highly invasive species between Army Training Ranges. Plants are aggressively controlled and monitored at the ICA created for this site and plants here are targeted for eradication; additional buffer surveys were conducted and no new plants were identified.
Incidental	Bottom corner of Kahanahaiki MU, just outside fence	*Eucalyptus urophylla*	This species was presumed planted on a Kuaokala Rd offshoot road, but now appears to be naturalizing with smaller size classes present. It is therefore considered a New State Record. No control is planned.
Incidental	None (Lower Peahinaia –Frog Pond)	*Nymphaea sp.*	A plant found growing in a mat type habit in the pond inside the Lower Peahinaia MU (rooted in the mud). Identified by OED as either *N. lotus*, or *N. rubra*. No control planned
Incidental	None (East of Whitmore Village)	*Thysanolaena latifolia*	Found a few 'patches' of overhead plants during a survey to scout potential Army training routes. OED notes that this species was historically known from this region (potentially as naturalized), and the observer for this collection noted that the plants appeared to have been occurrences of naturalization. No control planned.
Incidental	None (Keaau)	*Sideroxylon persimile*	This collection was taken from a single mature individual found in the ranch area in Keaau. It is noted in highest abundance in Makaha Valley, has been documented as naturalizing into Makua Valley, and is present in SBW. Any plants found inside the Keaau MU, and any MU in the Waianae Mts will be targeted for control.
Incidental	WT-Kapuna-01	*Veronica serpyllifolia*	Found along the Mokuleia trail while hiking into managed areas. Two 'patches' were found, one each in Keawapilau and Kapuna Gulches. While found on other islands, no additional locations of its presence has been reported on Oahu. No control planned.
Incidental	None (Palehua area)	*Viola hederacea*	This species is a small herb that was found growing as a mat growing in the middle of a cabin access road off the main Palehua Rd. It has been known from cultivation from other islands, but this observation is a new naturalizing record. No control planned.

1.8 INVASIVE SPECIES UPDATES

***Chromolaena odorata,* Devil Weed**

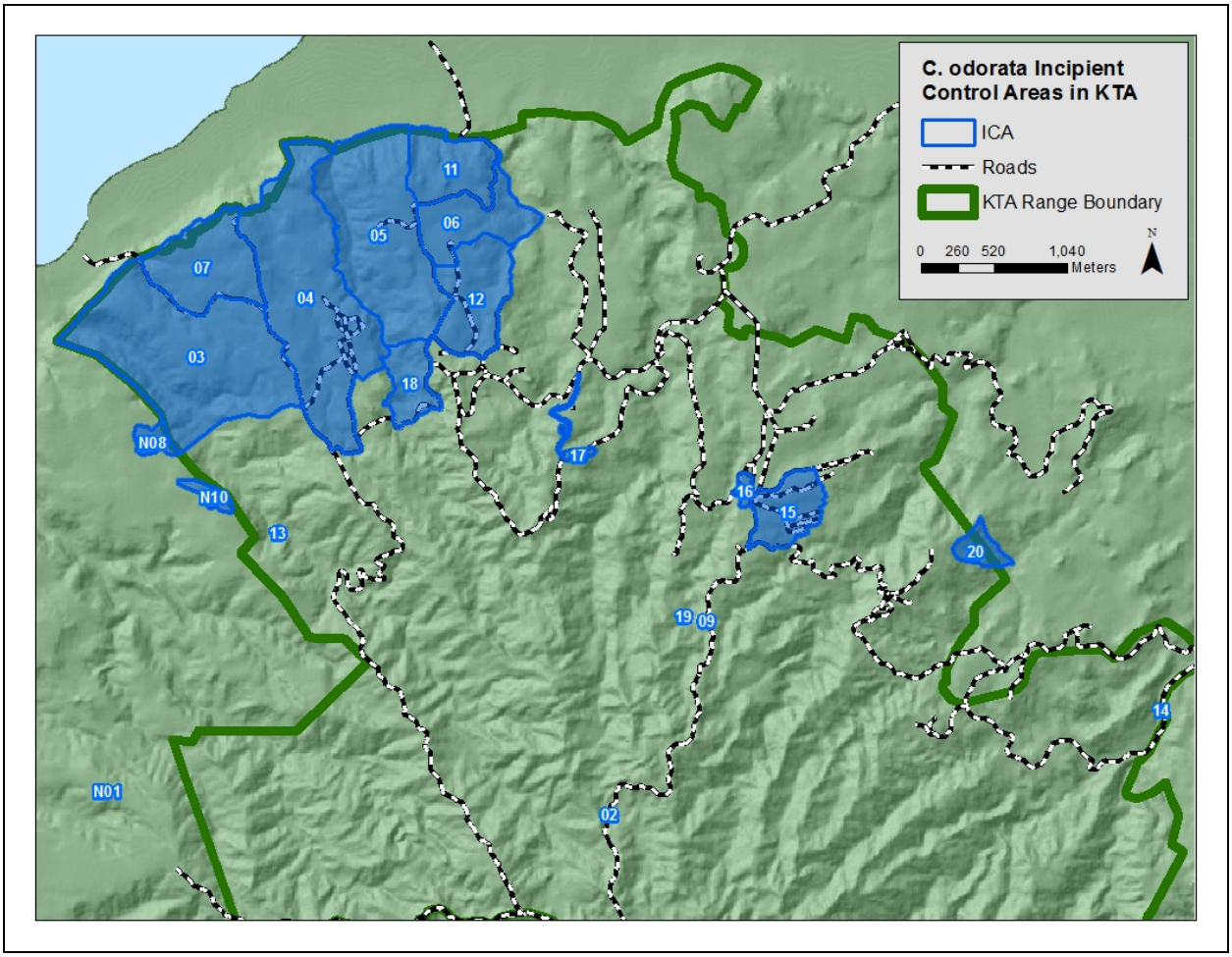
Control of *C. odorata* is a high priority for OANRP. Please see the 2011 Year End Report, Appendix 1-2 to view the draft management plan for *C. odorata* control.

It is clear that a much larger effort is needed if *C. odorata* is to be eliminated from Oahu. New finds at SBE and Aiea this year highlight the ease with which *C. odorata* moves on vehicles and humans. It seems likely that there are other unknown infestations located off Army training facilities; surveys need to be conducted across the island to better understand the scope of the infestation and set realistic goals. The Chromolaena odorata Working Group is one forum for discussing an island-wide control plan.

KTA Update

Control efforts at KTA account for almost 30% of all incipient control time this report year. In addition, OANRP continues to contract OISC to conduct control across almost half of the primary infestation.

C. odorata Incipient Control Areas at KTA



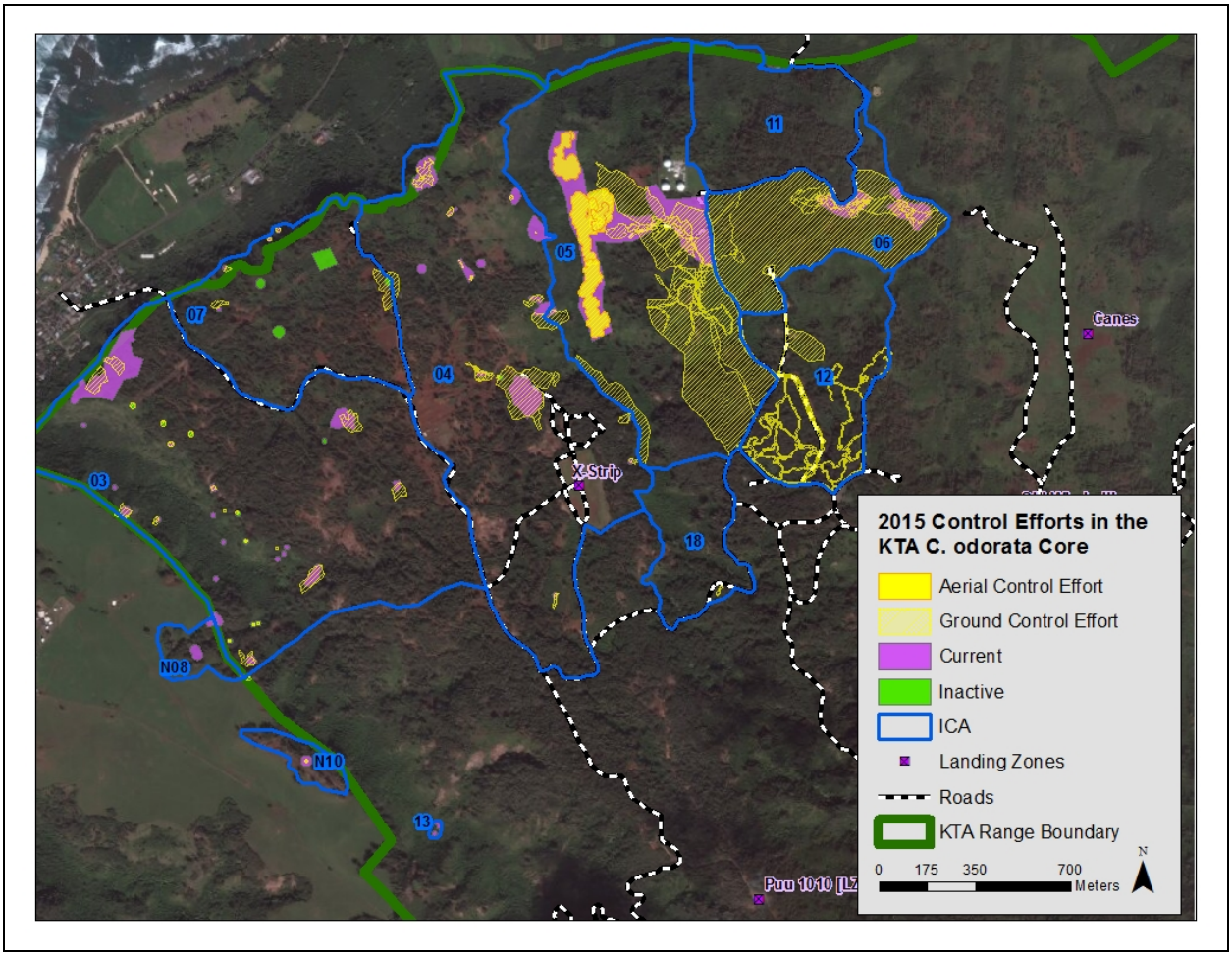
- Surveys resulted in one new ICA being discovered this year, #20. Located in the eastern, Delta Range, this ICA is on the border of the Training Range. Control efforts have not yet begun here.
- All control efforts are summarized in the table below. Each ICA is categorized. 'Outlier' ICA are isolated locations of few plants; all are located along roads or trails. 'OISC Contract' ICAs are managed by OISC; OANRP only conducts hotspot treatments in these ICAs. The 'Sweep + Hotspot + Aerial spray' ICA is the core of the infestation, and many control strategies are employed here. 'Sweep + Hotspot' ICAs require thorough ground sweeps, as well as hotspot treatments. ICAs marked as 'Trails, Roads, Hotspots' are not swept in their entirety, but rather, only pathways with high potential for dispersal are surveyed.

KTA Control Efforts

ICA	ICA Total Area (ha)	Area Weeded (ha)	Effort (person hours)	# Visits	ICA Type
WaimeaNoMU-ChrOdo-01	64 m²	64 m²	1.5	2	Outlier
KTA-ChrOdo-02	328 m²	328 m²	3	3	Outlier
KTA-ChrOdo-03	118.32	2.23	60.75	5	OISC Contract
KTA-ChrOdo-04	111.66	4.56	66.7	6	OISC Contract
KTA-ChrOdo-05	89.94	29.49	177	10	Sweep + Hotspot + Aerial spray
KTA-ChrOdo-06	29.32	27.14	92.75	7	Sweep + Hotspot
KTA-ChrOdo-07	40.69	0.73	13.5	2	OISC Contract
AimuuNoMU-ChrOdo-08	4.59	0	0	0	OISC Contract
KTA-ChrOdo-09	78 m²	78 m²	2	2	Outlier
AimuuNoMU-ChrOdo-10	3.73	78 m²	1.5	1	OISC Contract
KTA-ChrOdo-11	27.96	0	0	0	Sweep + Hotspot
KTA-ChrOdo-12	34.69	4.55	12.5	3	Trails, Roads, Hotspots
KTA-ChrOdo-13	0.21	0	0	0	Hotspot
KTA-ChrOdo-14	6 m²	6 m²	2.5	2	Outlier
KTA-ChrOdo-15	20.71	1.48	4	2	Trails, Roads, Hotspots
KTA-ChrOdo-16	2.20	0.13	1.5	2	Trails, Roads, Hotspots
KTA-ChrOdo-17	2.70	1.3	2	2	Trails, Roads, Hotspots
KTA-ChrOdo-18	16.43	0.03 (275 m²)	2.5	2	Trails, Roads, Hotspots
KTA-ChrOdo-19	78 m²	0	0	0	Outlier
KTA-ChrOdo-20	6.96	0	0	0	Trails, Roads, Hotspots
TOTALS	*510.15*	*71.72*	*443.7*	*51*	

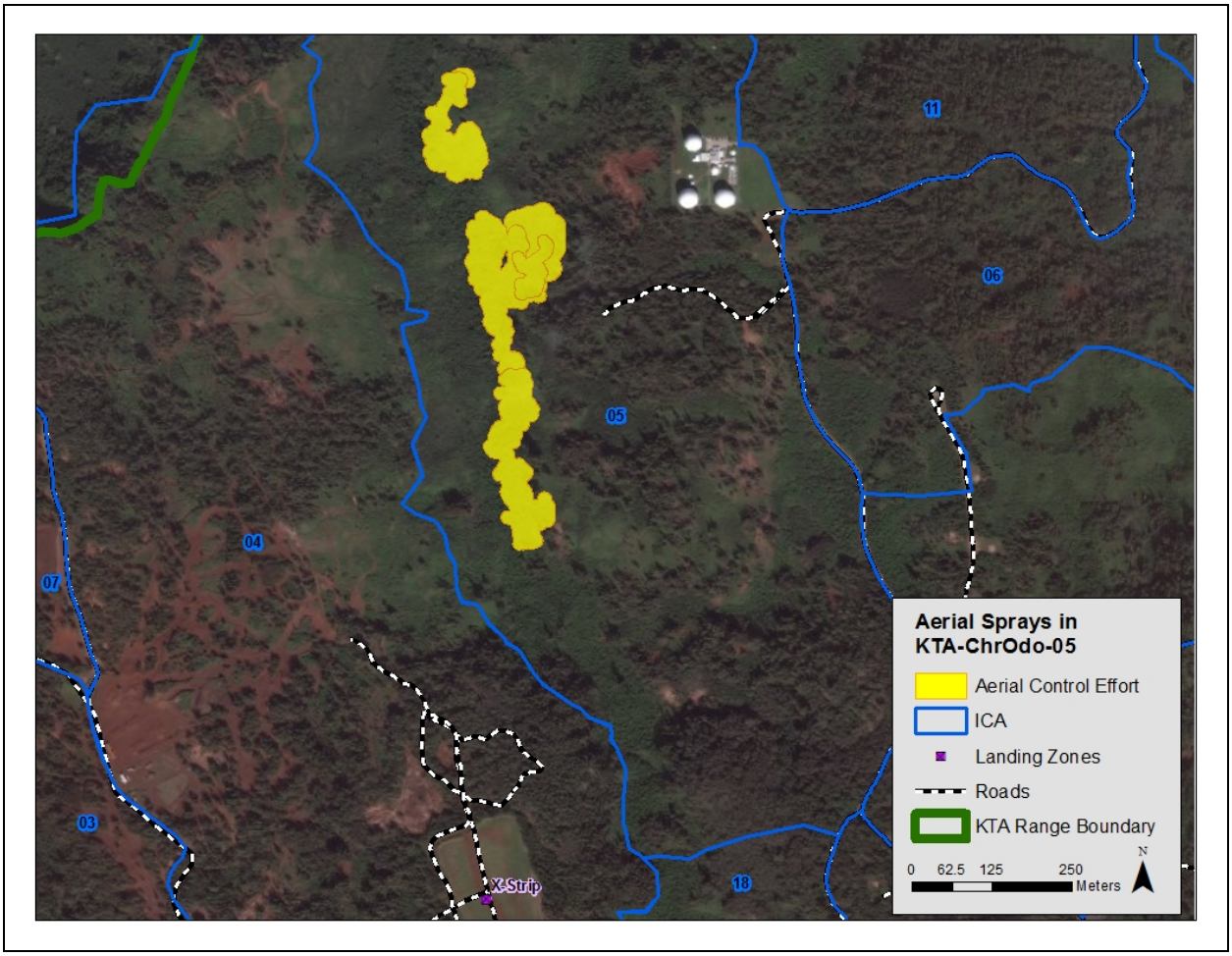
- The majority of effort was spent in ICAs #3, #4, #5, and #6; see map below. These ICAs encompass the primary infestation. All OANRP time spent in #3 and #4 was devoted to controlling designated hotspots. Many of these hotspots were surveyed, and few to no plants remain; these were classified as inactive, and will not receive special treatment trips outside of OISC ground sweeps any more. Lots of active hotspots remain, however, and they will continue to be targeted in the coming year. The majority of time spent in #5 and #6 was devoted to large scale sweeps. ICA #6 was swept in one day with a large crew. Large portions of #5 are not suitable for sweeps due to steep terrain; ground sweep efforts targeted the more gradual slopes. Some hotspot treatment was conducted in #5; these efforts were facilitated by clearing a path through a stand of trees to allow the power sprayer to be driven closer to known hotspots.

Control Effort in the Primary Infestation at KTA



- Aerial spray treatments finally began at KTA this year. Six were conducted, two in January, one in March, one in June and two in July. Several other trips were scheduled, but cancelled due to high winds. In all, 5.07 ha were treated aerially. The map below highlights aerial control efforts. While aerial sprays are efficient, they are not necessarily as effective as ground-based, high-powered sprays. Walking through one of the aerially treated zones, staff noted both completely dry and dead *C. odorata* plants, as well as plants which were re-sprouting, see photos below. This may be because some plants are sheltered by other vegetation, or do not receive a full dose of herbicide. Multiple aerial treatments may be needed to knock down large infestations to the point where follow-up treatments can be done from the ground.
- Mechanical problems plagued several of the aerial operations. Staff continue to make improvements. One early improvement was to switch from one aerosol type nozzle to an array of drip nozzles which produce a 'rain' like spray, see spray ball photos below. As equipment improves, staff hope both efficacy and efficiency are improved.
- While progress is being made at many ICAs, work is overdue at hotspot #s 11, 13, 19 and 20. These will be targeted in the coming year.

OANRP C. odorata Surveys at KTA



Left: array of three ‘rain’ nozzles. Right: spray ball with ‘rain’ nozzles being tested prior to flight.

Above: aerial control in progress. Below: close-up of ball sprayer in action.

Above: dead vegetation in the aerial spray area

Left: resprouting *C. odorata* along a trail. Right: dead *C. odorata* in the canopy

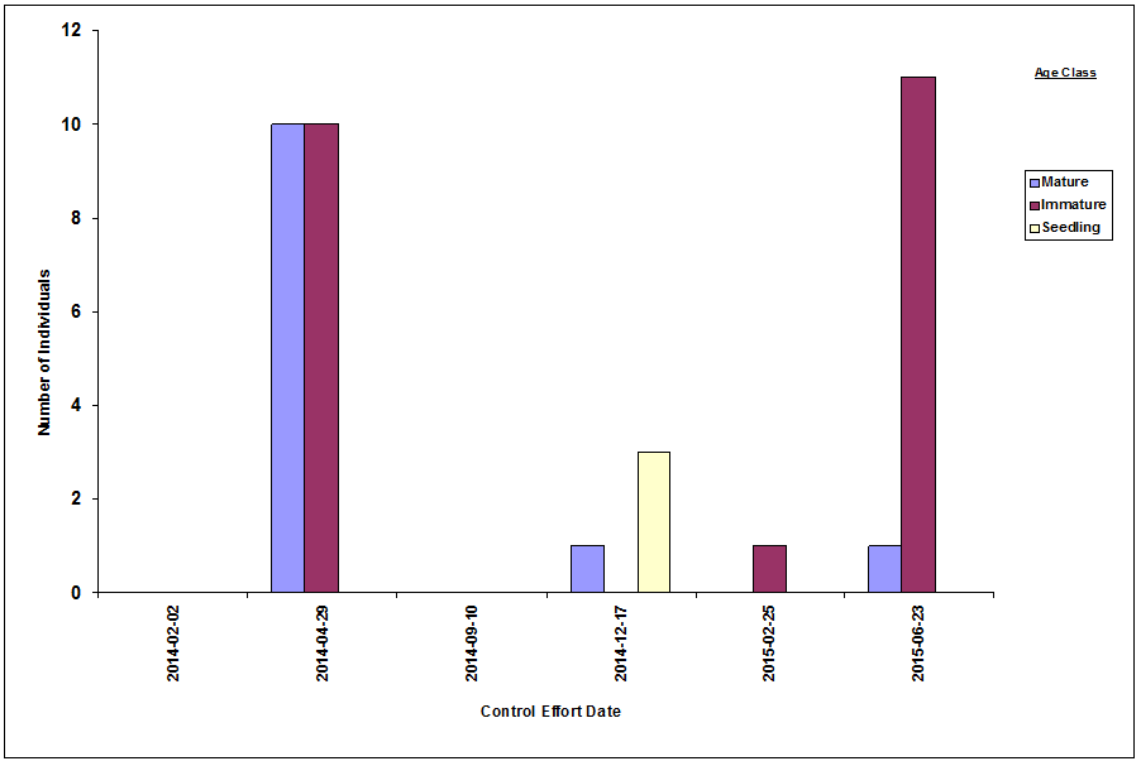
SB Update

Control efforts at SBW are limited by range availability and the need for a UXO escort in the area. OANRP has been able to take advantage of regularly scheduled range maintenance 'cold' days, which have provided sufficient access. The table below summarizes control efforts at Schofield in 2015:

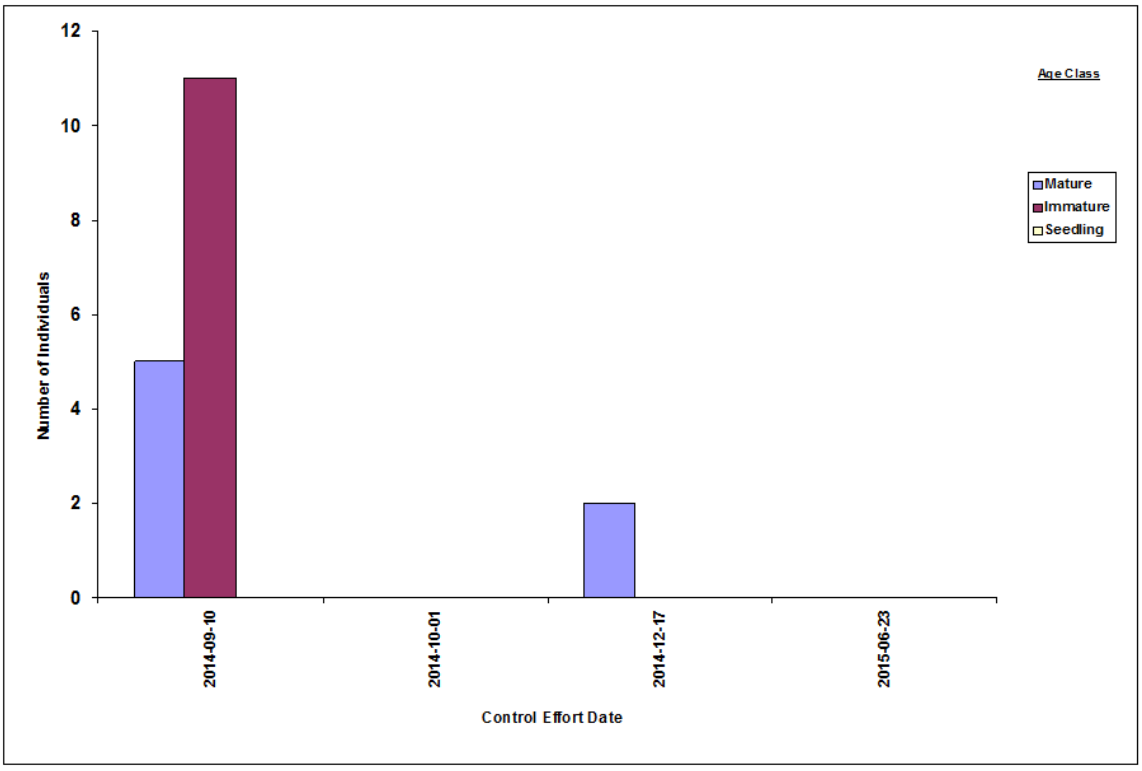
ICA	ICA Total Area (ha)	Area Weeded (ha)	Effort (person hours)	# Visits
SBWNoMU-ChrOdo-01	19.52	1.23	23	5
SBWNoMU-ChrOdo-02	1.11	0.70	5	3
SBWNoMU-ChrOdo-03	0.49	0.49	20	3
SBWNoMU-ChrOdo-04	22.68	3.66	24.5	5

- ICA #1 was split into two sections along the McCarthy Flats Access road. The split facilitates tracking of control efforts. ICA #1 remains the western end of the infestation, and ICA #4 now covers the eastern core of the infestation.
- Control efforts at ICA #1 focused on known hotspots. Surveys last year identified about five hotspots in this ICA. All were monitored and treated this year. Staff control all weeds in the hotspots with non-selective sprays, which suppress all vegetation, making *C. odorata* recruits easier to see, allowing for easier detection of potential UXO.
- ICA #2 is a discrete, outlier infestation. Despite aggressive sprays, staff noted many immature plants this year. In addition, the size of the ICA was increased when plants were found along the adjacent road, in a slightly new area. While overall numbers remain low, and few mature *C. odorata* have been observed since April 2014 (see ICA #2 graph below), it seems apparent that a persistent seed bank must have formed onsite.
- ICA #3 is also a discrete, outlier infestation. Despite very large, mature plants present on site, little recruitment has been observed thus far (see ICA #3 graph below). Much of this site is shaded, which may assist in suppressing recruitment of sun-loving *C. odorata*. Most of the 20 hours spent at this ICA were for delimiting surveys. Both ground and aerial surveys were conducted; fortunately, no additional plants were found.
- Efforts ramped up in the core of the infestation, ICA #4, significantly this year. Staff continued to spray easily accessible portions of the infestation from the ground, but only a small portion of the known plants can be reached in this way. UXO concerns prevent staff from walking through thickly vegetated areas (where the ground is obscured). To reach the rest of the infestation, staff began conducting aerial sprays. Four sprays were conducted, one in June, the rest in July. Note that the July hours are not reflected in the table above. Despite working through equipment challenges, 4.1 ha were treated. The map below shows both ground and aerial control for the past year, including the July sprays. In the coming year, staff hope to complete at least one full aerial treatment of all *C. odorata* patches in the ICA, as well as scout ground access routes into the gulch from the south.

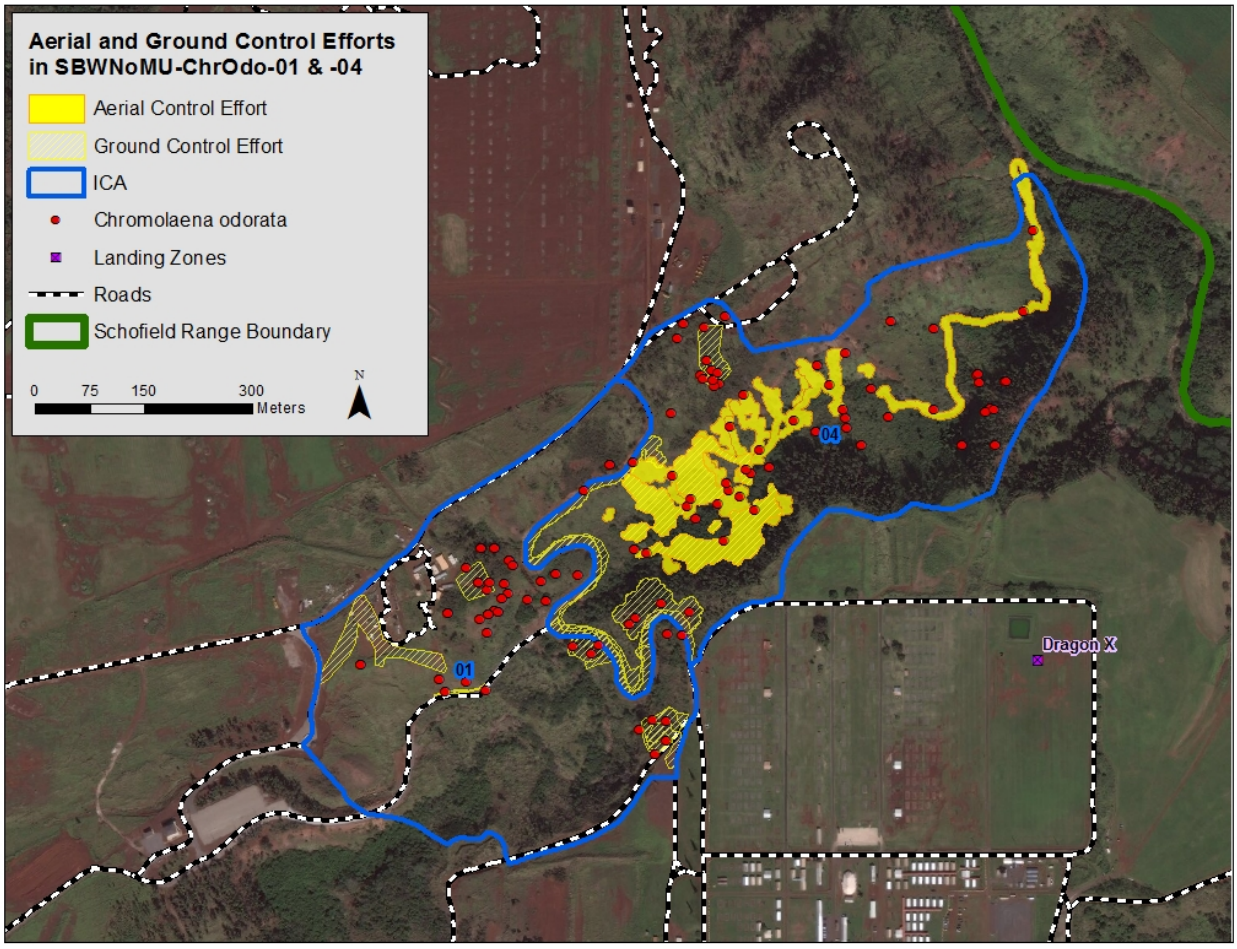
Numbers of plants found at C. odorata ICA #2, since discovery



Numbers of plants found at C. odorata ICA #3, since discovery



***C. odorata* Aerial Sprays and Ground Control at SB**



Looking across the gulch at part of the target aerial spray zone

SBE Discovery and Update

While conducting surveys for another incipient target at SBE, *Schizachyrium condensatum*, staff stumbled upon a small patch of immature *C. odorata*. This find was incredibly discouraging, as it demonstrated that *C. odorata* successfully dispersed to a third Army Training Range. SBE is heavily used, perhaps more so than KTA, so the find wasn't completely surprising. The plants were found at the end of a dirt road, in a clearing next to powerline poles, and there is concern that maintenance of powerline corridors could be yet another potential vector. Staff contacted HECO to discuss *C. odorata*; a meeting planned for earlier in the year was postponed, but is scheduled for the end of 2015.

C. odorata Location and Surveys at SBE

Control efforts are summarized in the table below. Staff completed a 200 m buffer survey around the site, with no new *C. odorata* sites found. Staff added *C. odorata* as a search target while conducting sweeps for *S. condensatum* across all of the heavily used western portion of SBE, and will continue to search for both incipient weeds in the coming year.

ICA	ICA Total Area (ha)	Area Weeded (ha)	Effort (person hours)	# Visits	Total # Plants Found
SBE-ChrOdo-01	0.18	0.14	8.4	3	15 immature (1st visit) 1 mature (2nd visit)

The road the plants were discovered on was surveyed in early 2014. Given the small size and immature status of the plants, it seems likely the infestation was less than a year old. Hopefully this site was caught early, before it could establish a seed bank.

Treated *C. odorata* at SBE

Aiea Discovery

At the end of November, an OANRP staff member hiking on the Aiea Loop Trail was startled to come across a large patch of *C. odorata* on the southeastern portion of the trail. OISC followed up with extensive surveys. The infestation connects with Camp Smith, where multiple trails connect from the facility to the Aiea Loop Trail. These side trails appear to be used by military personnel for physical training. OANRP staff assisted in connecting OISC with MCBH staff, who facilitated access to Camp Smith. OANRP also assisted with treating roadside plants at Camp Smith with the power sprayer.

In the coming year, OANRP will continue to provide support to OISC. This may include flying water to known hotspots, assisting with hotspot treatment with the power sprayer, and following up with Marine/Navy staff to leverage funding for further control.

1.9 NOVEL WEED CONTROL TECHNIQUE DEVELOPMENT

Blechnum appendiculatum Herbicide Control Trials

Background: *Blechnum appendiculatum* (palm fern) is an escaped ornamental fern from Central and South America that spreads by spores and subterranean stolons. It readily invades natural areas forming nearly solid mats on the forest floor where it displaces low-growing plants (Mootoka *et al.* 2003) and has been observed to inhibit seedling recruitment around rare plant species managed by OANRP. The palm fern is a direct competitor for space and nutrients with native ferns such as *Diellia* (Mehltreter *et al.* 2010). In previous field trials good results were achieved by trenching (isolating patches of the fern by cutting the network of stolons around the perimeter of the mat) followed by a foliar application of Garlon 5% G4 in water. DLNR has also had good results with herbicides containing the active ingredient imazapyr; however, they observed it migrated at least a foot from the treatment area thereby risking harm to non-target plants (Hardman, *unpub. data*).

These previous trials suffered from the lack of replication and control groups, so conclusions were limited and often qualitative. We set out to systematically evaluate differences in efficacy between three herbicides with different active ingredients. Though trenching worked in the previous trials, we did not trench in this test because it was labor intensive and we wanted to know whether the herbicides would be effective used alone. All were foliar applications and applied according to label rates (148 ml of herbicide mixture to 1 m^2). The three formulations tested were: Garlon 4 10% (*a.i.* triclopyr) with crop oil, Ranger pro 2% (*a.i.* glyphosate) with water and Polaris 2% (*a.i.* imazapyr) with water. This is the first time OANRP has tested glyphosate for control of this species. I refer to these herbicides by their trade names for the rest of this document (Garlon, Ranger and Polaris).

Research questions

1. Which of three herbicide formulations killed palm fern most rapidly with no trenching?
2. Which of the three herbicides remained effective at suppressing regrowth from rhizomes at 1 year?
3. Does patch size influence herbicide efficacy?

Secondary questions addressed:

4. How far outside of the treated area did herbicides migrate (as indicated by changes in plant vigor outside of the plot)?
5. Were non-target plants adversely impacted by treatment?

Methods: Palm fern patches share rhizomes and resources with neighbors. Treated plants surrounded by untreated plants are therefore expected to be more resistant to herbicide and/or resprout more quickly than those growing in small isolated patches. We controlled for this by arranging plots in a randomized block design, with each of the three herbicide treatments and a control plot replicated within each discreet fern patch (block). In March 2014 we located 10 patches of palm fern in Ekahanaui MU (Figure 1). Within each patch four 1 m^2 plots were established no closer than 1 m to the patch edge and to one another. This meant that the smallest measured 25 m^2 while the remainder varied in size with the largest patch covering an area 100 m^2. Blocks were classified as small ($25 \leq 45$ m^2), medium ($45 \leq 65$ m^2) or large ($65 \leq 100$ m^2). Four blocks were small; four medium, and two were in the largest group. Most patches had dense healthy cover and a one-way ANOVA confirmed no significant difference in cover between blocks ($F_{9,30} = 2.10$, $p = 0.3$).

The response variable was measured in the following manner. At each monitoring event a photo point was taken, the percent cover (dead and alive) of palm fern recorded (mean from two different observers), the presence of dead fern or other plants outside of the plot boundary noted and the presence of any co-occurring species. These data were taken immediately prior to treatment on March 20 (day 0) then at one, two, six and 13 months subsequently. No significant pre-treatment differences in live fern cover (Fig. 2) was evident between herbicide and control groups according to a one-way ANOVA ($F_{3,36} = 0.56$, $p = 0.64$).

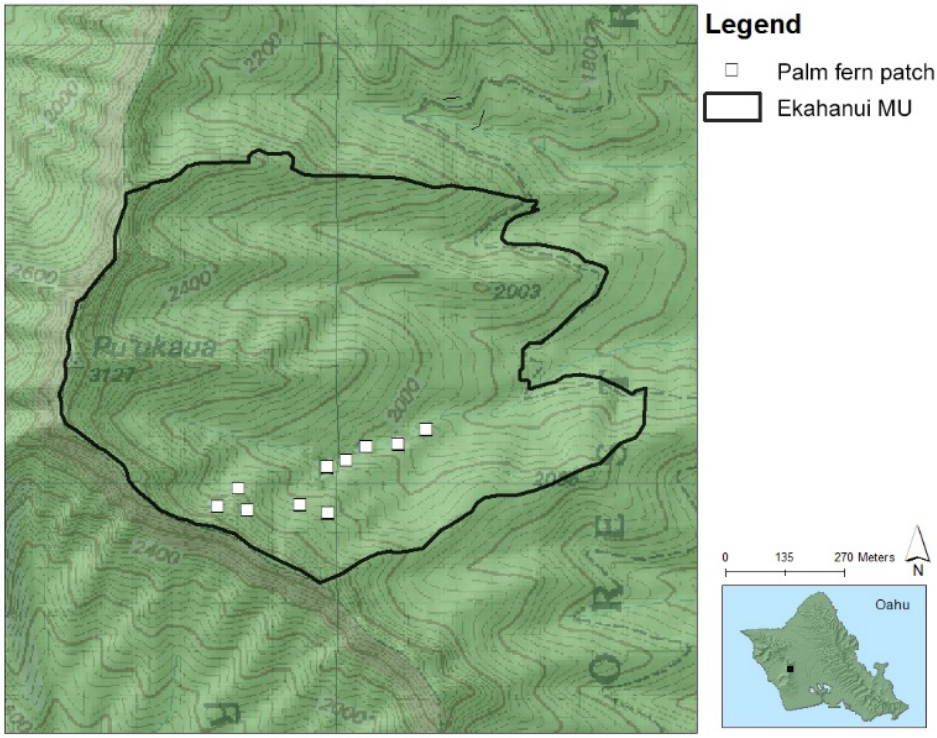


Figure 1. Palm fern patch (block) locations. Three herbicide treatments were repeated within each block.

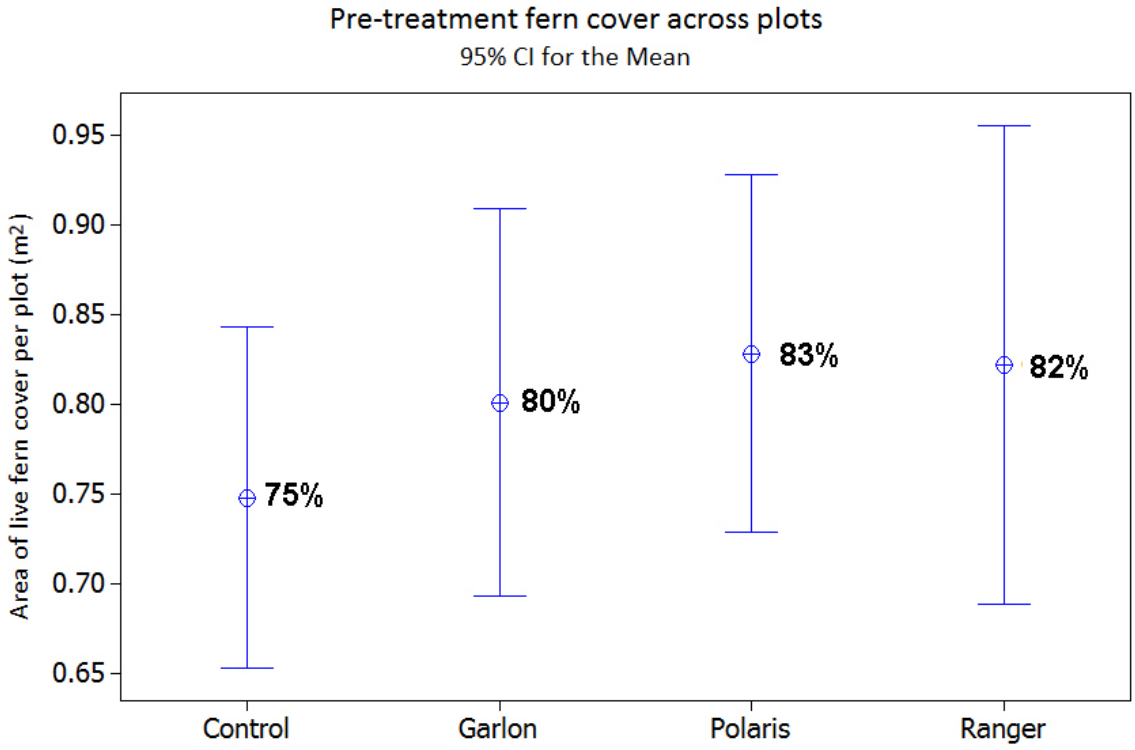


Figure 2. Pre-treatment fern cover shows no significant differences between groups. Mean cover ranged from 75-83%.

Results: Change in live fern cover at each time period was calculated as a percent deviation from pre-treatment values. A positive number indicated an increase; zero equaled to no change and negative values, a reduction in fern cover. All herbicide treatments significantly reduced fern cover over the control group by 2 months and treatments were equally effective at 6 months, however, Polaris had a slower onset (Fig. 3). While Garlon and Ranger immediately reduced fern cover by close to 100%, Polaris needed as least 6 months to catch up with the other two treatments (Fig. 4). The effect of treatment, time, and block (fern patch size) was analyzed using General Linear Model (GLM) and we made post-hoc comparisons between groups using a Tukey's HSD. Fern cover was significantly affected by treatment (GLM, $F_{3,108} = 174.81$, $p = 0.000$) but not by block (GLM, $F_{9,108} = 0.95$, $p = 0.498$). Reductions in fern cover by treatment and block are shown in Figure 5.

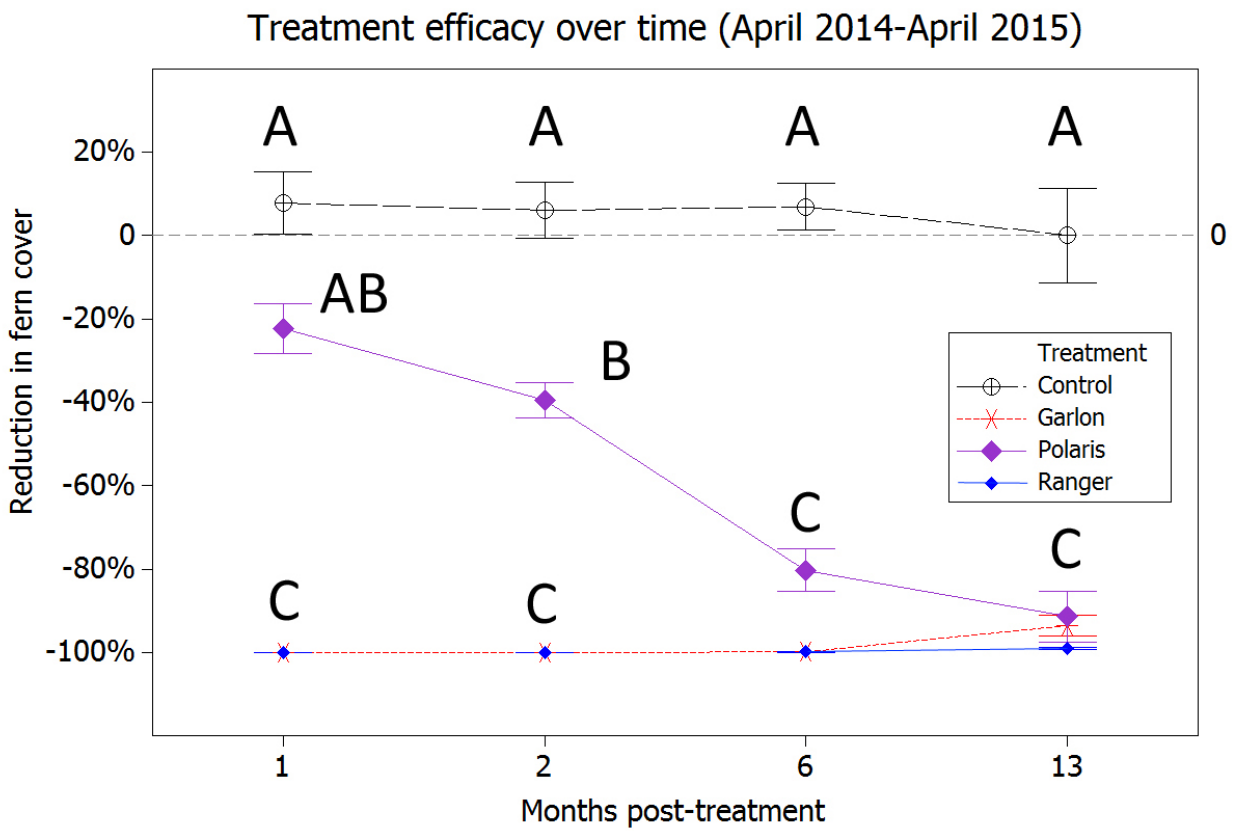


Figure 3. Change in fern cover over time by herbicide treatment. Bars are ± 1 standard error from the mean (SEM). Letters indicate groups which differed significantly from one another according to post-hoc comparisons.

Figure 4. Photos of representative plots of Polaris vs. Garlon over time. Notice that the Polaris at two months has not yet killed all of the fern, but by 13 months has achieved complete suppression. An asterisk (*) marks a kukui (*Aleurites moluccanus*) tree in the Polaris plot for reference.

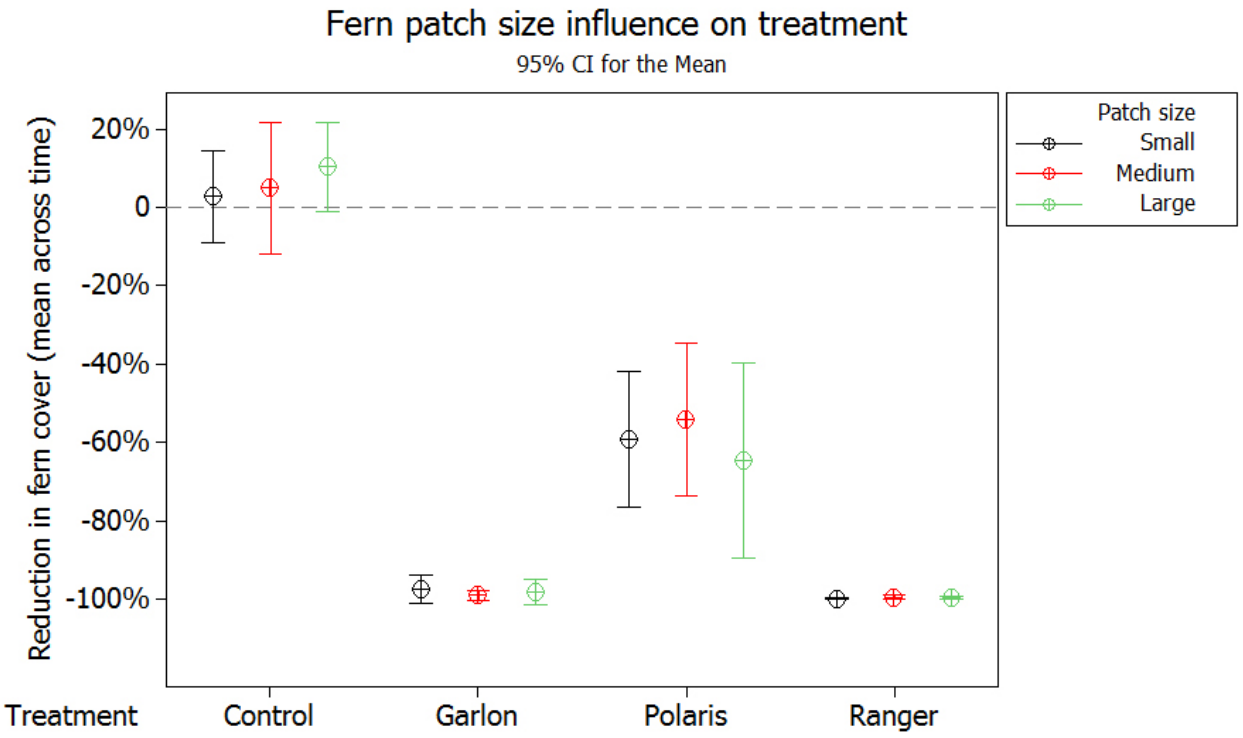


Figure 5. Performance of herbicides within differently sized blocks. This is an average of all times and does not reflect final herbicide efficacy at 13 months. Notice that the herbicides performed similarly despite fern patch size and that larger patch sizes did not confer herbicide resistance.

Neither Garlon or Ranger was observed to migrate outside of the plot (as indicated by dead or dying adjacent plants). Polaris appeared to have a slightly greater influence on nearby vegetation but only at small distances (not exceeding 40 cm from plot boundary). Co-occurring plants within plots did not fare well under any herbicide regimen (Table 1). Not all species occurred in all plots, *Clidemia*, for example only occurred in only two plots and died following treatment. *Passiflora suberosa* died in one of the control plots for unknown reasons.

Table 1. List of co-occuring plants which also died after treatment.

Species	Treatment
Pisonia spp.	Polaris, Garlon, Ranger
Oplismenus hirtellus	Polaris, Garlon, Ranger
Aleurites moluccana	Polaris, Garlon, Ranger
Clidemia hirta	Polaris, Garlon
Passiflora suberosa	Polaris, Garlon, Ranger, Control

Conclusions: Foliar application of any of the three herbicides tested are effective at controlling palm fern for up to 13 months regardless of the size of the patch. Trenching and cutting of stolons is not necessary. Non-target plants will be impacted by treatments so care should be used around native species, especially if they are uncommon. This is the first time Ranger was tested on palm fern and it is an acceptable alternative to Garlon. Both Garlon and Ranger are postemergent systemic (translocated) herbicides that do not persist for a long time in the soil. The half-life for Ranger in soil is 60 days and for Garlon it is about 30 days. Polaris, by contrast, is a preemergent herbicide which suppresses regrowth and new plant regeneration over time. Though slower to take action, it prevents regrowth of plants and is designed to

persist in soil for 5 months or longer depending on rainfall. The label also cautions: “untreated trees can .. be affected by root uptake .. through movement into topsoil.. and onto areas where their roots extend.” Thus, Polaris use would not be appropriate in an area where rare plant outplanting is planned within the next 5 months, or where rare native plants may be exposed. It may be appropriate, however in very weedy areas where natives won’t be introduced for one year or more following weed control.

Works Referenced

Mehltreter, K., L.R. Walker, J.M. Sharpe. 2010. Fern Ecology. Cambridge University Press.

Motooka, P., L. Castro, D. Nelson, G. Nagai, and L. Ching. 2003. Weeds of Hawai‘i’s Pastures and Natural Areas; An Identification and Management Guide. College of Tropical Agriculture and Human Resources, University of Hawai‘i at Manoa.

CHAPTER 2: RARE PLANT MANAGEMENT

2.1 PROJECT HIGHLIGHTS

During this reporting period, OANRP outplanted a total of 2,136 individuals of MIP and OIP taxa. Specifically, 1,491 individuals of seven Makua taxa, 462 individuals of three OIP taxa and 152 individuals of four taxa shared between both IPs. In the last year, OANRP made 287 observations at *in situ* sites of IP taxa and 286 observations at outplanting sites. Some of this year's highlights include:

Cyanea grimesiana subsp. *obatae* (MIP & OIP): A project was initiated to conduct supplemental pollination experiments to compare the fitness of progeny from self-pollinated, intra-population and inter-population hand crosses. This project was designed to address concerns for difficulty of *ex situ* propagation and poor survival and lack of recruitment at outplantings and wild sites. OANRP decided to conduct supplemental pollinations and not emasculate flowers at the risk of damaging the flowers and inhibiting fertilization. This technique also allowed for the quantification of pollen limitation by comparing seed set in fruits that receive supplemental pollen to controls (open-pollinated; natural conditions). If methods, however, can be developed to emasculate flowers without negatively impacting pollination, they will allow for certainty that propagules are from hand-pollinations and not from autogamy (flower selfing). Bags were applied to prevent additional pollen deposition on hand-pollinated flowers. Pollen was collected and used within a two week period to reduce artificial selection during storage. Early-life stage fitness measurements include fruit set, seed set, seed weight, seed viability, seed storage potential and seedling survivorship (from germination to the first true leaves). Long-term fitness measurements include nursery success, survival after outplanting, years to maturity, and the number of flowers and fruits produced at the first year of maturity. We could also assess pollen viability from these first flowers by collecting pollen samples. In lieu of measuring later life stages, seeds could be used in seed sow trials to compare fitness via recruitment (dependent on the number of seeds collected per treatment). Methods were approved by OANRP, NARS, and OPEPP staff. This project is ongoing and results will be presented over the next several years.

Eugenia koolauensis (OIP): Collections were made from all known sites in the last year. Vegetative cuttings and small immature plants have been salvaged from every site to secure a nursery living collection of 150 founders. There are now 117 founders represented in the OANRP nursery including 30 small immature plants that were removed from the wild populations. In the coming year, OANRP will complete these collections, replicate the founders and pursue experimental outplantings to investigate feasibility of maintaining an *inter situ* collection.

Gardenia mannii (OIP): Collections were made from 26 founders in the last year to secure a living collection in the OANRP nursery. This collection will be used to produce propagules by vegetatively cloning the trees for outplanting. Efforts are also being made to induce flowering in these collections to begin breeding system research and produce viable seeds for storage and propagation for outplanting. The first outplanting of stock grown from the nursery living collection was conducted in January 2015 in Lihue (SBW). All outplants are still alive and one began to flower shortly after it was planted. These sites will be supplemented with additional male founders from the Koolau Mountain PUs in the coming year because all of the four founders with known sex from the Waianae Mountains are observed to be female (pollen absent; ovules present). There are two founders with unknown sex. All of the six founders in the Koolau Mountains with known sex are believed to be male (pollen present; ovules absent). There are approximately 28 more trees in the Koolau Mountains and 3 from the Waianae Mountains with unknown sex. In the coming year, clones of male trees from the Koolau Mountains will be added to the Lihue PU.

Labordia cyrtandrae (OIP): The outplanting sites at Kaala were monitored in the last year and many of the plants were observed in flower. Staff spent time to hand-pollinate the flowering plants and many were

observed producing fruit soon afterwards. This is likely to have increased the amount of seed produced at the site this year. The sites will be monitored for seedlings in the coming year as fruit will not likely mature and dehisce until early 2016. In the coming flowering season, OANRP will investigate whether the outplants are being effectively pollinated and producing viable seeds.

Pritchardia kaalae (MIP): A bulk collection of 200 fruit was scheduled to be made from the large wild population in Makua for testing protocols for storage at the National Center for Genetic Resources Preservation. However, when the plants were visited in Oct. 2014 and again in Feb. 2015, there were not enough mature fruit to make a collection. Rat damage was observed to be more extensive than in previous years and it is also possible that high-wind events limited fruit production during that season. Due to access restrictions into MMR, the site has not been revisited since.

Sanicula mariversa (MIP): The first large-scale outplanting with this taxon occurred in February 2015. The 186 plants were grown for two full seasons before being outplanted in February 2015. Due to access restrictions into MMR, the site has not been monitored since and their fate is unknown.

Stenogyne kanehoana (OIP): The first outplanting of this taxon back into a historic site in SBW occurred in January 2015. Stock grown from the two original wild founders from Kaluaa and Lihue were planted with stock cloned from two seedlings produced via a hand-pollination cross of the two founders. These sites will be supplemented with additional stock in the coming year.

2.2 TAXON STATUS SUMMARY

In the last year, there have been changes in the number of mature plants at 56/131 of the Manage for Stability Population Units managed by OANRP. Table 2.2.1 shows the Population Units where a change was observed in the last reporting period. The difference in the number of mature plants reported last year and this year is given (#Mat), with the percent change observed at each (%change). Most of the largest changes are due to fluctuations at outplanting sites when more plants are added, many plants in the same cohort mature at the same time, or are observed to have died at the same time. PU that are in **bold text** are wild *in situ* PUs that have not been augmented with outplants, so that the increase in the total number of plants is due to natural recruitment, the death of known plants OR better estimates from recent surveys. For taxa covered by the Makua Implementation Plan, the largest changes occurred in PU that have been augmented with outplants with a few exceptions. For example, there were notable declines in the number of wild mature plants in the Makua PU of *Euphorbia celastroides* var. *kaenana* and significant declines at smaller PUs of *Alectryon macrococcus* var. *macrococcus, Tetramolopium filiforme* and *Hibiscus brackenridgei* subsp. *mokuleianus*. Increases at the *Melanthera tenuifolia* PU at Mt. Kaala NAR, and *Nototrichium humile* were due to more thorough surveys of known sites. For taxa covered by the Oahu Implementation Plan, the largest changes also occurred due to fluctuations in the number of mature outplants, especially for *Phyllostegia hirsuta, Gardenia mannii, Stenogyne kanehoana* and *Abutilon sandwicense*. Otherwise, surveys by OANRP and the Koolau Mountains Watershed Partnership located more wild individuals of *Cyanea acumintata, C. koolauensis, Gardenia mannii*. More wild plants were observed in flower at known populations of *Abutilon sandwicense* in the last year, causing increases at two MFS PUs. Significant declines continue at PUs of *Eugenia koolauensis*, and fewer *Cyanea acuminata* were observed at the Helemano-Punaluu PU, but otherwise most decreases in OIP taxa occurred at outplantings of *Phyllostegia* sp. The declines observed at these sites were not a surprise, but are a reminder that these PUs may have to be maintained by repeated short-lived outplantings.

Table 2.2.1 MFS PUs sorted by Decreasing and Increasing numbers of Mature Plants. **Bold** PUs have only wild plants. ΔMat = the change (negative or positive) to the number of mature plants from 2014. %change= percent observed (negative or positive).

IP	Species and MFS PUs with DECREASES	Δ Mat	% change	IP	Species and MFS PUs with INCREASES	Δ Mat	% change
MIP	**AleMacMac- Kahanahaiki to Keawapilau**	-3	-100%	OIP	GarMan- Haleauau	67	3350%
MIP	**HibBraMok- Keaau**	-1	-100%	OIP	AbuSan- Kahanahaiki	59	454%
MIP	**VioChaCha- Halona**	-19	-86%	OIP	PhyHir- Koloa	72	288%
OIP	PhyMol- Ekahanui	-65	-86%	OIP	AbuSan- Ekahanui and Huliwai	28	156%
OIP	PhyMol- Pulaii	-22	-67%	OIP	**GarMan- Helemano and Poamoho**	3	113%
MIP	**TetFil- Waianae Kai**	-10	-50%	OIP	SteKan- Haleauau	109	100%
MIP	**EupCelKae- Makua**	-40	-47%	MIP	CenAgrAgr- Makaha and Waianae Kai	161	94%
MIP	**AleMacMac- Makua**	-5	-46%	MIP	CyaLong- Makaha and Waianae Kai	95	86%
MIP	**AleMacMac- Kaluaa to Central Waieli**	-1	-33%	MIP	HesOah- Pualii	5	83%
OIP	PhyMol- Kaluaa	-44	-33%	MIP	**SanMar- Kamaileunu**	4	80%
MIP	SchNut- Kapuna-Keawapilau Ridge	-24	-32%	MIP	TetFil- Puhawai	11	52%
OIP	**CyaAcu- Helemano-Punaluu**	-59	-31%	MIP	HesOah- Pahole NAR	2	50%
OIP	**EugKoo- Oio**	-2	-29%	OIP	LabCyr- Koloa	10	44%
MIP	SchKaa- Pahole	-23	-28%	MIP	**MelTenf- Mt. Kaala NAR**	51	42%
MIP	DelWai- Manuwai	-24	-27%	OIP	**AbuSan- Makaha Makai**	27	42%
MIP	SchObo- Keawapilau to West Makaleha	-14	-24%	MIP	SchObo- Makaha	42	29%
MIP	NerAng- Waianae Kai Mauka	-3	-23%	MIP	NerAng- Manuwai	27	24%
OIP	PhyHir- Haleauau- Mohiakea	-20	-22%	MIP	EupHer- Kapuna to Pahole	13	23%
MIP	**HibBraMok- Haili to Kawaiu**	-1	-20%	OIP	**AbuSan- Kaawa to Puulu**	5	19%
MIP	SchKaa- Kaluaa and Waieli	-32	-19%	MIP	SchObo- Kahanahaiki to Pahole	51	18%
OIP	**SchTri- Kalena to East Makaleha**	-56	-16%	MIP	**NotHum- Kaluakauila**	28	18%
OIP	**HesSwe- Kaukonahua**	-10	-15%	OIP	**CyaKoo- Poamoho**	3	17%
OIP	**EugKoo- Kaunala**	-3	-13%	MIP	SchNut- Makaha	11	16%
MIP	HibBraMok- Makua	-9	-11%	MIP	CyaGriOba- Pahole to West Makaleha	11	15%
MIP	HibBraMok- Manuwai	-13	-8%	MIP	DelWai- Ekahanui	28	14%
MIP	CyaSupSup- Pahole to Kapuna	-7	-7%	MIP	CyaSupSup- Kahanahaiki	8	14%
OIP	SteKan- Kaluaa	-2	-7%	MIP	CyaGriOba- South Ekahanui	11	13%
OIP	**CyaKoo- Kaipapau, Koloa & Kawainui**	-7	-6%	OIP	PhyHir- Puu Palikea	13	13%
MIP	DelWai- Kahanahaiki to Keawapilau	-13	-5%	MIP	KadDegDeg- Alaiheihe and Manuwai	8	10%
MIP	CyaGriOba- Palikea (South Palawai)	-5	-5%	MIP	CyaGriOba- Kaluaa	13	10%
MIP	SchNut- Kahanahaiki to Pahole	-5	-5%	MIP	DelWai- Kaluaa	60	9%
OIP	**CyaAcu- Makaleha to Mohiakea**	-7	-4%	OIP	LabCyr- East makaleha to North Mohiakea	24	9%
MIP	NotHum- Manuwai	-4	-4%	OIP	**CyaAcu- Kaluanui and Maakua**	10	9%
MIP	**AleMacMac- Makaha**	-1	-3%	MIP	**CyrDen- Kahanahaiki**	3	8%
MIP	CenAgrAgr- Kahanahaiki and Pahole	-8	-3%	MIP	CyaLong- Kapuna to West Makaleha	2	7%
MIP	PriKaa- Makaleha to Manuwai	-1	-1%	MIP	**CyaLong- Pahole**	3	5%
				OIP	**CyaKoo- Opaeula to Helemano**	1	5%
				MIP	PlaPriPri- Ekahanui	2	4%

The Taxon Status Summary for each IP taxon is included as Appendix 2-1. The example shown below (Table 2.2.2), displays the management designation, the original MIP or OIP population total, last year's reported total and the current status of the wild and outplanted plants for each PU. The PUs are grouped

by those located inside the MIP or OIP AA (In) and PUs where all plants are outside of both AAs (Out). Definitions for each field are given below.

Table 2.2.2. Example of a Taxon Status Summary using *Cenchrus agrimonioides* var. *agrimonioides*

Makua Implementation Plan - Population Unit Status

Action Area: In

TaxonName: Cenchrus agrimonioides var. agrimonioides Target # of Matures: 50 # MFS PU Met Goal: 3 of 3

Population Unit Name	Management Designation	Total Mature Original IP	Total Imm Original IP	Total Seedling Original IP	Total Mature 2014	Total Immature 2014	Total Seedling 2014	Total Mature Current	Total Immature Current	Total Seedling Current	Wild Mature Current	Wild Immature Current	Wild Seedling Current	Outplanted Mature Current	Outplanted Immature Current	Outplanted Seedling Current	PU LastObs Date	Population Trend Notes
Kahanahaiki and Pahole	Manage for stability	210	66	0	327	138	128	319	61	79	80	42	70	239	19	9	2015-09-02	Thorough monitoring in the last year showed a decline
Kuaokala	Genetic Storage				1	3	0	1	3	0	1	3	0	0	0	0	2014-04-30	No monitoring in the last year
	In Total:	210	66	0	328	141	128	320	64	79	81	45	70	239	19	9		

Action Area: Out

TaxonName: Cenchrus agrimonioides var. agrimonioides Target # of Matures: 50 # MFS PU Met Goal: 3 of 3

Population Unit Name	Management Designation	Total Mature Original IP	Total Imm Original IP	Total Seedling Original IP	Total Mature 2014	Total Immature 2014	Total Seedling 2014	Total Mature Current	Total Immature Current	Total Seedling Current	Wild Mature Current	Wild Immature Current	Wild Seedling Current	Outplanted Mature Current	Outplanted Immature Current	Outplanted Seedling Current	PU LastObs Date	Population Trend Notes
Central Ekahanui	Manage for stability	20	0	0	168	89	0	168	89	0	47	72	0	121	17	0	2014-09-02	Monitoring showed no change
Makaha and Walanae Kai	Manage for stability	9	3	0	10	7	5	171	128	5	5	7	5	166	121	0	2015-04-13	More plants were added to the outplanting site
South Huliwai	Genetic Storage	27	0	0	15	13	0	15	13	0	15	13	0	0	0	0	2014-09-03	Monitoring showed no change
	Out Total:	56	3	0	193	109	5	354	230	5	67	92	5	287	138	0		
	Total for Taxon:	266	69	0	521	250	133	674	294	84	148	137	75	526	157	9		

Population Unit Name: Groupings of Population Reference Sites. Only PUs designated to be 'Manage for Stability' (MFS), 'Manage Reintroduction for Stability/Storage,' or 'Genetic Storage' (GS) are shown in the table. Other PUs with 'No Management' designations are not managed and their status will not be tracked or reported.

Management Designation: For PUs with naturally occurring (*in situ*) plants remaining, the designation is either 'Manage for Stability' or 'Genetic Storage'. Some MFS PUs will be augmented with outplantings to reach stability goals. When reintroductions alone will be used to reach stability, the designation is 'Manage Reintroduction for Stability.' When a reintroduction will be used for producing propagules for genetic storage, the designation is 'Manage Reintroduction for Storage'.

Total Original IP Mature, Immature, Seedling: These first three columns of numbers display the original population numbers as noted in the first Implementation Plan reports of MIP (2005), and OIP (2008). When no numbers are displayed, the PU was not known at the time of the IPs

Total Mature, Immature and Seedling 2014: This displays the **SUM** of the number of *wild and outplanted* mature, immature plants and seedlings from the previous year's report. These numbers should be compared to those in the next three columns to see the change observed over the last year.

Total Current Mature, Immature, Seedling: The **SUM** of the *current* numbers of *wild and outplanted* individuals in each PU. This number will be used to determine if each PU has reached stability goals for mature plants. These last three columns can be compared with the previous three columns to see the change observed over the last reporting period.

Wild Current Mature, Immature, Seedling: These set of three columns display the most up to date population estimates of the wild (*in situ*) plants in each PU. These numbers are generated from OANRP

monitoring data, data from the Oahu Plant Extinction Prevention Program (OPEP), Koolau Mountains Watershed Partnership and Oahu NARS staff. The estimates may have changed from last year if estimates were revised after new monitoring data was taken or if the PUs have been split or merged since the last reporting period. The most recent estimate is used for all PUs, but some have not been monitored in several years. Several PU have not been visited yet by OANRP and no plants are listed in the population estimates. As these sites are monitored, estimates will be updated.

Outplanted Current Mature, Immature, Seedling: The third set of three columns display the numbers of individuals OANRP and partner agencies have outplanted into each PU. This includes augmentations of *in situ* sites, reintroductions into nearby sites and introductions into new areas.

PU LastObs Date: Last Observation Date of the most recent Population Reference Site observed within a PU. Where thorough monitoring was done, the estimates were updated.

Population Trend Notes: Comments on the general population trend of each PU are given here. This may include notes on whether the PU was monitored in the last year, a brief discussion of the changes in population numbers from the previous estimates, and some explanation of whether the change is due to new plants being discovered in the same site, a new site being found, reintroductions or augmentations that increased the numbers or fluctuations in the numbers of wild plants. In some cases where the numbers have not changed, OANRP has monitored the PU and observed no change. When the PU has not been monitored, the same estimate from the previous year is repeated.

2.3 THREAT CONTROL SUMMARY

The Threat Control Summary for each IP taxon is included as Appendix 2-2. An example shown below (Table 2.3.1), includes the current status of fence construction and removal of pigs and goats from Management Units, invasive plant, rat and slug control and preventing wildfire. For MIP taxa in the last reporting period, changes in ungulate threat control were due to construction of a new fence at Keaau for *Hibiscus brackenridgei* subsp. *mokuleianus* and a significant reduction in ungulates within the fenced Lihue MU, resulting in a lower threat. The ungulates remaining in the Upper Kapuna MU and the Opaeula MU have been eliminated and a determination was made that ungulates are not a threat to the few *Cyanea longiflora* at the Kapuna to West Makaleha PU that are outside of the fence. It was also determined that ungulates are not a threat to the *Hibiscus brackenridgei* subsp. *mokuleianus* at the Haili to Kawaiu PU or to the *Tetramolopium filiforme* at the Puhawai PU and *Viola chamissoniana* subsp. *chamissoniana* at the Puu Kumakalii PU and Puu Hapapa PU. If ungulate sign is observed near these PUs, the threat will be added and control will be prioritized. Fence construction and ungulate removal is ongoing at the Keaau PU of *Gouania vitifolia* by the Oahu Plant Extinction Prevention Program and the Waianae Mountains Watershed Partnership. The PUs where ungulates remain a threat to MIP taxa are the *Kadua degeneri* subsp. *degeneri* at Central Makaleha and West Branch of East Makaleha, the *Melanthera tenuifolia* at Kamaileunu and Waianae Kai, the *Kadua parvula*, *Plantago princeps* var. *princeps* and *Viola chamissoniana* at Halona, and the *Pritchardia kaalae* in the Makaleha to Manuwai PU. For the OIP MFS PUs in the last year, many pigs have been removed from the within the Lihue MU and the threat was reduced for: *Cyanea acuminata, Gardenia mannii, Labordia cyrtandrae, Phyllostegia hirsuta, Schiedea trinervis,* and *Stenogyne kanehoana*. Additional OIP MFS PUs will be protected from ungulates once they are removed from the recently completed Poamoho MU fence. Other fences being considered by DOFAW for Kaluanui, East Makaleha and Poamoho would protect additional OIP MFS PUs. The PUs where ungulates would remain a threat to OIP taxa are the *Hesperomannia sweezyi* at the Lower Peahinaia PU and the Kaukonahua PU, and the *Cyanea acuminata* at the Helemano-Punaluu Summit Ridge to North Kaukonahua PU.

Weed control continues at most MU. Due to time constraints caused by the reduced reporting period, data for weed control was not analyzed. Over the last reporting period, weed control was conducted at 46/100 MIP MFS PUs. This is a 33% reduction from last year because the reporting period was three months shorter than the previous period and access restrictions in Makua prevented staff from weeding there. Many of the PUs where no weeding was done occur on difficult terrain such as cliffs, or are PUs where outplantings have not yet begun and therefore the sites have not been managed. For OIP taxa, weed control was conducted at 18/31 MFS PUs in the last reporting period. The same number of PUs had weed control in the previous period. Little or no control was conducted around PUs in remote areas such as Opeaula, Helemano, Kaluanui, Kaipapau, Koloa and Kaukonahua. These sites are relatively native-dominated and may not require as much invasive plant management as other PU. Some of these areas are managed by the Koolau Mountains Watershed Partnership which also conducts weed control. Other PUs receiving less OANRP weed control than others are the Kaawa to Puulu PU and Makaha Makai PU of *Abutilon sandwicense* and sites with *Eugenia koolauensis*. The sites with *E. koolauensis* have been a lower priority in the last few years given the overwhelming threat of Myrtle Rust to the remaining plants, however, the habitat is being rapidly degraded and fuel levels are increasing at all sites.

Rat control continued around many PU in the last year. Although rats are considered a potential threat to most IP taxa, they are only controlled around sites where significant damage has been observed. There are situations where occasional damage to a few plants is observed. In those cases, if the damage is not observed again, control is not immediately installed and the site is monitored more closely. Rats are considered a threat to 11 of the 28 taxa in the MIP and are controlled at 15 of the 45 MFS PU with those taxa. Rats are considered a threat to six of the OIP taxa at 17 PUs, but currently are controlled only around the Ekahanui PU of *Phyllostegia mollis*.

Slugs are a threat to seedlings and small immature plants of many native plants. They are noted as a threat to 16 of the 28 MIP taxa and are currently controlled at 10 of the 57 MFS PUs with those taxa. For the nine OIP taxa where slugs are a threat, there are currently 24 MFS PUs, but slugs are not currently controlled at any PUs. Decisions on where to initiate control are based on staff availability and only at sites without native snails that qualify under label restrictions. Future outplantings for IP taxa that may be dependent on slug control will be planned for areas that do not have those restrictions.

Fire is noted to be a threat to all taxa in both IPs. For the purposes of this report, fire is considered to be a threat to 17 of the 100 MFS PUs for MIP taxa. Of those, fuels have been reduced and the threat from wildfire reduced at four PUs in Makua and in Waianae Kai. For the OIP taxa, wildfire is considered to threaten 5 of the 31 MFS PUs. Fuels and the threat of fire has been reduced at the three MFS PUs for *Eugenia koolauensis* and at the Kaawa to Puulu PU of *Abutilon sandwicense*, but not at the Ekahanui and Huliwai PU for *A. sandwicense*. OANRP has continued to contract mowing of fallow agriculture lands along the Kaukonahua Rd. to eliminate fuels and prevent wildfires from moving from that area into the Lower Kaala NAR as one did in 2007. This action partially controls the threat of fire to Genetic Storage PUs of *Hibiscus brackenridgei* subsp. *mokuleianus* and *Eugenia koolauensis*, and to the MFS Kaawa to Puulu PU for *Abutilon sandwicense*.

The Threat Control Summary for each IP taxon is included as Appendix 2-2. An example shown below (Table 2.3.1), summarizes the threat status at each Population Unit for every IP taxa. “Yes,” “No,” or “Partial” is used to indicate the level of threat management. Partial management has additional percentage based upon the number of mature plants being protected.

Table 2.3.1. Example of a Threat Control Summary using *Cenchrus agrimonioides* var. *agrimonioides*

Threat Control Summary

Action Area: In

TaxonName: Cenchrus agrimonioides var. agrimonioides

PopulationUnitName	ManagementDesignation	# Mature Plants	Ungulates Managed	Weeds Managed	Rats Managed	Slugs Managed	Fire Managed
Kahanahaiki and Pahole	Manage for stability	319	Yes	Partial 2%	Partial 37%	No	No
Kuaokala	Genetic Storage	1	No	No	No	No	No

Action Area: Out

TaxonName: Cenchrus agrimonioides var. agrimonioides

PopulationUnitName	ManagementDesignation	# Mature Plants	Ungulates Managed	Weeds Managed	Rats Managed	Slugs Managed	Fire Managed
Central Ekahanui	Manage for stability	168	Yes	No	Yes	No	No
Makaha and Waianae Kai	Manage for stability	171	Partial 97%	Partial 96%	No	No	No
South Huliwai	Genetic Storage	15	No	No	No	No	No

= Threat to Taxon within Population Unit
No Shading = Absence of threat to Taxon within Population Unit
Ungulate Managed = Culmination of Cattle, Goats, and Pig threats

Yes=All PopRefSites within Population Unit have threat controlled
No=All PopRefSites within Population Unit have no threat control
Partial%=Percent of mature plants in Population Unit that have threat controlled
Partial 100%= All PopRefSites within Population Unit have threat partially controlled
Partial 0%= Threat partially controlled, but no mature plants

Population Unit Name: Groupings of Population Reference Sites. Only PUs designated to be 'Manage for Stability' (MFS), 'Manage Reintroduction for Stability/Storage,' or 'Genetic Storage' (GS) are shown in the table.

Management Designation: Designations for PUs with ongoing management are listed. Population Units that are MFS are the first priority for complete threat control. PUs that are managed in order to secure genetic storage collections receive the management needed for collection (ungulate and rodent control), but may be a lower priority for other threat control.

 # Mature Plants: Number of Mature Plants within the Population Unit.

Threat Columns: The most common threats are listed in the next columns. To indicate if the threat is noted at each PU, a shaded box is used. If the threat is not present at that PU, it is not shaded.
Threat control is defined as:
Yes = All sites within the PU have the threat controlled
No = All sites within the PU have no threat control
Partial %= Percent of mature plants in Population Unit that have threat controlled
Partial 100%= All PopRefSites within Population Unit have threat partially controlled
Partial (with no %) = All PopRefSites within Population Unit have threat partially controlled and only immature plants have been observed.
Partial 0%= Threat partially controlled, but no mature plants are currently present in the PU.

Ungulates: This threat is indicated if pigs, goats or cattle have been observed at any sites within the PU. This threat is controlled (Yes) if a fence has been completed and all ungulates removed from the site. Most PUs are threatened by pigs, but others are threatened by goats and cattle as well. The same type of fence is used to control for all three types of ungulates on Oahu. Partial indicates that the threat is controlled for some but not all plants in the PU or only one of the ungulate threats has been controlled. If some of the mature plants in a MFS PU are outside of the fence, the threat is partially controlled for the percentage of mature plants inside the fence. If all plants are fenced, but only goats have been eliminated, the threat has been partially controlled for 100% of the mature plants.

Weeds: This threat is indicated at all PUs for all IP taxa. This threat is controlled if weed control has been conducted in the vicinity of the sites for each PU. If only some of the sites have had weed control, 'Partial' is used to indicate what portion of the PU has had control.

Rats: This threat is indicated for any PUs where damage from rodents has been confirmed by OANRP staff. This includes fruit predation and damage to stems or any part of the plant. The threat is controlled if the PU is protected by snap traps and bait stations. For some taxa, rats are not known to be a threat, but the sites are within rat control areas for other taxa so the threat is considered controlled. In these cases, the box is not shaded but control is 'Yes' or 'Partial.' Partial indicates that the threat is fully controlled over part of the PU.

Slugs: This threat is indicated for IP taxa as confirmed by OANRP staff. Currently, slug control is conducted under an Experimental Use Permit from Hawaii State Department of Agriculture, which permits the use of Sluggo®. Partial indicates that the threat is fully controlled over part of the PU.

Fire: This threat is indicated for PUs that occur on Army lands within the high fire threat area of the Makua AA, and some PUs within the Schofield West Range AA and Kahuku Training Area that have been threatened by fire within the last ten years. Similarly, PUs that are not on Army land were included if there is a history of fires in that area. This includes the PUs below the Honouliuli Contour Trail, the gulches above Waialua where the 2007 fire burned including Puulu, Kihakapu, Palikea, Kaimuhole, Alaiheihe, Manuwai, Kaomoku iki, Kaomoku nui and Kaawa and PUs in the Puu Palikea area that were threatened by the Nanakuli fire. Threat control conducted by OANRP includes removing fuel from the area with pesticides, marking the site with Seibert Stakes for water drops, and installing fuel-breaks in fallow agricultural areas along roads. 'Partial' means that the threat has been partially controlled to the whole PU, not that some plants are fully protected. Firebreaks and other control measures only partially block the threat of fire which could make it into the PU from other unprotected directions.

2.4 GENETIC STORAGE SUMMARY

The Genetic Storage Summary for each IP taxon is included as Appendix 2-3. Every year, OANRP collects propagules from IP taxa for *ex situ* genetic storage. The amount of propagules to meet these goals were pre-determined in the MIP and OIP. In general, each wild plant (up to 50 plants from each PU) needs either 50 viable seeds (as estimated at the time of collection) or 3 explants/plants in tissue culture or nursery. There were 46 PUs where genetic storage collections were already completed as of September 2014. In the year since, collections were completed at an additional 8 PUs. These include *Cyanea grimesiana* subsp. *grimesiana* in Pahole to West Makaleha PU and Kaluaa PU; *Cyrtandra dentata* in Pahole to West Makaleha PU, *Delissea waianaeensis* in Kahanahaiki to Keawapilau PU, *Eugenia koolauensis* in Palikea to Kaimuhole PU, *Nototrichium humile* in Kaimuhole to Palikea Gulch PU, *Phyllostegia hirsuta* in Kaipapau to Kawainui PU, and *Schiedea nuttallii* in Kapuna-Keawapilau Ridge.

Two PU that met the 100% goal due to a decline in the number of founders in the PU were excluded from this list.

When we look at the number of founders that need to be represented, 40% of them are complete and PU average 41% completion. This is an increase from 37% in 2014 (Table 2.4.1). We completed representation of an additional 18 founders this past year, in addition to starting collections of many other founders. In 2014, we averaged 33% completion of collections inside of the Action Area and currently we have completed 36% of the collections. We averaged 47% completion for MIP and MIP/OIP overlap taxa in 2015, up from 44% completion in 2014; OIP taxa average 28% completion in 2015 (up from 24% in 2014). We had 142 out of 228 PU (62%) with some progress towards completion in 2014 and 2015, indicating that we did not complete a collection from a new founder in a new PU this year, despite the fact that new collections were made from new PU (*i.e. Gardenia mannii*). In 2014, we had 49 PU with greater than 90% completion and in 2015 we had 58%. Lastly, on average we have made more progress toward completing collections from MFS PU (52%) than GS PU (31%).

For the second year in a row we were unable to collect *Pritchardia kaalae* fruits from the main population at Ohikilolo to send to the National Center for Genetic Resources Preservation (NCGRP). In 2014, invasive rodents and birds are suspected for removing and destroying fruits so that there were very few mature fruit to collect at a single point in time. At the end of 2014 through the beginning of 2015 we increased rodent control and frequency of monitoring but we have been denied access by the Army for most of 2015 and collections for this year and next year are doubtful due to the rodent control efforts that will be necessary to yield a large number of mature fruits at one time. OANRP currently contracts NCGRP to determine cryopreservation techniques for *P. kaalae* and to create and maintain a genetic storage collection for this species. Fortunately, we were able to collect hundreds of fruit from our living collection of *Eugenia koolauensis* to send to NCGRP to determine cryopreservation techniques.

Table 2.4.1. Summary statistics to indicate progress during the FY2015 in genetic storage collections. There are 228 total PU that require *ex situ* representation via seed banking, tissue culture, or living collections in the Army Nursery.

Completion Summary Statistics	*2014*	*2015*
Average PU Genetic Storage Completion	37%	41%
MIP and MIP/OIP Overlap Species	44%	47%
OIP Species	24%	28%
PU With No Founder Representation	86 (38%)	86 (38%)
PU With >90% Representation	49 (21%)	58 (25%)
PU With ≥75% Representation	60 (26%)	74 (32%)
Additional Founders Represented in FY2015 (# of founders with completed collections)	(1776)	18 (1794)
Comparison of MFS PU : GS PU Completion	48%: 27%	52%: 31%

The Genetic Storage Summary for each IP taxon is included as Appendix 2-3. In the example below (Table 2.4.2), estimates of seeds remaining in genetic storage account for the expected viability of the stored collections. The viability rates of a sample of most collections are measured prior to storage. These rates are used to estimate the number of viable seeds in the rest of the stored collection. If the product of (the total number of seeds stored) and (the initial percentage of viable seeds) is >50, that founder is considered secured in genetic storage. If each collection of a species is not tested, the initial viability is determined from the mean viability of (preference in descending order): 1. Other founders in that collection; 2. That founder from other collections; 3. All founders in that population reference site; 4. All founders of that species.

Table 2.4.2. Example of a Genetic Storage Summary using *Cenchrus agrimonioides* var. *agrimonioides*

Genetic Storage Summary

		# of Potential Founders			Partial Storage Status				Storage Goals				Storage Goals Met	
Population Unit Name	Management Designation	Current Mature	Current Imm.	Dead and Repres.	# Plants >= 10 in SeedLab	# Plants >= 10 Est Viable in SeedLab	# Plants >=1 Microprop	# Plants >=1 Army Nursery	# Plants >= 50 in SeedLab	# Plants >= 50 Est. Viable in SeedLab	# Plants >=3 in Microprop	# Plants >=3 Army Nursery	# Plants that Met Goal	% Completed Genetic Storage Requirement
Action Area: In														
Cenchrus agrimonioides var. agrimonioides														
Kahanahaiki and Pahole	Manage for stability	80	42	40	74	56	0	2	34	10	0	1	11	22%
Kuaokala	Genetic Storage	1	3	0	0	0	0	1	0	0	0	1	1	100%
Action Area: Out														
Cenchrus agrimonioides var. agrimonioides														
Central Ekahanui	Manage for stability	47	72	18	36	19	0	40	12	1	0	38	38	76%
Makaha and Waianae Kai	Manage for stability	5	7	6	3	2	0	9	0	0	0	9	9	82%
South Huliwai	Genetic Storage	15	13	13	18	10	0	20	6	3	0	17	19	68%

Total Current Mature	Total Current Imm.	Total Dead and Repres.	Total # Plants w/ >=10 Seeds in SeedLab	Total # Plants w/ >=10 Est Vaible Seeds in SeedLab	Total # Plants w/ >=1 Microprop	Total # Plants w/ >=1 Army Nursery	Total # Plants w/ >=50 Seeds in SeedLab	Total # Plants w/ >=50 Est Viable Seeds in SeedLab	Total # Plants w/ >=3 in Microprop	Total # Plants w/ >=3 Army Nursery	Total # Plants that Met Goal
148	137	77	131	87	0	72	52	14	0	66	78

Number (#) of Potential Founders: These first columns list the current number of live *in situ* immature and mature plants in each PU. These plants have been collected from already, or may be collected from in the future. The number of dead plants from which collections were made in the past is also included to show the total number of plants that could potentially be represented in genetic storage for each PU since collections began. Immature plants are included as founders for all taxa, but they can only serve as founders for some. For example, for *Hibiscus brackenridgei* subsp. *mokuleianus*, cuttings can be taken from immature plants for propagation. In comparison, for *Sanicula mariversa*, cuttings cannot be taken and seed is the only propagule used in collecting for genetic storage. Therefore, including immature plants in the number of potential founders for *S. mariversa* gives an over-estimate. The 'Manage reintroduction for stability/storage' PUs have no potential founders. The genetic storage status of the founder stock used for these reintroductions is listed under the source PU.

Partial Storage Status: To meet the IP genetic storage goal for each PU for taxa with seed storage as the preferred genetic storage method, at least 50 seeds must be stored from 50 plants. This year, the number of seeds needed for each plant (50) accounts for the original viability (Estimate Viability) of seed collections. In order to show intermediate progress, this column displays the number individual plants that have collections of >10 seeds in storage. For taxa where vegetative collections will be used to meet storage goals, a minimum of three clones per plant in either the Lyon Micropropagation Lab, the Army nurseries or the State's Pahole Mid-elevation Nursery is required to meet stability goals. Plants with one or more representatives in either the Lyon Micropropagation Lab or a nursery are considered to partially meet storage goals. The number of plants that have met this goal at each location is displayed.

 # Plants that Met Goal: This column displays the total number of plants in each PU that have met the IP genetic storage goals. As discussed above, a plant is considered to meet the storage goal if it has 50 seeds in storage or three clones in micropropagation or three in a nursery. For some PUs, the number of founders has increased in the last year; therefore, it is feasible that NRS could be farther from reaching collection goals than last year. Also, as seeds age in storage, plants are outplanted, or explants contaminated, this number will drop. In other PUs where collections have been happening for many years, the number of founders represented in genetic storage may exceed the number of plants currently extant in each PU. In some cases, plants that are being grown for reintroductions are also being counted for genetic storage. These plants will eventually leave the greenhouse and the genetic storage goals will be met by retaining clones of all available founders or by securing seeds in storage. This column does not show the total number of seeds in storage; in some cases thousands of seeds have been collected from one plant.

% Completed Genetic Storage Requirement: Describes the percent of Founder Plants that have met Genetic Storage goals. Genetic storage of at least 50 seeds each from 50 individuals, or at least three clones each in propagation from 50 individuals, is required for each PU. If there are fewer than 50 founders for a PU, genetic storage is required from all available founders. For example, if there are at least 50 seeds from five individuals, or at least three clones in propagation from five individuals, then listed in the tables is 10%.

CHAPTER 3: *ACHATINELLA MUSTELINA* MANAGEMENT

3.1 BACKGROUND

In 2014 OANRP prepared a three year management plan for *Achatinella mustelina* ESUs. This year OANRP reports on ESU highlights of the past year and progress toward the goals set in 2014. The three snail enclosures are working as designed and construction plans are being developed for additional snail enclosures in suitable habitat. Without snail enclosures almost all native snail populations of *A. mustelina* would be headed for extinction.

OANRP have prepared a tree snail monitoring overview which is included as Appendix 3-1. This overview summarizes the history and context that have influenced OANRP's tree snail monitoring schedule, frequency and applied methods. This section was prepared at the request of the USFWS.

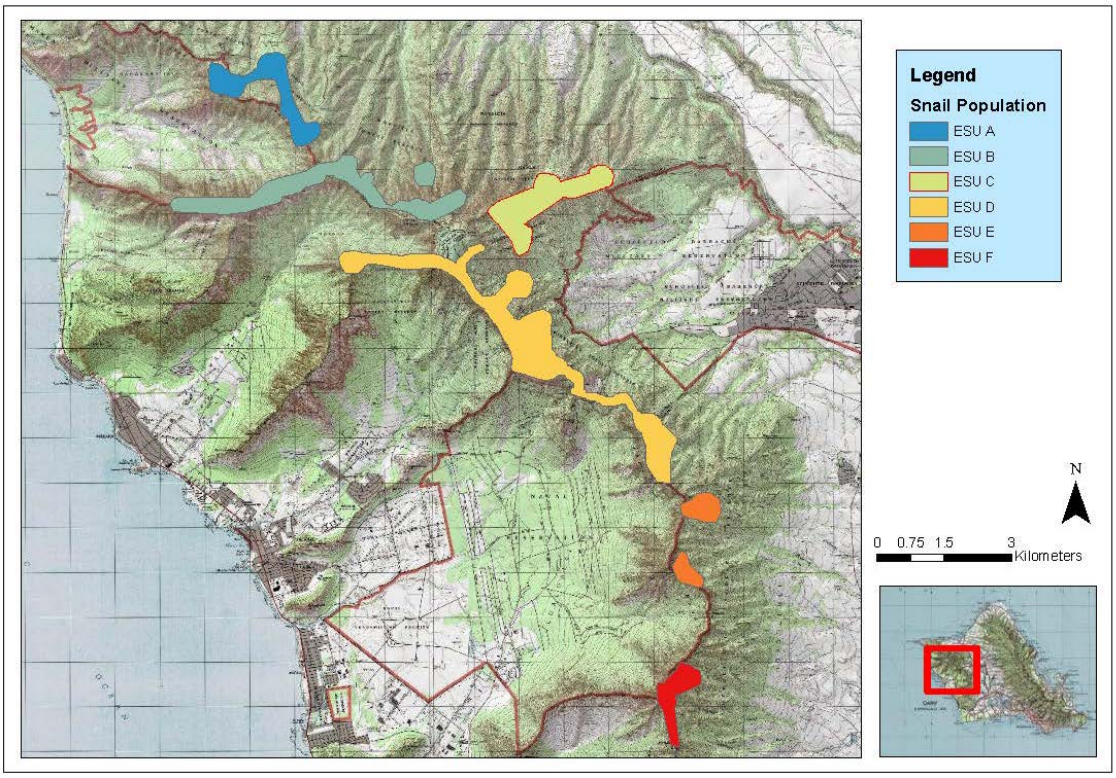


Figure 1. Map of Six ESUs

3.2 ESU-A

Map removed to protect rare resources. Available upon request

Figure 2. Map of ESU-A

3.2.1 Update ESU-A

3.2.1.1 MMR-A, Kahanahaiki Enclosure PU

Monitoring of the *A. mustelina* population within the enclosure has been continued quarterly, including timed-counts and ground shell monitoring. There has been no evidence of predator incursion, and *A. mustelina* mortality has been very limited. Current TCM (Timed Count Monitoring) numbers continue to show a stable trend within the enclosure and TCM will continue be conducted quarterly.

Installation of the remote monitoring system has been delayed due to upgrading of the system being conducted by technicians in California. A new remote monitoring system should be set up in the next few months. Additional upgrades to the enclosure were conducted in May, which included further fortification of the buried section of the wall with plastic lumber and wall supports. The database shows that there are approximately 250 snails have been moved inside the enclosure and staff have been able to count 177 of them in a single monitoring event. Not all snails are found on any one monitoring, thus there are many more than 177 inside the enclosure.

Figure 3. Recent enclosure wall upgrades showing plastic lumber at ground level and wall supports on the inside.

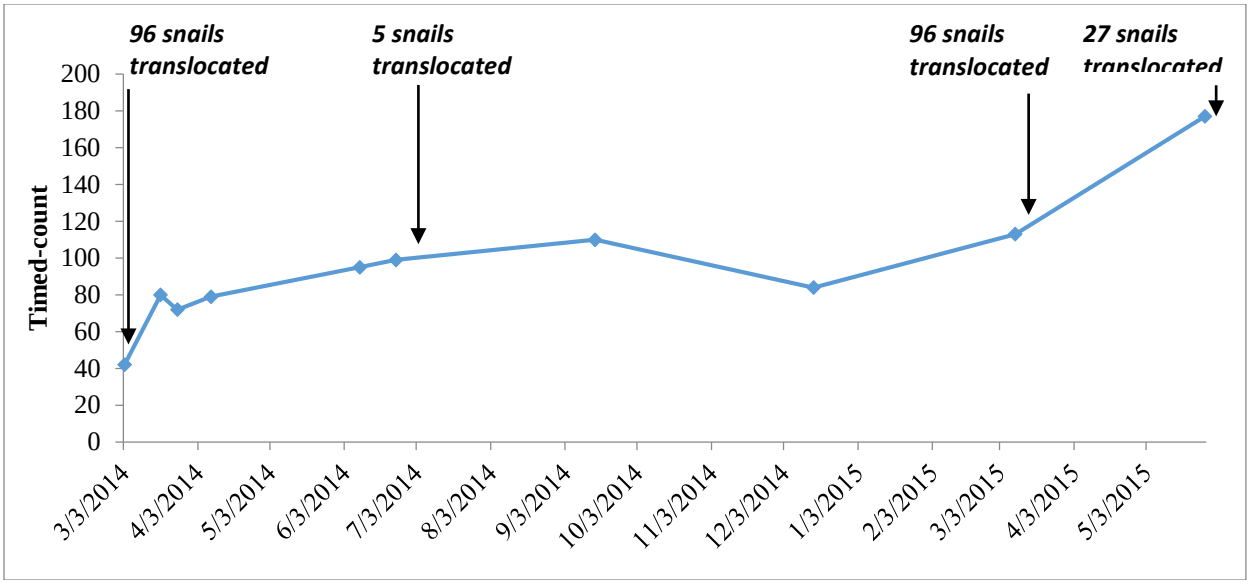


Figure 4. Timed-counts for *A. mustelina* in Kahanahaiki snail enclosure from March 2014 to May 2015.

3.2.1.2 MMR-C, Maile Flats PU

Remaining snails from this population have been and will continue to be collected and placed into the MMR-A enclosure. A total of 12 snails were moved on September 15, 2014, including 1 small, 3 medium, and 8 large snails. Twenty-seven additional snails were translocated into the enclosure on June 27, 2015, including 4 small, 9 medium, and 24 large snails. It is believed that only a small number of snails remain outside the enclosure in Maile Flats.

3.2.1.3 MMR-O, Giant Olopua

The remaining snails in this population were collected and brought into the MMR-A enclosure. On March 9, 2015, 2 small, 3 medium and 4 large for a total of 9 snails were translocated. On June 27, 2015, no snails were found at this site to be translocated.

3.2.1.4 ESU-A, No Management PUs

With a collaborative effort from SEPP and NARS staff, a total of 71, including 12 small, 22 medium and 37 large *A. mustelina* were translocated from No Management PUs into the Kahanahaiki enclosure. On March 19, 2015, 10 snails were translocated from the KAP-A population. A total of 7 snails were translocated from the KAP-C population. Lastly, 54 snails were collected from the PAH-C population and were brought into the MMR-A enclosure. Staff will return to these three sites and continue to search for any remaining snails. See OANRP 2014 Makua and Oahu Implementation Plan Status Report for detailed plans.

Number of Snails Counted

Population Reference Site	Management Designation	Total Snails	Date of Survey	Size Classes				Threat Control				
				Large	Medium	Small	Unk	Ungulate	Weed	Rat	Euglandina rosea	Jackson's Chameleon
Achatinella mustelina												
ESU: A Pahole to Kahanahaiki												
KAP-A	Manage for stability	10 *	2015-03-18	2	5	3	0	Yes	No	Yes	No	No
Just below Makua rim on trail above hunter's cabin.												
KAP-B	No Management	1	2005-09-27	1	0	0	0	Yes	Yes	No	No	No
Chaher weeding site												
KAP-C	Manage for stability	7 *	2015-03-24	2	3	2	0	Yes	Yes	Yes	No	No
One Acre Site												
LEH-F	No Management	1	2005-03-08	1	0	0	0	Yes	No	No	No	No
West Makaleha off of Keawapilau ridge												
MMR-A	Manage for stability	177	2015-05-27	83	64	30	0	Yes	Yes	Yes	Yes	No
Kahanahaiki Exclosure												
MMR-C	Manage for stability	12	2014-09-15	8	3	1	0	Yes	Yes	Yes	No	No
Maile Flats												
MMR-D	No Management	0	2015-03-11	0	0	0	0	Yes	Yes	No	No	No
Kahanahaiki Gulch												
MMR-M	No Management	17	2014-09-17	0	7	10	0	Partial	No	No	No	No
East Rim 2A ridge												
MMR-N	No Management	0	2015-03-11	0	0	0	0	Yes	Yes	No	No	No
Kahanahaiki gulch at Steph Joe's slug boxes												
MMR-O	Manage for stability	15	2014-09-15	6	7	2	0	Yes	No	Yes	No	No
Giant Olopua												
PAH-A	No Management	0	2011-07-15	0	0	0	0	Yes	Yes	No	No	No
Cyasup Pahole gulch reintro lower site												
PAH-B	Manage for stability	61	2015-02-04	37	14	10	0	Yes	Yes	Yes	Yes	No
Pahole Exclosure												
PAH-C	Manage for stability	54 *	2015-04-08	33	14	7	0	Yes	No	Yes	No	No
below Pahole snail exclosure												
	ESU Total:	355		173	117	65	0					

*=Total Snails were Trans Located or Reintroduced

= Threat to Taxon at Population Reference Site

No Shading = Absence of threat to Taxon at Population Reference Site

Yes=Threat is being controlled at PopRefSite

No=Threat is not being controlled at PopRefSite

Partial=Threat is being partially controlled at PopRefSite

Size Class Definitions

SizeClass	DefSizeClass
Large	>18 mm
Medium	8-18 mm
Small	< 8 mm

Table shows the number of snails, size classes, and threats to the snails in the ESU sites. Yes = threat is being controlled; In some cases the threat may be present but not actively preying on A. mustelina.

Figure 5. ESU-A Population Structure Summary

The following spreadsheet shows how many snails have come from which populations.

Taxon Code Pop Ref Site ID	Pop Ref Site Name	Observation Date	Reintro Origin	Reintro Small	Reintro Medium	Reintro Large
AchMus.MMR-A	Kahanahaiki Exclosure	2015-03-19	AchMus.KAP-A	3	5	2
AchMus.MMR-A	Kahanahaiki Exclosure	2015-03-25	AchMus.KAP-C	2	3	2
AchMus.MMR-A	Kahanahaiki Exclosure	2015-04-09	AchMus.PAH-C	7	14	33

Figure 6. Kahanahaiki Translocations 2015

3.2.2 Plans for Next Year

OANRP staff plan to survey the five populations where snails can still be found in ESU-A and move any other located snails into the snail enclosure. Staff are waiting for final support from FWS to also move the remaining snails from MMR-M. Maintenance and monitoring will follow the protocol written in the 2014 report.

3.3 ESU-B

Map removed to protect rare resources. Available upon request

Figure 7. Map of ESU-B1

3.3.1 Update ESU-B1

3.3.1.1 MMR-E, Ohikilolo Mauka PU

This site was last surveyed in 2012. Due to an accident in Makua, access has been denied since April 2015. Staff plan to conduct a current survey when the range is opened up for field work again. The habitat at this site has improved because there has been a considerable amount of weed control performed here.

3.3.1.2 MMR-F, Ohikilolo Makai PU

Due to an accident in Makua, access has been denied since April 2015. A TCM was conducted in 2014 and staff plan to follow-up with another survey in 2016. This site is protected by an extensive rat grid and fortunately, no *Euglandina rosea* have ever been seen in this area. The habitat here is improving due to weed control and outplanting and the snail numbers have been stable.

3.3.1.3 MMR-H, Ohikilolo Koiahi Prikaa Reintro PU

Monitoring of this PU was conducted on October 21, 2014 and April 6, 2015, with 32 and 19 snails observed, respectively. Access for further monitoring has been denied due to the accident in Makua. If the number of observed snails drops to a total of 15 or less, they will be translocated to the MMR-F PU about 700 meters upslope. No fresh ground shells have been observed here during opportunistic surveys.

Number of Snails Counted

Population Reference Site	Management Designation	Total Snails	Date of Survey	Size Classes				Threat Control				
				Large	Medium	Small	Unk	Ungulate	Weed	Rat	Euglandina rosea	Jackson's Chameleon
Achatinella mustelina												
ESU: B1 Ohikilolo												
LEH-L	No Management	6	2013-04-30	4	1	1	0	Yes	No	No	No	No
3 Points												
MMR-E	Manage for stability	70	2012-05-02	45	6	19	0	Yes	Yes	Yes	No	No
Ohikilolo Mauka												
MMR-F	Manage for stability	357	2014-03-12	204	115	38	0	Yes	Yes	Yes	No	No
Ohikilolo Makai												
MMR-G	No Management	1	2010-12-02	1	0	0	0	Yes	No	No	No	No
Ohikilolo Alemac Site												
MMR-H	Manage for stability	32	2014-10-21	17	11	4	0	Yes	Yes	Yes	No	No
Ohikilolo Koiahi Prikaa Reintro Site												
MMR-I	No Management	2	2002-06-03	2	0	0	0	Yes	No	No	No	No
Hedpar MMR-B												
MMR-J	No Management	5	2000-11-27	0	0	0	5	Partial	Yes	No	No	No
One ridge east of Lower Makua Camp												
MMR-K	No Management	3	1998-03-02	0	0	0	3	Partial	Yes	No	No	No
Ctesqu ridge												
MMR-L	No Management	5	1998-03-03	5	0	0	0	Partial	No	No	No	No
Myrsine along Ohikilolo fence from 3 pts												
	ESU Total:	481		278	133	62	8					

Size Class Definitions

SizeClass	DefSizeClass
Large	>18 mm
Medium	8-18 mm
Small	< 8 mm

= Threat to Taxon at Population Reference Site

No Shading = Absence of threat to Taxon at Population Reference Site

Yes=Threat is being controlled at PopRefSite

No=Threat is not being controlled at PopRefSite

Partial=Threat is being partially controlled at PopRefSite

Table shows the number of snails, size classes, and threats to the snails in the ESU sites. Yes = threat is being controlled; In some cases the threat may be present but not actively preying on A. mustelina.

Figure 8. ESU-B1 Population Structure Summary

3.3.2 Update ESU-B2

Map removed to protect rare resources. Available upon request

Figure 9. Map of ESU-B2

3.3.2.1 LEH-D, East Branch of East Makaleha Culvert 73 PU

A TCM was conducted on February 23, 2015 with a total of 41 snails observed. These snails could potentially be released into the planned snail enclosure that is being designed for 3 Points in the near future.

3.3.2.2 No Management PUs

OANRP has reached the goal numbers with just the two largest MFS sites; therefore, no effort was made in 2015 to revisit the no management sites to get updated numbers and status. The next survey scheduled for LEH-C is in 2016.

Number of Snails Counted

Population Reference Site	Management Designation	Total Snails	Date of Survey	Size Classes				Threat Control				
				Large	Medium	Small	Unk	Ungulate	Weed	Rat	Euglandina rosea	Jackson's Chameleon
Achatinella mustelina												
ESU: B2	**East and Central Makaleha**											
AAW-A Kaawa Gulch	No Management	46	2009-11-17	38	6	2	0	No	No	No	No	No
LEH-A Central Makaleha (culvert 39)	No Management	63	2011-04-27	37	19	7	0	No	No	No	No	No
LEH-B East Makaleha (culvert 45)	No Management	33	2011-04-19	11	12	10	0	No	No	No	No	No
LEH-C East Branch of East Makaleha (culvert 69)	Manage for stability	263	2014-07-24	201	56	6	0	No	No	Yes	No	No
LEH-D East Branch of East Makaleha (culvert 73)	Manage for stability	41	2015-02-23	34	5	2	0	No	No	Yes	No	No
LEH-E East Makaleha (culvert 56-57)	No Management	31	2011-04-20	16	7	8	0	No	No	Yes	No	No
LEH-G East Makaleha (culvert 59)	No Management	3	2006-04-17	3	0	0	0	No	No	No	No	No
LEH-H East Makaleha (culvert 54)	No Management	34	2000-03-23	0	0	0	34	No	No	No	No	No
LEH-I East Makaleha (culvert 67)	No Management	16	2000-03-23	16	0	0	0	No	No	No	No	No
LEH-J East Makaleha (culvert 69 - lower down	No Management	2	2006-11-16	2	0	0	0	No	No	No	No	No
LEH-K Culvert 43 Ridge	No Management	6	2009-08-04	3	3	0	0	No	No	No	No	No
	ESU Total:	538		361	108	35	34					

Size Class Definitions

SizeClass	DefSizeClass
Large	>18 mm
Medium	8-18 mm
Small	< 8 mm

= Threat to Taxon at Population Reference Site

No Shading = Absence of threat to Taxon at Population Reference Site

Yes=Threat is being controlled at PopRefSite

No=Threat is not being controlled at PopRefSite

Partial=Threat is being partially controlled at PopRefSite

Table shows the number of snails, size classes, and threats to the snails in the ESU sites. Yes = threat is being controlled; In some cases the threat may be present but not actively preying on A. mustelina.

Figure 10. ESU-B2 Population Structure Summary

3.3.3 Plans for Next Year

OANRP will pursue building a snail enclosure at 3 Points for ESU-B snails in Makaleha and Ohikilolo. Maintenance and monitoring will follow the protocol written in the 2014 report.

3.4 ESU-C

Map removed to protect rare resources. Available upon request

Figure 11. Map of ESU-C

3.4.1 Update ESU-C

3.4.1.1 SBW-A, North Haleauau-Hame Ridge PU

This site was last surveyed on June 29, 2013 when a total of 80 snails were counted. Since then 23 snails were sampled for genetic analysis with Melissa Price's DNA project. It is difficult to get permission to camp here because the site is behind the live fire ranges. A current survey will be planned for the coming year.

3.4.1.2 SBW-B, North Haleauau One Ridge North of Hame PU

It is difficult to get permission to camp here because the site is behind the live fire ranges. A current survey will be planned for the coming year.

3.4.1.3 SBW-W, Skeet Pass PU

This site continues to impress staff as a rich area for snails. On August 27, 2014 a total of 303 snails were counted here. It is very steep habitat and staff are proposing to build an enclosure on the top of Mt. Kaala where the terrain is flat. Staff will continue to work with USFWS to conduct surveys of the area and study the weather data available. In addition, data loggers have been deployed to better quantify difference between skeet pass and Kaala.

3.4.1.4 No Management PUs

There are a total of 12 sites in this category and many of them have not been surveyed recently. Although most of them only had a few snails, staff plan to conduct current surveys and ascertain whether or not there are any snails surviving here. Extensive surveys were conducted in the Lower Kaala NAR sites but no snails were found. In general, these lower elevation areas appear to be drier than the areas where snails survive higher up the ridge.

Number of Snails Counted

Population Reference Site	Management Designation	Total Snails	Date of Survey	Size Classes				Threat Control				
				Large	Medium	Small	Unk	Ungulate	Weed	Rat	Euglandina rosea	Jackson's Chameleon
Achatinella mustelina												
ESU: C	**Schofield Barracks West Range, Alaiheihe and Palikea Gulches**											
ALI-A Palikea gulch	No Management	0	2009-06-02	0	0	0	0	No	No	No	No	No
ALI-B Palikea gulch west. Just east of Alaiheihe/Palikea dividing ridge.	No Management	0	2009-06-02	0	0	0	0	No	No	No	No	No
ANU-A Manuwai gulch	No Management	1	2004-06-02	0	1	0	0	No	No	No	No	No
IHE-A Alaiheihe Gulch Western Most Site	No Management	0	2005-03-22	0	0	0	0	No	No	No	No	No
IHE-B Alaiheihe middle site "Ptemac Site"	No Management	3	2009-06-02	1	2	0	0	No	No	No	No	No
IHE-C Alaiheihe below Nalu's LZ, TT's spot	No Management	0	2005-03-22	0	0	0	0	No	No	No	No	No
SBW-A North Haleauau Hame Ridge	Manage for stability	80	2013-06-29	36	39	5	0	Yes	No	Yes	No	No
SBW-B North Haleauau one ridge north of Hame	Manage for stability	9	2009-09-06	9	0	0	0	Yes	No	Yes	No	No
SBW-C North Haleauau just above Pouteria pair territory	No Management	0	2009-09-06	0	0	0	0	Partial	No	No	No	No
SBW-P South Water gulch by Stenogyne kanehoana	No Management	10	2005-01-19	3	7	0	0	Partial	No	No	No	No
SBW-W Skeet Pass	Manage for stability	303	2014-08-27	190	89	24	0	Partial	No	Yes	No	No
SBW-X elepaio #4	No Management	1	2009-11-23	0	1	0	0	Partial	No	Yes	No	No
SBW-Y Elepaio #8	No Management	3	2009-11-23	0	3	0	0	Partial	No	Yes	No	No
SBW-Z Clair's Ridge	No Management	14	2010-06-03	10	4	0	0	Yes	No	No	No	No
	ESU Total:	424		249	146	29	0					

Size Class Definitions

SizeClass	DefSizeClass
Large	>18 mm
Medium	8-18 mm
Small	< 8 mm

= Threat to Taxon at Population Reference Site

No Shading = Absence of threat to Taxon at Population Reference Site

Yes=Threat is being controlled at PopRefSite

No=Threat is not being controlled at PopRefSite

Partial=Threat is being partially controlled at PopRefSite

Table shows the number of snails, size classes, and threats to the snails in the ESU sites. Yes = threat is being controlled; In some cases the threat may be present but not actively preying on A. mustelina.

Figure 12. ESU-C Population Structure Summary

3.4.2 Plans for Next Year

OANRP staff will work with FWS and pursue building a temporary snail enclosure on Mt. Kaala. Maintenance and monitoring will follow the protocol written in the 2014 report.

3.5 ESU-D

Map removed to protect rare resources. Available upon request

Figure 13. Map of ESU-D1

3.5.1 Update ESU-D1

3.5.1.1 KAL-G Puu Hapapa Snail Enclosure PU

A total of 531 snails were counted here on January 5, 2015 and 491 on April 15, 2015. At the present time there are approximately 1500 snails inside the enclosure. Staff continue to conduct TCM here on a quarterly basis. The habitat continues to improve and the snails appear to be spreading out into new vegetation as outplanted trees become bigger. Staff did find two Jackson's chameleons inside the enclosure and it was thought that they might have climbed in when fast growing *Pipturus albidus* trees on the inside and outside bridged. Since then staff have been diligent in trimming the trees along the fence walls and no more Jackson's have been seen inside since.

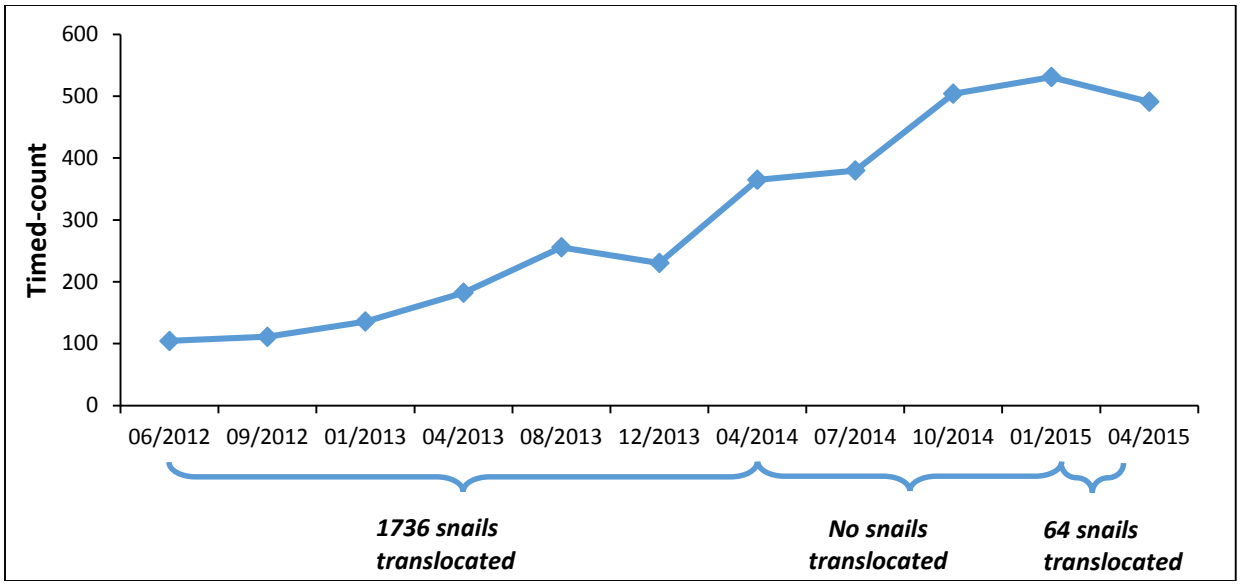


Figure 14. Timed-counts for *A. mustelina* in Hapapa snail enclosure from June 2012 to April 2015.

3.5.1.2 No Management PUs

Many snails have been collected from these populations and released into the snail enclosure. The following spreadsheet shows how many snails have come from which populations.

Taxon Code Pop Ref Site ID	Pop Ref Site Name	Observation Date	Reintro Origin	Reintro Small	Reintro Medium	Reintro Large
AchMus.KAL-G	Puu Hapapa snail enclosure	2015-01-14	AchMus.KAL-B	0	5	7
AchMus.KAL-G	Puu Hapapa snail enclosure	2015-01-14	AchMus.KAL-D	2	5	13
AchMus.KAL-G	Puu Hapapa snail enclosure	2015-01-27	AchMus.KAL-C	0	4	1
AchMus.KAL-G	Puu Hapapa snail enclosure	2015-02-12	AchMus.KAL-B	1	6	6
AchMus.KAL-G	Puu Hapapa snail enclosure	2015-02-12	AchMus.KAL-F	1	5	8

Figure 14. Puu Hapapa Translocations 2015

SEPP has translocated into the snail enclosure 15 adult *Amastra spirizona* from Makaha and they presently number 50+; 18 *Laminella sanguinea* from the Army side of Puu Hapapa; 1 *Amastra intermedia* from Mikilua and 7 from Daniel Chung's captive propagation project and they've produced one offspring; 16 *Cookeconcha* from Puu Hapapa and 1 *Leptachatina* from Mikilua.

Number of Snails Counted

Population Reference Site	Management Designation	Total Snails	Date of Survey	Size Classes				Threat Control				
				Large	Medium	Small	Unk	Ungulate	Weed	Rat	Euglandina rosea	Jackson's Chameleon
Achatinella mustelina												
ESU: D1	**North Kaluaa, Waieli, Puu Hapapa, and Schofield Barracks South Range**											
ELI-A	No Management	34 *	2014-03-05	22	10	2	0	Yes	No	No	No	No
South Waieli Gulch North Branch												
KAL-A	No Management	6 *	2014-03-06	5	1	0	0	Yes	Yes	Yes	Partial	No
Land of 10,000 snails												
KAL-B	No Management	13 *	2015-02-12	6	6	1	0	Yes	No	No	No	No
Gulch 1 Kaluaa												
KAL-C	No Management	5 *	2015-01-27	1	4	0	0	No	No	No	No	No
North Kaluaa												
KAL-D	No Management	20 *	2015-01-14	13	5	2	0	Yes	Yes	No	No	No
Gulch 3												
KAL-E	No Management	8	2012-04-16	8	0	0	0	Yes	Yes	No	No	No
Gulch 2												
KAL-F	No Management	14 *	2015-02-12	8	5	1	0	Yes	Yes	No	No	No
Central Kaluaa South Branch												
KAL-G	Manage for stability	491	2015-04-15	245	203	43	0	Yes	Yes	Yes	Yes	Yes
Puu Hapapa snail enclosure												
MIK-A	No Management	0	2012-10-04	0	0	0	0	No	No	No	No	No
Mikilua Gulch												
SBS-A	No Management	0	2012-12-19	0	0	0	0	Yes	Yes	No	No	No
Moho Gulch Lamsan and Amamic exclosure												
SBS-B	No Management	295 *	2013-12-11	143	99	53	0	No	No	No	No	No
Puu Hapapa												
	ESU Total:	886		451	333	102	0					

*=Total Snails were Trans Located or Reintroduced

= Threat to Taxon at Population Reference Site

No Shading = Absence of threat to Taxon at Population Reference Site

Yes=Threat is being controlled at PopRefSite

No=Threat is not being controlled at PopRefSite

Partial=Threat is being partially controlled at PopRefSite

Size Class Definitions

SizeClass	DefSizeClass
Large	>18 mm
Medium	8-18 mm
Small	< 8 mm

Table shows the number of snails, size classes, and threats to the snails in the ESU sites. Yes = threat is being controlled; In some cases the threat may be present but not actively preying on A. mustelina.

Figure 15. ESU-D1 Population Structure Summary

3.5.1.3 No Management PUs

Since a lot of these populations are not being managed and have not been recently surveyed, OANRP recommend performing current surveys and moving some of these snails into the Puu Hapapa snail enclosure. All of these snails are part of ESU-D. Although this might conceivably involve moving some snails approximately two to four kilometers, mixing them will help to preserve genetic material, possibly strengthen the existing population, and prevent the non-managed snails from being preyed upon by rats, *E. rosea* and Jackson's chameleons.

Number of Snails Counted

Population Reference Site	Management Designation	Total Snails	Date of Survey	Size Classes				Threat Control				
				Large	Medium	Small	Unk	Ungulate	Weed	Rat	Euglandina rosea	Jackson's Chameleon
Achatinella mustelina												
ESU: D	**No Management ESU Sites of Waianae Kai, Kaluaa, Puhawai, SBS, and SBW**											
PHW-A	No Management	11	2009-11-05	10	0	1	0	No	No	No	No	No
Lualualei, Puhawai below Tetfil finger												
SBS-C	No Management	10	2003-04-16	10	0	0	0	No	No	No	No	No
Lower Moho Gulch - Jennifer Crummer's spot												
SBS-D	No Management	15	2012-12-19	12	2	1	0	No	No	No	No	No
Two gulches west of Moho gulch enclosure												
SBW-AA	No Management	12	2012-10-25	7	5	0	0	Yes	No	No	No	No
Mt Kaala below blue trail fence												
SBW-BB	No Management	15	2013-10-10	6	5	4	0	Yes	No	No	No	No
Below transect 790												
SBW-D	No Management	1	2000-02-18	0	0	0	1	Yes	No	No	No	No
Kaala-Kalena ridge on "M" in Military												
SBW-E	No Management	1	2000-02-18	1	0	0	0	Yes	No	No	No	No
Kaala-Kalena ridge between Military and Reservation												
SBW-F	No Management	4	2006-06-22	3	0	1	0	Yes	No	No	No	No
North Mohiakea Banana Gulch												
SBW-G	No Management	0	2003-10-14	0	0	0	0	Yes	No	No	No	No
South of Puu Kalena												
SBW-H	No Management	10	1999-08-02	10	0	0	0	Yes	No	No	No	No
North Branch of South Mohiakea												
SBW-I	No Management	32	2002-08-28	27	3	2	0	Yes	No	No	No	No
South Mohiakea Sicyos site												
SBW-J	No Management	10	2000-05-17	10	0	0	0	Yes	No	No	No	No
Zandip site along Kalena-Kumakalii Ridge												
SBW-K	No Management	47	2009-11-05	30	9	8	0	Yes	No	No	No	No
Kumakalii-Kalena ridge-"TR" gulch on the map by "Wahiawa District"												
SBW-L	No Management	43	2009-11-04	22	10	11	0	Yes	No	No	No	No
Kalena-Kumakalii Ridge-Dike rock gulch												
SBW-M	No Management	23	2009-06-24	17	4	2	0	Yes	No	No	No	No
Puu Kumakalii												

Number of Snails Counted

Population Reference Site	Management Designation	Total Snails	Date of Survey	Size Classes				Threat Control				
				Large	Medium	Small	Unk	Ungulate	Weed	Rat	Euglandina rosea	Jackson's Chameleon
SBW-N 1st Peak North of Kolekole Pass	No Management	0	2009-06-24	0	0	0	0	No	No	No	No	No
SBW-O North of Puu Kalena Alstri Notch	No Management	7	2000-02-18	2	5	0	0	Yes	No	No	No	No
SBW-Q North of Puu Kalena below Schtri Notch	No Management	81	2007-08-21	47	32	2	0	Yes	No	No	No	No
SBW-R Mt. Kaala southern end of Haleauau fencline	No Management	121	2014-09-11	92	25	4	0	Yes	No	No	No	No
SBW-S Upper Banana Gulch	No Management	4	2007-08-29	3	1	0	0	Yes	Yes	Yes	No	No
SBW-T Albizzia Gulch	No Management	33	2009-06-10	25	1	7	0	Yes	Yes	Yes	No	No
SBW-U Gulch #1/Tri Gulch Camp	No Management	17	2007-08-22	13	3	1	0	Yes	No	No	No	No
SBW-V Gulch #4/Tri Gulch Camp	No Management	31	2007-08-22	21	9	1	0	Yes	No	No	No	No
WAI-A Waianae Kai - Hesarb site	No Management	10	2000-06-26	0	0	0	10	No	No	No	No	No
	ESU Total:	538		368	114	45	11					

Size Class Definitions

SizeClass	DefSizeClass
Large	>18 mm
Medium	8-18 mm
Small	< 8 mm

= Threat to Taxon at Population Reference Site

No Shading = Absence of threat to Taxon at Population Reference Site

Yes=Threat is being controlled at PopRefSite

No=Threat is not being controlled at PopRefSite

Partial=Threat is being partially controlled at PopRefSite

Table shows the number of snails, size classes, and threats to the snails in the ESU sites. Yes = threat is being controlled; In some cases the threat may be present but not actively preying on A. mustelina.

Figure 16. ESU-D Population Structure Summary

3.5.2 Update ESU-D2

Map removed to protect rare resources. Available upon request

Figure 17. Map of ESU-D2

3.5.2.1 MAK-B Kumaipo Ridge Crest PU

Many of the trees at this site that used to harbor snails have died and the snails have since declined. On the June 17, 2015 survey only one snail was observed. OANRP proposes to move this snail to MAK-D where there is a thriving population of 127 snails.

3.5.2.2 MAK-C Near Pinnacle Rocks PU

Some of the trees at this site have also died and the population is struggling. Since the 14 snails are mostly in individual trees the proposal is to move these snails also to the MAK-D site where they will continue to benefit from the expanded rat grid and share the habitat with 127 other snails.

3.5.2.3 MAK-E Ridge East of Cyasup PU

This site had not been surveyed for six years, but on June 17, 2015 a total of 60 snails were counted here. These snails seem to have a more favorable and healthy habitat, consisting mostly of *Nestigis sandwicensis*. The site is protected by the large rat grid and staff will search here for *E. rosea* whenever working in the area.

3.5.2.4 MAK-F Waianae Kai Trail PU

This site was recently surveyed on June 17, 2015. Surveyors had more time available than the previous year and thus covered more ground. A total of 48 snails were counted. This site is further away from the other sites at a higher elevation and because the area is steep it does not lend itself to rat control.

Number of Snails Counted

Population Reference Site	Management Designation	Total Snails	Date of Survey	Size Classes				Threat Control				
				Large	Medium	Small	Unk	Ungulate	Weed	Rat	Euglandina rosea	Jackson's Chameleon
Achatinella mustelina												
ESU: D2 Makaha												
MAK-A Isolau ridge	Manage for stability	11	2014-08-20	8	3	0	0	Yes	Partial	Yes	No	No
MAK-B Kumaipo ridge crest	Manage for stability	1	2015-06-17	1	0	0	0	Yes	Partial	Yes	No	No
MAK-C Near pinnacle rocks. Includes Hesarb ridge.	Manage for stability	14	2015-06-16	11	3	0	0	Yes	No	Yes	No	No
MAK-D On ledge below ridge crest above MAK-A site.	Manage for stability	127	2014-08-20	88	36	3	0	Yes	No	Yes	No	No
MAK-E Ridge east of Cyasup exclosure	Manage for stability	60	2015-06-18	47	10	3	0	Yes	Yes	Yes	No	No
MAK-F Waianae Kai trail to Kaala	No Management	48	2015-06-17	36	11	1	0	No	No	No	No	No
	ESU Total:	261		191	63	7	0					

Size Class Definitions

SizeClass	DefSizeClass
Large	>18 mm
Medium	8-18 mm
Small	< 8 mm

= Threat to Taxon at Population Reference Site
No Shading = Absence of threat to Taxon at Population Reference Site
Yes=Threat is being controlled at PopRefSite
No=Threat is not being controlled at PopRefSite
Partial=Threat is being partially controlled at PopRefSite

Table shows the number of snails, size classes, and threats to the snails in the ESU sites. Yes = threat is being controlled; In some cases the threat may be present but not actively preying on A. mustelina.

Figure 18. ESU-D2 Population Structure Summary

3.5.3 Plans for Next Year

OANRP staff plan to work with FWS on future translocations into the Puu Hapapa snail enclosure. Maintenance and monitoring will follow the protocol written in the 2014 report.

3.6 ESU-E

Map removed to protect rare resources. Available upon request

Figure 19. Map of ESU-E

3.6.1 Update ESU-E

3.6.1.1 EKA-A Mamane Ridge PU

This site was surveyed on August 27, 2014 and a total of 58 snails were counted. The trees at this site still look healthy but staff have collected more *E. rosea* and it appears that this predator is having a detrimental effect on the snails here. Staff plan to build a temporary enclosure in Ekahanui in October 2015 as a stop gap measure to protect the snails until a larger enclosure can be built.

3.6.1.2 EKA-B Below Tetlep PU

This site was also surveyed on August 27, 2014 and 13 snails were counted. This site is also showing decline and likely also attributed to *E. rosea.* These snails will also be included with snails from other sites and placed in the temporary enclosure.

3.6.1.3 EKA-C Plapri PU

This is the primary site in the entire ESU. Staff worked here with Melissa Price on August 28, 2014 to collect genetic samples for her DNA project. A total of 88 snails were counted here but this site is also in danger of decline because staff have found and controlled *E. rosea* here while surveying. These *A. mustelina* will also be prime candidates for the temporary enclosure.

3.6.1.4 EKA-D Puu Kaua PU

Snails at this site have been in serious decline since a dieback affected most of the *Myrsine lessertiana* trees in the area. *E. rosea* have also been a serious problem here.

3.6.1.5 EKA-H South Ekahanui

This site was last surveyed on May 16, 2013 when a total of 21 snails were counted. The habitat is very steep and requires rope work to locate most of the snails. These snails could benefit from the construction of a temporary enclosure.

3.6.1.6 No Management PUs

These sites are mostly ones with few snails that could benefit greatly by the construction of a temporary predator-free enclosure. These sites are part of the expanded rat grid but do not receive regular *E. rosea* control.

Number of Snails Counted

Population Reference Site	Management Designation	Total Snails	Date of Survey	Size Classes				Threat Control				
				Large	Medium	Small	Unk	Ungulate	Weed	Rat	Euglandina rosea	Jackson's Chameleon
Achatinella mustelina												
ESU: E Puu Kaua / Ekahanui												
EKA-A Mamane Ridge and Near Plapripri EKA-A	Manage for stability	58	2014-08-27	38	15	5	0	Yes	No	Yes	No	No
EKA-B Below north population of Tetlep. Between Plapri EKA-A, EKA-B and EKA-C	Manage for stability	13	2014-08-27	13	0	0	0	Yes	No	Yes	No	No
EKA-C At Plapripri EKA-C site	Manage for stability	88	2014-08-28	69	18	1	0	Yes	No	Yes	No	No
EKA-D Puu Kaua	Manage for stability	11	2012-07-18	7	4	0	0	Yes	No	No	No	No
EKA-E Amastra site	No Management	8	2014-05-28	6	1	1	0	Yes	No	Yes	No	No
EKA-F from Plapri-C head along blue trail under cliffs mauka	Manage for stability	1	2008-11-03	1	0	0	0	Yes	No	Yes	No	No
EKA-G Cenagr	Manage for stability	0	2013-02-17	0	0	0	0	Yes	Yes	Yes	No	No
EKA-H South Ekahanui North Branch	Manage for stability	21	2013-05-16	12	6	3	0	Yes	No	Yes	No	No
HUL-A North Huliwai south branch	No Management	17	2014-12-16	11	6	0	0	No	No	No	No	No
HUL-B South Huliwai Gulch	No Management	1	2007-06-18	1	0	0	0	No	No	No	No	No
HUL-C Off Ridge Crest South of Puu Kanehoa	No Management	1	2009-06-16	1	0	0	0	No	No	No	No	No
	ESU Total:	219		159	50	10	0					

Size Class Definitions

SizeClass	DefSizeClass
Large	>18 mm
Medium	8-18 mm
Small	< 8 mm

= Threat to Taxon at Population Reference Site

No Shading = Absence of threat to Taxon at Population Reference Site

Yes=Threat is being controlled at PopRefSite

No=Threat is not being controlled at PopRefSite

Partial=Threat is being partially controlled at PopRefSite

Table shows the number of snails, size classes, and threats to the snails in the ESU sites. Yes = threat is being controlled; In some cases the threat may be present but not actively preying on A. mustelina.

Figure 20. ESU-E Population Structure Summary

3.6.2 Plans for Next Year

OANRP plan to construct a temporary enclosure in Ekahanui and a permanent one somewhere else. Maintenance and monitoring will follow the protocol written in the 2014 report.

3.7 ESU-F

Map removed to protect rare resources. Available upon request

Figure 21. Map of ESU-F

3.7.1 Update ESU-F

3.7.1.1 KAA-A Mauna Kapu

Due to a decline in both the population of snails and the habitat, a total of 29 snails were moved from this site on July 22, 2015 into the Palikea snail enclosure. OANRP worked together with SEPP on this project and contacted the landowners to receive their support. The snails were all photographed and will be tracked using the "Hotspotter" monitoring technology to determine the relative success of the translocation.

3.7.1.2 PAK-A Puu Palikea Ohia Spot

On April 22, 2015 a total of 23 snails were collected here and moved into the snail enclosure. On June 8, 2015 another 15 snails were placed into the enclosure. This site is situated along side of an eroded area and had been showing signs of decline over the past five years. The site will continue to be monitored for more snails.

3.7.1.3 PAK-C Steps

This site has also been in decline the past three years. On April 21, 2015 a total of 17 snails were collected here and released into the snail enclosure. On June 9, 2015 another seven snails were collected and released into the enclosure.

3.7.1.4 PAK-D Joel's

This site is due for a survey in the upcoming quarter. The last thorough survey was performed here in 2008. Depending on the number of snails found they will either remain at the site or be moved into the snail enclosure.

3.7.1.5 PAK-G Hame

On April 22, 2015 a total of 15 snails were collected here and released into the enclosure. The site will continue to be monitored in case more snails are found.

3.7.1.6 PAK-H Hadfield's

This site will be surveyed in the next quarter and depending on how many snails are found there, they will either remain at the site or be moved into the snail enclosure.

3.7.1.7 PAK-K Pilo

This site will also be surveyed in the next few months and likely these snails will remain here as the previous survey showed 59 snails. The site will be evaluated as a possible site for a new ground shell plot.

3.7.1.8 PAK-L Olapa

This site had 32 snails when it was surveyed in 2008. Depending on the number of snails found and the condition of the habitat, staff will decide whether to leave the snails or move them into the enclosure.

3.7.1.9 PAK-M Middle

This is the largest population in the ESU and had 201 snails in 2012. It is likely that these snails will remain at their present location.

3.7.1.10 PAK-P Enclosure

OANRP staff have translocated snails into the Palikea snail enclosure and will now begin TCM on a quarterly basis. Snails outside the enclosure in small populations will continue to be brought inside for protection from predators.

3.7.1.11 PAK-Q Outside the Enclosure

Snails fouond outside the snail enclosure are being brought inside since the habitat is similar and there are no predators.

3.7.1.12 No Management PUs

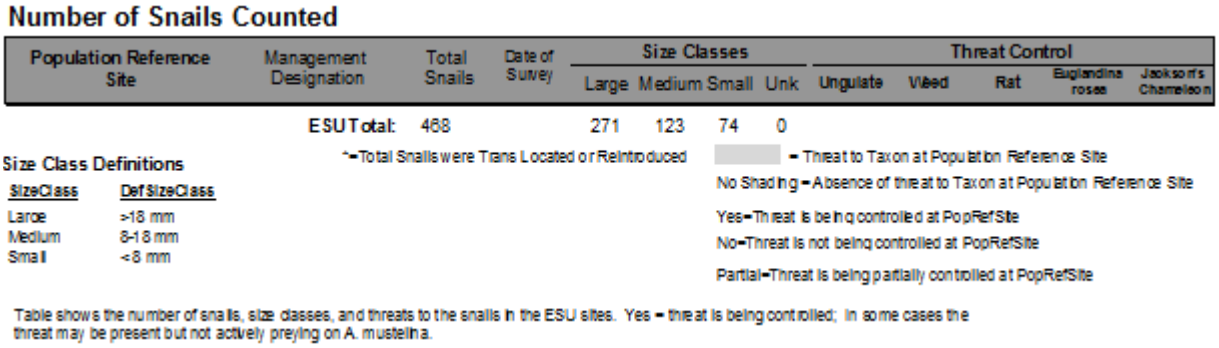
These sites have historically had very few snails and the plan is to perform current surveys in these areas and if any remaining snails are found they will be brought into the enclosure.

3.7.2 Plans for Next Year

OANRP staff plan to continue working with FWS to continue translocations of smaller populations. Maintenance and monitoring will follow the protocol written in the 2014 report. Consideration will be given to potential enclosure sites for snails in Ekahanui.

Number of Snails Counted

Population Reference Site	Management Designation	Total Snails	Date of Survey	Size Classes				Threat Control				
				Large	Medium	Small	Unk	Ungulate	Weed	Rat	Euglandina rosea	Jackson's Chameleon
Achatinella mustelina												
ESU: F Puu Palikea												
KAA-A Mauna Kapu (Palehua)	Manage for stability	29 *	2015-07-21	16	11	2	0	No	No	Yes	No	No
PAK-A Puu Palikea-Ohia spot	Manage for stability	15 *	2015-06-08	9	4	2	0	Yes	Yes	Yes	No	No
PAK-B Iele Patch	Manage for stability	2	2014-08-05	2	0	0	0	Yes	Yes	Yes	No	No
PAK-C Steps spot	Manage for stability	7 *	2015-06-09	1	5	1	0	Yes	Yes	Yes	No	No
PAK-E Exogau site	Manage for stability	0	2010-03-04	0	0	0	0	Yes	Yes	Yes	No	No
PAK-F Dodonaea site	Manage for stability	2	2012-03-14	2	0	0	0	Yes	Yes	Yes	No	No
PAK-G Hame and Alani site just above Cyagri fence	Manage for stability	15 *	2015-04-22	7	4	4	0	Yes	Yes	Yes	No	No
PAK-H Mike Hadfield's study site at Puu Palikea	Manage for stability	17	2013-08-12	6	8	3	0	Yes	Yes	Yes	No	No
PAK-K Pilo site	Manage for stability	59	2012-10-24	32	15	12	0	Yes	No	Yes	No	No
PAK-L Olapa site north of Puu Palikea	Manage for stability	15	2011-05-25	12	2	1	0	Yes	Yes	Yes	No	No
PAK-M Middle Site	Manage for stability	201	2012-05-15	109	50	42	0	Yes	No	Yes	No	No
PAK-N Campside of Lobelia Ridge	No Management	1	2015-06-23	0	1	0	0	No	No	No	No	No
PAK-O Below camp fence	No Management	1	2009-09-23	1	0	0	0	No	No	Yes	No	No
PAK-P Palikea snail exclosure	Manage for stability	83	2015-03-04	59	20	4	0	Yes	Yes	Yes	Yes	Yes
PAK-Q outside snail enclosure	Manage for stability	9 *	2015-04-21	6	2	1	0	Yes	Yes	Yes	No	No
PAL-A Palawai next to Pri sp.	No Management	8	2014-05-14	6	1	1	0	No	No	No	No	No
PAL-B Delsub Lama Fence	No Management	2	2011-04-18	1	0	1	0	No	No	Yes	No	No
PAL-C Palawai Hesarb trail	No Management	2	2007-04-30	2	0	0	0	No	Yes	No	No	No



Number of Snails Counted

Population Reference Site	Management Designation	Total Snails	Date of Survey	Size Classes				Threat Control				
				Large	Medium	Small	Unk	Ungulate	Weed	Rat	Euglandina rosea	Jackson's Chameleon
	ESU Total:	468		271	123	74	0					

*=Total Snails were Trans Located or Reintroduced

= Threat to Taxon at Population Reference Site

No Shading = Absence of threat to Taxon at Population Reference Site

Yes=Threat is being controlled at PopRefSite

No=Threat is not being controlled at PopRefSite

Partial=Threat is being partially controlled at PopRefSite

Size Class Definitions

SizeClass	DefSizeClass
Large	>18 mm
Medium	8-18 mm
Small	<8 mm

Table shows the number of snails, size classes, and threats to the snails in the ESU sites. Yes = threat is being controlled; in some cases the threat may be present but not actively preying on A. mustelina.

Figure 22. ESU-F Population Structure Summary

Taxon Code Pop Ref Site ID	Pop Ref Site Name	Observation Date	Reintro Origin	Reintro Small	Reintro Medium	Reintro Large
AchMus.PAK-P	Palikea snail exclosure	2015-04-22	AchMus.PAK-A	7	5	11
AchMus.PAK-P	Palikea snail exclosure	2015-04-23	AchMus.PAK-G	4	4	7
AchMus.PAK-P	Palikea snail exclosure	2015-04-24	AchMus.PAK-Q	1	2	6
AchMus.PAK-P	Palikea snail exclosure	2015-06-08	AchMus.PAK-A	2	4	9
AchMus.PAK-P	Palikea snail exclosure	2015-06-09	AchMus.PAK-C	1	5	1
AchMus.PAK-P	Palikea snail exclosure	2015-07-22	AchMus.KAA-A	2	11	16

Figure 23. Palikea Translocations 2015

CHAPTER 4: RARE VERTEBRATE MANAGEMENT

4.1 OIP ELEPAIO MANAGEMENT 2015

4.1.1 Background

In 2000, the U.S. Fish and Wildlife Service (USFWS) granted the Oahu Elepaio (*Chasiempis ibidis*) endangered species status under the Federal Endangered Species Act and designated critical habitat on Oahu for the Elepaio in 2001. Under the terms of the Biological Opinion for Routine Military Training and Transformation dated 2003, Oahu Army Natural Resources Program (OANRP) is required to manage a minimum of 75 Oahu Elepaio pairs. Management of a pair includes monitoring and rodent control during the breeding season. The OANRP is required to conduct on-site management at Schofield Barracks West Range (SBW) for as many of the 75 pairs as possible, with the remaining number managed at off-site locations with cooperating landowners. The OANRP has conducted rodent control and Elepaio monitoring at Schofield Barracks Military Reservation (SBMR) (1998-present), Ekahanui Gulch in the Honouliuli Forest Reserve (2005-present), Moanalua Valley (2005-present), Palehua (2007-present), Makaha Valley (2005-2009), and Waikane Valley (2007-2008). This chapter summarizes Elepaio reproduction results at each of the sites currently being managed, and provides recommendations for improving the Elepaio stabilization program. This section also lists and discusses the terms and conditions for the implementation of reasonable and prudent measures outlined in the 2003 Biological Opinion.

4.1.2 Methods

Monitoring

Throughout the nesting season, from early January to late June, each managed Elepaio territory was visited at one or two-week intervals depending on breeding activity. Single male and paired territories where rodent control is not taking place are also monitored for breeding activity whenever possible, though their results are not included with that of managed pairs. The location and age of all birds observed and color band combination, if any, was noted on each visit. Nests were counted as successful if they fledged at least one chick. Nest success (successful nests/active nests) was calculated by the number of successful nests per the number of active nests. Active nests are nests known to have had eggs laid in them as determined by observations of incubation. Reproductive success (fledglings/managed pair) was measured as the average number of fledglings produced per managed pair. Some nests were abandoned for unknown reasons before eggs were laid. If a nest is abandoned after an egg is laid it is considered to have failed.

To facilitate demographic monitoring, Elepaio have been captured with mist-nets and marked with a standard aluminum bird band and a unique combination of three colored plastic bands. This is useful because it allows individual birds to be distinguished through binoculars and provides important information about the demography of the population, such as survival and movement of birds within and between years. It also makes it easier to distinguish birds from neighboring territories, yielding a more accurate population estimate. In most cases, Elepaio vocal recordings were used to lure birds into a mist-net. Each bird was weighed, measured, inspected for molt, fat, overall health, and then released unharmed at the site of capture within 30 minutes.

OANRP research specialist, Stephanie Joe, with a subadult Elepaio at Ekahanui.

Rodent Control

This breeding season saw the use of small and large-scale trapping grids containing only Victor® rat snap traps baited with peanut butter. Small-scale grids, deployed throughout the territory of an Elepaio pair at SBW and Moanalua Valley, consisted of 12 snap traps that were tied to trees or rocks to prevent scavengers from removing them. Territories labeled as single or vacant may have also contained snap traps baited throughout the breeding season. These territories once contained an Elepaio pair, but one or both birds have not recently been observed. These territories continue to be baited to help control rodents throughout the management area. Traps were counted as having caught a rodent if hair or tissue was found on the trap. Traps were cleaned with a wire brush after each capture so previous captures were not counted twice. Rodent control was conducted for the duration of the Elepaio nesting season. At Ekahanui, a large-scale rat trapping grid containing over 600 snap traps was deployed in 2011 for management of all Elepaio territories in the management unit. A second large-scale grid containing 170 snap traps was deployed in 2015 at Palehua to ensure rodent protection for all resident pairs. Traps at all four sites were checked and re-baited once a week for the first month (December) , then once every two weeks for the rest of the breeding season (January – June). The frequency of re-baiting in December is higher in order to kill as many rodents as possible before Elepaio nesting begins, thus giving the birds the best chance at having successful nests. Due to Army training at SBW the frequency of baiting was less often than the other management units (MUs). This lack of access to the MU compelled the program to

deploy 40 automatic traps at paired territories in Banana and North Haleauau gulches to assist the existing small-scale trapping grids. Pono Pacific was contracted to conduct rodent control and monitoring of Elepaio at Moanalua. At SBW, Ekahanui and Palehua, they were contracted to conduct rat control only. OANRP conducted monitoring of birds at SBW, Ekahanui and Palehua. OANRP also assisted in monitoring Elepaio at Moanalua.

4.1.3 Results

With 97 Elepaio pairs managed during the 2015 breeding season, the OANRP fulfilled the required 75 pairs for species management. The results of management conducted for each area during the 2015 breeding season are compiled below. The results from each area are presented in two ways. First, a map presents a compilation of all the known Elepaio territories within each Elepaio MU. The map denotes all of the territories that were baited. Second, the data is presented in tabular form with the number of territories that were single or contained pairs. The table also presents the number of paired territories in which rodent control was conducted, the number of active nests observed, total successful and failed nests, how many fledglings were observed, and the ratio of fledglings per pair. Rodent control data and a summary of results are also presented.

Adult Elepaio being released at Palehua. ***Photos by Roy Kikuta***

Schofield Barracks West Range

Schofield Barracks West Range Territory Occupancy Status and Rat Control 2015

Map removed to protect rare resources. Available upon request

Schofield Barracks West Range Site Demographic Data

SBW	2015	2014	2013	2012	2011
Singles	16	17	18	16	15
Pairs	58	57	60	58	56
Pairs with Rat Control	26	22	29	28	31
Active Nests[1]	14	16	18	23	34
Successful Active Nests[2]	8/14=57%	8/16=50%	9/18=50%	16/23=70%	22/34=65%
Unknown Nest Outcome[3]	2	3	0	0	0
Failed Active Nests	4	5	9	7	12
Family Groups Found[4]	5	8	15	11	11
Fledglings Observed[5]	14	20	28	28	46
Fledglings/Managed Pair[6]	0.54	0.91	0.97	1	1.48

[1] Nest containing eggs or nestlings.
[2]Percentage of successful active nests observed.
[3]Total number of active nests with unknown outcome (sufficient time gap between visits).
[4]Total number of occurrences where pairs were observed with fledglings in which no nests were found.
[5]Total number of fledglings observed from successful active nests and family groups.
[6]The ratio of fledglings per managed pair.

Reproductive Results

Of the active nests monitored in SBW, 57% (8/14) were successful in producing 9 fledglings, while 29% (4/14) of the active nests failed. Two nests had unknown outcomes (nests with sufficient time gap between visits in which a nest could have fledged with no subsequent detection of a fledgling). Another 5 fledglings were found with five managed pairs where no nesting had been observed (family groups). A total of 14 fledglings were observed in territories benefiting from rodent control management. Another 3 fledglings were observed in territories not protected from rats.

This male from SBW is the oldest living Elepaio in Hawaii. He turned 20 this year! Notice all his white head feathers.

Rodent Control Results

In 2015, the number of rodents caught in snap traps increased from the previous two years. This is likely due to increasing the number of site visits from one to two days of baiting during our four days of SBW access per month. We also deployed 40 automatic traps at paired territories in North Haleauau and Banana gulches to assist the existing small-scale trapping grids. The number of rodents killed in the automatic traps are not displayed in the table below.

Schofield Barracks West Range Rodent Control Data

SBW	# Traps	# Rats in Traps	Rats/Trap
2015	364	1754	4.8
2014	352	931	2.6
2013	372	1176	3.2

Summary

Access in SBW was limited to four days per month in 2015 due to weekly training by the Army. This allows for approximately one day per month of access to each of the three managed gulches in SBW. This significantly reduces the time needed during the breeding season for the OANRP to detect active nests and fledglings. With such restricted access it's also difficult to determine a cause for this decline in breeding activity, though it is suspected to be weather related and/or a shortage in food resources. This decrease in breeding activity is unfortunate, though it's positive to see that the number of resident pairs has remained stable throughout the years.

Recording site-specific vocalizations is an effective technique used to lure territorial Elepaio into mist-nets.

Honouliuli Forest Reserve - Ekahanui

Ekahanui Territory Occupancy Status and Rat Control 2015

Map removed to protect rare resources. Available upon request

Ekahanui Site Demographic Data

EKA	2015	2014	2013	2012	2011
Singles	0	5	1	11	14
Pairs	39	30	39	31	30
Pairs with Rat Control	37	28	36	29	30
Active Nests[1]	23	14	26	21	15
Successful Active Nests[2]	13/23=56%	7/14=50%	17/26=65%	9/21=43%	8/15=53%
Unknown Nest Outcome[3]	5	3	3	0	1
Failed Active Nests	6	6	9	12	6
Family Groups Found[4]	6	12	8	6	15
Fledglings Observed[5]	24	21	29	18	26
Fledglings/Managed Pair[6]	0.65	0.75	0.81	0.62	0.87

[1] Nest containing eggs or nestlings.
[2]Percentage of successful active nests observed.
[3]Total number of active nests with unknown outcome (time gap between visits).
[4]Total number of occurrences where pairs were observed with fledglings in which no nests were found.
[5]Total number of fledglings observed from successful active nests and family groups.
[6]The ratio of fledglings per managed pair.

Reproductive Results

Of the active nests monitored, 56% (13/23) were successful, producing fifteen fledglings, and 26% (6/23) of active nests failed. Five nests had unknown outcomes (nests with sufficient time gap between visits in which a nest could have fledged with no subsequent detection of a fledgling). Nine fledglings were found in six managed pairs where no nesting had been observed (family groups). A total of 24 fledglings were observed in territories benefiting from rodent control management. Another two fledglings were observed in territories not protected from rats.

Adult feeding a rare 3 nestlings at Ekahanui.

Rodent Control Results

The majority of snap traps in the large-scale grid at Ekahanui have now been removed from protective wooden boxes and placed directly onto nearby tree limbs. This has proven to be a more effective method at killing rodents. More traps were also added this season in the upper sections of this MU to benefit both Elepaio and endangered tree snails. The result of these changes is the highest number of rodent kills ever recorded at Ekahanui during an Elepaio breeding season. As with previous years, the status of each snap trap in the grid was checked and re-baited every two weeks during the breeding season.

Ekahanui Rodent Control Data

EKA	# Traps	# Rats in Traps	Rats/Trap
2015	672	1459	2.2
2014	618	1285	2.1
2013	620	774	1.2
2012	619	520	0.8

Summary

It was a positive breeding season at Ekahanui in this year. The MU was just shy of forty pairs with a record 37 of them benefiting from rodent control. The number of active nests was above average with more than half resulting in one or more fledglings. Unfortunately, the number of unknown nest outcomes was above normal, likely contributing to the modest 0.65 fledglings per managed pair. On an interesting note, during the first week in October of 2014 a pair was observed building a nest at Ekahanui. This is the earliest nesting record for Elepaio in the state of Hawaii. This nest resulted in one successful fledgling.

Elepaio nesting in October at Ekahanui.

Palehua

Palehua Territory Occupancy Status and Rat Control 2015

Map removed to protect rare resources. Available upon request

Palehua Site Demographic Data

HUA	2015	2014	2013	2012	2011
Singles	1	2	0	0	0
Pairs	15	11	17	16	17
Pairs with Rat Control	15	10	17	16	17
Active Nests[1]	6	8	16	8	13
Successful Active Nests[2]	3/6=50%	4/8=50%	11/16=69%	3/8=38%	10/13=76%
Unknown Nest Outcome[3]	0	0	0	0	2
Failed Active Nests	3	4	5	5	1
Family Groups Found[4]	1	4	5	3	5
Fledglings Observed[5]	5	10	21	6	16
Fledglings/Managed Pair[6]	0.33	1	1.24	0.38	0.94

[1] Nest containing eggs or nestlings.
[2]Percentage of successful active nests observed.
[3]Total number of active nests with unknown outcome (time gap between visits).
[4]Total number of occurrences where pairs were observed with fledglings in which no nests were found.
[5]Total number of fledglings observed from successful active nests and family groups.
[6]The ratio of fledglings per managed pair.

Reproductive Results

Of the active nests monitored, 50% (3/6) were successful in producing four fledglings, while 50% (3/6) of the nests failed. One fledgling was found with one managed pair where no nesting had been observed (family groups). A total of five fledglings were observed in territories benefiting from rodent control management.

Rodent Control Results

Palehua underwent an alteration to its previous trapping grids this year. The 12 Victor® traps per Elepaio territory were replaced with a large-scale trapping grid similar to what is currently being used at Ekahanui. This increases rodent control protection throughout the entire MU by widening the placement of traps, but unfortunately, does reduce protection within individual Elepaio territories. Staying consistent with previous years, Pono Pacific re-baited all snap traps every two weeks during the breeding season.

Palehua Rodent Control Data

HUA	# Traps	# Rats in Traps	Rats/Trap
2015	170	662	3.9
2014	168	434	2.6
2013	180	393	2.2

Summary

Palehua had another disappointing breeding season this year. Despite a gain of five managed pairs and an increase in the total population of 23%, breeding activity was very low. Only six active nests were observed. This absence of nesting hasn't been seen at Palehua since management began back in 2007/2008. Five fledglings were found, which is the lowest since 2010. An explanation of why 2015 was such an unproductive breeding year is unknown, though weather may have played a role. Cooler spring temperatures may have delayed nesting, as all nests were not found until March and April. Such temperatures combined with storms producing rain and high winds likely discouraged many Palehua pairs from giving nesting a go this year.

Moanalua Valley

Moanalua Territory Occupancy Status and Rat Control 2015

Map removed to protect rare resources. Available upon request

Moanalua Site Demographic Data

MOA	2015	2014	2013	2012	2011
Singles	6	7	14	19	10
Pairs	33	32	33	32	21
Pairs with Rat Control	19	21	23	24	16
Active Nests[1]	7	16	17	15	13
Successful Active Nests[2]	3/7=43%	5/16=31%	14/17=82%	10/15=67%	5/13=38%
Unknown Nest Outcome[3]	1	7	6	2	5
Failed Active Nests	3	6	3	5	3
Family Groups Found[4]	4	4	2	2	3
Fledglings Observed[5]	7	11	17	13	9
Fledglings/Managed Pair[6]	0.37	0.5	0.74	0.54	0.56

[1] Nest containing eggs or nestlings.
[2]Percentage of successful active nests observed.
[3]Total number of active nests with unknown outcome (time gap between visits).
[4]Total number of occurrences where pairs were observed with fledglings in which no nests were found.
[5]Total number of fledglings observed from successful active nests and family groups.
[6]The ratio of fledglings per managed pair.

Reproductive Results

Of the active nests monitored, 43% (3/7) were successful in producing three fledglings, 43% (3/7) failed. One nest had an unknown outcome (nests with sufficient time gap between visits in which a nest could have fledged with no subsequent detection of a fledgling). Four fledglings were found in four managed pairs where no nesting had been observed (family groups). A total of seven fledglings were observed in territories benefiting from rodent control management.

Rodent Control

Despite fewer snap traps the number of rodents caught this year increased from the previous season. All snap traps from 2013-2015 were checked and re-baited every two weeks during the breeding season.

Moanalua Rodent Control Data

MOA	# Traps	# Rats in Traps	Rats/Trap
2015	252	1293	5.1
2014	288	716	2.5
2013	312	1576	5.1

Summary

Moanalua Valley had another below average breeding season in 2015. Resident pairs tied an all-time high, though just three nests were successful from only seven that were active at 19 managed pairs. Unfavorable weather conditions during the spring likely played a large role in the lack of breeding success at this MU.

Adult Elepaio pair captured in Moanalua. Notice the plumage variation with the male displaying a bit more black below the bill and around the throat.

4.1.4 OIP Summary

Management Action Highlights 2015

- Conducted rodent control in a total of 97 territories with pairs at four management sites.
- A large-scale grid containing 170 Victor® snap traps was deployed at Palehua to ensure rodent protection for all resident pairs.
- The table below summarizes the number of managed pairs and reproductive output since 2006.

Summary of Elepaio Management Table

Year	Managed Pairs	Success Active Nests	Family Groups	Fledglings	Fledglings/ Managed Pair
2015[1]	97	27	20	50	0.52
2014[1]	81	24	28	62	0.77
2013[1]	105	51	38	95	0.90
2012[1]	97	38	22	65	0.67
2011[1]	94	47	34	96	1.02
2010[1]	87	18	15	39	0.45
2009[2]	81	29	24	60	0.74
2008[3]	74	25	20	56	0.76
2007[3]	78	18	26	46	0.59
2006[4]	69	11	17	33	0.48

[1]SBW, Ekahanui, Moanalua, Palehua
[2]SBW, Ekahanui, Makaha, Moanalua, Palehua
[3]SBW, Ekahanui, Makaha, Moanalua, Waikane, Palehua
[4]SBW, Ekahanui, Makaha, Moanalua

Management Actions 2016

- Continue to mist-net and band all adult and juvenile Elepaio within the MUs to improve yearly demographic monitoring. In the process, recording songs and calls in order to expand our collection of Oahu Elepaio vocalizations at all MUs.
- Conduct surveys within and beyond MUs to monitor bird movements and population growth of the species. This includes a follow-up survey of South Haleauau gulch in SBW to update the original survey that was conducted in 2010.
- OANRP will be assisting the Waianae Mountains Watershed Partnership on Gill family property at Palehua to construct a small fenced area that will be used for outreach and education, bringing awareness to the need for protection of Elepaio and other native resources.
- Conduct rodent control and Elepaio monitoring at Ekahanui, SBW, Palehua and Moanalua to meet required 75 managed pairs.

4.1.5 Terms and Conditions for Implementation

Minimize direct impacts of military activities on survival and reproduction of Oahu Elepaio within the action area at Schofield Barracks Military Reserve (SBMR).

1. *The Army will report to the Service in writing at least semiannually (twice per year) the number of high explosive rounds that land above the fire break road, the locations where such rounds land, and whether these locations are within any known Elepaio territories.*

[No high explosive rounds landed above the firebreak road]

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

[No fires affected any known Elepaio territories during the 2015 breeding season]

3. *The Army will limit training actions in the forest above the fire break road at SBMR in the Elepaio nesting season (January to May) to small numbers of troops (platoon or less) that remain in one location for short periods of time (one hour or less), to limit possible nest disturbance.*

[No training actions have occurred above the firebreak road]

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

[One deceased Oahu Elepaio juvenile was collected this year and turned over to the U.S. Geological Survey. The cause of death could not be determined.]

Minimize loss of Oahu Elepaio habitat at SBMR, Schofield Barracks East Range (SBER), and Kawailoa Training Area (KLOA).

1. *The Army will report to the Service in writing on a semi-annual (twice per year) the number of fires above the fire break road, the area burned by each fire above the fire break road, including the amount of critical habitat burned, and how each fire was ignited or crossed the fire break road.*

[No fires occurred above the firebreak road]

2. *The Army will notify the Service within 24 hours of any instance in which training was not conducted in accordance with the Wildland Fire Management Plan (WFMP).*

[All training was conducted in accordance with the WFMP]

Manage threats to Oahu Elepaio and Oahu Elepaio habitat at SBMR, SBER, and KLOA.

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

[This report documents all of the above requirements]

2. *The Army, Service, and ornithological experts will formally reassess all impacts to Oahu Elepaio and Elepaio critical habitat that have occurred during the first five years following completion of this biological opinion. This formal review will occur before the end of calendar year 2008 and its purpose will be to reassess impacts from training exercises and, if necessary, correct any outstanding issues that are still impacting Elepaio and resulting in the loss suitable Elepaio habitat at SBMR. The feasibility of restoring critical habitat areas that have been lost also will be reassessed during this formal review.*

[Completed]

4.2 MIP ELEPAIO MANAGEMENT 2015

4.2.1 Background

The initial Biological Opinion (BO) that triggered the development of the Makua Implementation Plan (MIP) was issued in 1999. At that time, the Oahu Elepaio (*Chasiempis ibidis*) was not listed as an endangered species, but the 1999 BO did include recommendations related to Elepaio. These included conducting complete surveys of the Makua Action Area (AA) for Elepaio presence, monitoring of all known Elepaio within Makua Military Reservation (MMR) and installing and maintaining predator control grids around nesting pairs within MMR. In 2000, the U.S. Fish and Wildlife Service (USFWS) granted the Oahu Elepaio endangered species status under the Federal Endangered Species Act and in 2001 designated critical habitat on Oahu for the Elepaio. In the *Supplement to the Biological Opinion and Conference Opinion for Proposed Critical Habitat for Routine Military Training at Makua Military Reservation* issued in 2001, the recommendations from the 1999 BO became requirements. In September 2004, the USFWS issued another BO that covered newly designated critical habitat within the Makua AA for plants and Elepaio. This BO outlined additional requirements related to this critical habitat. The most recent BO issued in 2007 required the protection of all Elepaio pairs within the Makua AA. A term and condition in this 2007 in this BO was to construct ungulate-proof fencing around Makua Military Reservation and control rodents using aerially broadcast rodenticide when authorized.

4.2.2 Methods/Results

The methods section and the presentation of the results are the same as in OIP Elepaio management section of this year-end report.

Elepaio held in the photographer's grip. This involves holding the top of the bird's legs close to the belly in a scissor-like grip, while pinching the bird's tarsi between the thumb, fore, and middle fingers.

Makua Territory Occupancy Status and Rat Control 2015

Map removed to protect rare resources. Available upon request

Makua Site Demographic Data

Makua	2015	2014	2013	2012	2011	2010	2009	2008	2007	2006
Single Males	0	0	2	2	2	2	1	1	2	4
Single Females	0	0	0	0	0	0	0	1	1	1
Pairs	0	0	0	0	0	0	2	2	2	1
Pairs with Rat Control	0	0	0	0	0	0	2	2	2	1
Active Nests[1]	0	0	0	0	0	0	1	1	0	0
Successful Active Nests[2]	0	0	0	0	0	0	0	0	0	0
Unknown Active Nests[3]	0	0	0	0	0	0	1	0	0	0
Failed Active Nests	0	0	0	0	0	0	0	1	0	0
Family Groups Found[4]	0	0	0	0	0	0	0	0	0	0
Fledglings Found[5]	0	0	0	0	0	0	0	0	0	0
Fledglings/Pair[6]	0	0	0	0	0	0	0	0	0	0

[1] Nest containing eggs or nestlings.
[2]Total number of successful active nests observed.
[3]Total number of active nests with unknown outcome (time gap between visits).
[4]Total number of occurrences where pairs were observed with fledglings in which no nests were found.
[5]Total number of fledglings observed from successful active nests and family groups.
[6]The ratio of fledglings per managed pair.

Reproductive Results

Due to logistical/weather related complications and restricted access resulting from an incident involving UXO and Makua range personnel our program was not able to conduct surveys in 2015. A breeding pair of Elepaio has not been observed in Makua Valley since the 2009 breeding season.

4.2.3 MIP Summary

Management Actions 2015

- There were no Elepaio territories monitored for breeding activity in Makua Valley.

Management Actions 2016

- Conduct yearly territory occupancy surveys at all territories and surrounding gulches within the Makua AA, monitoring and banding, and data entry and organization.

Nests of Oahu Elepaio are constructed using lichens, mosses, moss sporophytes, grasses, leaf skeletons, and spider webs.

4.3 NENE MANAGEMENT 2015

4.3.1 Background

A family of four nene geese (*Branta sandvicensis*) were observed using a construction site at the eastern end of the Wheeler Army Airfield runway for foraging activities during the summer and early fall of 2014. The nene were observed once in July 2015. The table and aerial photo below summarize observations through July 16, 2015

Summary of nene observations through Oct 6, 2014

Date	Time(hrs)	Observed	Location
8/14/14	0745-1000	4 birds, K59, K60, 001 and 002	New planted and watered grass
9/23/14	1813	4 birds, K59, K60, 001 and 002	Southeast corner of airfield next to Medevac helicopter park, evaporation pond being built.
10/3/14	0830-0900	4 birds, bands not observed	North west edge of construction site, adjacent to pooling water and green new grass
10/4/14	1100	4 birds, bands not observed, one bird could see transmitter.	North west edge of construction site, adjacent to pooling water and green new grass. Northern pintail duck also observed using same pool.
10/6/14	0715-0845 And 1000-1435	4 birds, K59, K60, 001 and 002	North west edge of construction site, adjacent to pooling water and green new grass
7/16/15	0915	3 birds	Area E Central, resting in planted grass area.

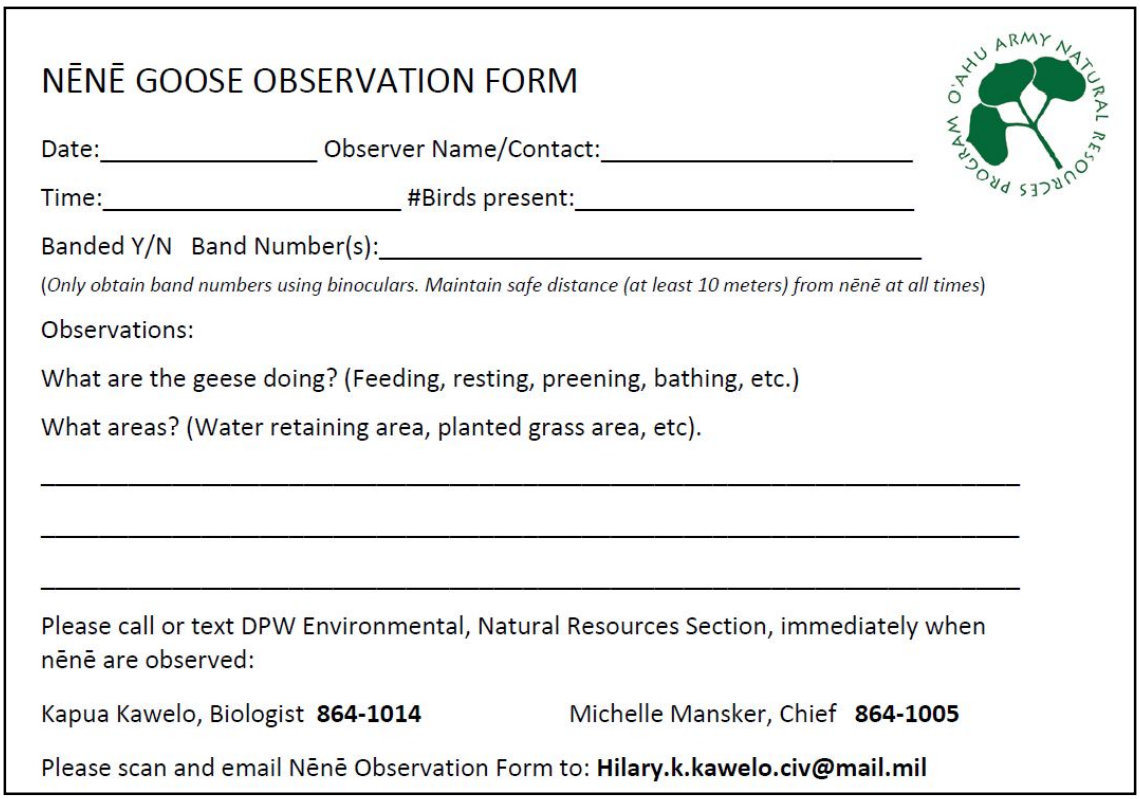
Aerial photo of the WAAF construction site.

The parent birds were Kauai Island individuals, translocated to Hawaii Island in an effort to reduce the number of nene near the Lihue airport. These birds left Hawaii Island and nested at the James Campbell National Wildlife Refuge (NWR) in Kahuku, Oahu in 2014. They successfully fledged two chicks, aided by ongoing predator control program at the NWR. The male parent bird died during the past year (Aaron Nadig, USFWS, pers comm.) so only three birds are known to remain on Oahu.

Nene geese at Wheeler Army Airfield.

4.3.2 Nene Management Summary

In order to avoid any harm to the geese, the USFWS recommended all activity cease within 150 feet of the birds. In addition, OANRP outreach staff conducted an educational campaign. An article was published in the Hawaii Army Weekly that included information on how to report and avoid negatively impacting the nene. In addition, outreach staff produced posters with the same information for sites around Wheeler where the nene would most likely be observed including; the Wheeler Tower, Wheeler Airfield operations and the construction site offices. Additionally, the Leilehua golf course staff was notified to report any nene appearances. OANRP are coordinating closely with USFWS to modify practices at the construction site to reduce the site's attractiveness and are including nene in the Biological Assessment being prepared for Oahu training. OANRP developed a nene observation form on which construction workers and airfield employees can record data and to ensure consistency. This form is included below.



NĒNĒ GOOSE OBSERVATION FORM

O'AHU ARMY NATURAL RESOURCES PROGRAM

Date:_____ Observer Name/Contact:_____

Time:_____ #Birds present:_____

Banded Y/N Band Number(s):_____

(*Only obtain band numbers using binoculars. Maintain safe distance (at least 10 meters) from nēnē at all times*)

Observations:

What are the geese doing? (Feeding, resting, preening, bathing, etc.)

What areas? (Water retaining area, planted grass area, etc).

_____

_____

_____

Please call or text DPW Environmental, Natural Resources Section, immediately when nēnē are observed:

Kapua Kawelo, Biologist **864-1014** Michelle Mansker, Chief **864-1005**

Please scan and email Nēnē Observation Form to: **Hilary.k.kawelo.civ@mail.mil**

Nene goose observation form used to standardize data collection.

4.4 OPEAPEA MANAGEMENT 2015

4.4.1 Background

OANRP conducted acoustic monitoring for the Hawaiian Hoary bat (*Lasiurus cinereus semotus)* or Opeapea from 2010 to 2013 on all Oahu Army Training Areas, Dillingham Military Reservation (DMR), Kahuku Training Area (KTA), Kawailoa Training Area (KLOA), Makua Military Reservation (MMR) and Schofield Barracks Military Reservation (SBMR). These surveys were conducted for over 301 nights in order to establish bat presence or absence and document potential seasonal use of habitats by the Opeapea. OANRP found Opeapea present at all Oahu Training Areas (Fig. 4-1). Specific foraging behavior was documented from KTA, DMR and Schofield Barracks West Range (SBW). In general, bat detections on Oahu are much lower than from data collected on Hawaii, Maui and Kauai islands (C. Pinzai pers. comm.).

Map removed to protect rare resources. Available upon request

Figure 4-1 OANRP bat survey sites on Army Training lands

4.4.2 Opeapea Management Summary

OANRP secured funding in FY 15 to conduct more intensive acoustic monitoring surveys across a majority of the Army installations on Oahu including cantonment areas. The survey period is from January 2015 to January 2016. Figure 4-2 shows all of the current placement of the bat detectors

throughout the island of Oahu. A total of 30 monitoring stations are being run nightly for this study. These data will be used to inform the upcoming consultation with the USFWS.

Map removed to protect rare resources. Available upon request

Figure 4-2: Current survey sites for Opeapea on Army controlled lands

In the interim, the USFWS provided restrictions to minimize impacts to bats through an informal consultation. Consequently, the Army has ceased felling trees which are greater than 15 feet tall during the bat pupping season, June 1st through Sept 15th each year. During the 2015 pupping season, permission was given to remove trees that were safety hazards or necessary for ongoing construction projects. The Army's expert arborist provided guidance on the necessity of trimming or removal in regards to the safety issues. In each case, OANRP employed acoustical monitoring surveys, thermal imager surveys or a combination of both to determine if bats were utilizing the trees for roosting and if pups were present. Results of all the surveys are listed in Appendix 4-1. A total of five surveys were conducted by OANRP before the end of this reporting period, 18 hours were spend conducting these surveys, 41 trees were surveyed and zero roosting bats were found. These procedures will be formalized in the upcoming Section 7 consultation. Also, tree removal contracts are now being designed to include bat pupping season restrictions and the summer cutting limitations are being built into landscape maintenance timelines. In early September 2015 an official Garrison policy was signed placing a moratorium on tree cutting during the bat pupping season. This policy is included as Appendix 4-2.

OANRP has purchased a Fluke 400T and an IR Hunter Mark II thermal imagers to use for detecting possible roosting bat pups. OANRP has been working closely with the biologist for HECO to formulate a bat survey program and find alternative methods for determining the presence of a roost tree with pups.

CHAPTER 5: *DROSOPHILA* SPECIES MANAGEMENT

5.1 BACKGROUND

Fourteen species of Hawaiian picture wing *Drosophila* flies are currently listed as threatened or endangered, and many more are equally rare. Six listed species are endemic to Oahu, and three – *D. montgomeryi*, *D. obatai*, and *D. substenoptera* – are currently known to occur on Army lands. OANRP work on *Drosophila* began in March 2013, focusing on monitoring known populations, surveying for new ones, and restoration of habitat.

5.2 SURVEY METHODS

Many species of Hawaiian *Drosophila*, including the picture wing group to which all of the endangered species belong, are readily attracted to baits of fermented banana and mushrooms. Both baits are spread on a cellulose sponge which is hung from a tree in a cool, shaded, sheltered site, and checked for flies after about one hour. Depending on the quality of the site (number and size of host plants, and microclimate) and the density of baiting spots, surveys typically consist of setting out 16-32 sponges, in groups of four or eight with groups separated by 20-100 m. Baits are checked at least every hour, as flies do not necessarily stay at baits for long periods; number and species of all picture wings on each sponge are recorded at each check. The greatest activity is typically during the cooler hours before 10 AM and after 2 PM, but flies may appear at any time. Direct quantification of *Drosophila* populations is extremely tenuous, as populations may fluctuate not only seasonally but from day to day. However, repeated surveys may yield useful data on long-term trends. Abundance numbers are reported as the maximum number of individuals observed on a survey day (compiled by adding the maximum observed at each discrete group of bait sponges at any one time, assuming that the same individual flies may move between sponges within a group but are unlikely to be seen at two different sponge groups), since numbers fluctuate through the day.

Known, significant populations of *D. montgomeryi* at Kaluaa MU and *D. substenoptera* at Palikea MU, where flies occur relatively consistently, are monitored monthly in order to determine approximate population trends through the year. For *D. montgomeryi*, Pualii (designated as a management site for *D. montgomeryi*) and Waianae Kai (not a managed population, but the largest known population) were monitored quarterly. Other known populations were visited periodically through the year. New populations of endangered *Drosophila* were searched for by looking in similar habitat both in areas suggested by other staff as having host plants, at historic collecting localities, and in new sites where surveys have been minimal.

5.3 RESULTS

5.3.1 *Drosophila montgomeryi*

Drosophila montgomeryi is a small yellow-brown species which breeds in rotting bark of *Urera kaalae* and *Urera glabra* (opuhe). It is currently known from ten sites that are regarded as five population units (PUs), effectively covering nearly its entire historic range in the Waianae mountains (Figure 1). Field work this year has focused on monitoring known populations and searching for new sites, but few potential suitable areas have been found. While *Urera glabra* occurs widely across the Waianae range, it often occurs as scattered clumps of a few or only one individual, unsuited for survival of *D. montgomeryi* and probably not viable for long-term survival of this dioecious, wind-pollinated tree.

Map removed to protect rare resources. Available upon request

Figure 1. Distribution of *Drosophila montgomeryi* observations in 2015 and earlier records from 2013-14, with known *Urera* spp. sites and all survey points in the Waianae range.

Kaluaa & Waieli MU

Three sites in this MU – Puu Hapapa, North Kaluaa, and Central Kaluaa gulch 1 – have been monitored monthly since June 2013 (though not every site was visited each month) over a total of 54 survey days. Abundance of *D. montgomeryi* appears to follow a distinct seasonal pattern, increasing dramatically over the winter months to a peak between January and May (Figure 2). This is most likely due to increased rain and treefalls from storms that cause death or branch breakage of *Urera* near monitoring sites. Both the general seasonal pattern and high month-to-month fluctuations were strongly correlated with those of some other species, including the common *D. ambochila*, *D. crucigera*, and *D. inedita*, but not *D. punalua* or the rare *D. divaricata*, suggesting that the effect was independent of at least host plant. There was also no obvious difference in weather or bait quality from high-abundance days that would explain the low numbers.

Pualii

This site was visited for the first time last year, and quarterly monitoring began in 2015. At the time of the first visit, the last wild *Urera kaalae* tree in North Pualii Gulch had recently fallen and the decaying trunk was supporting a large number of *D. montgomeryi*. Unfortunately, the species has not been seen since the second visit there, and the survival of this population is uncertain. Only seven *U. kaalae* (all outplanted), and no *U. glabra* (aside from recent outplants), remain at the site; with no reproduction

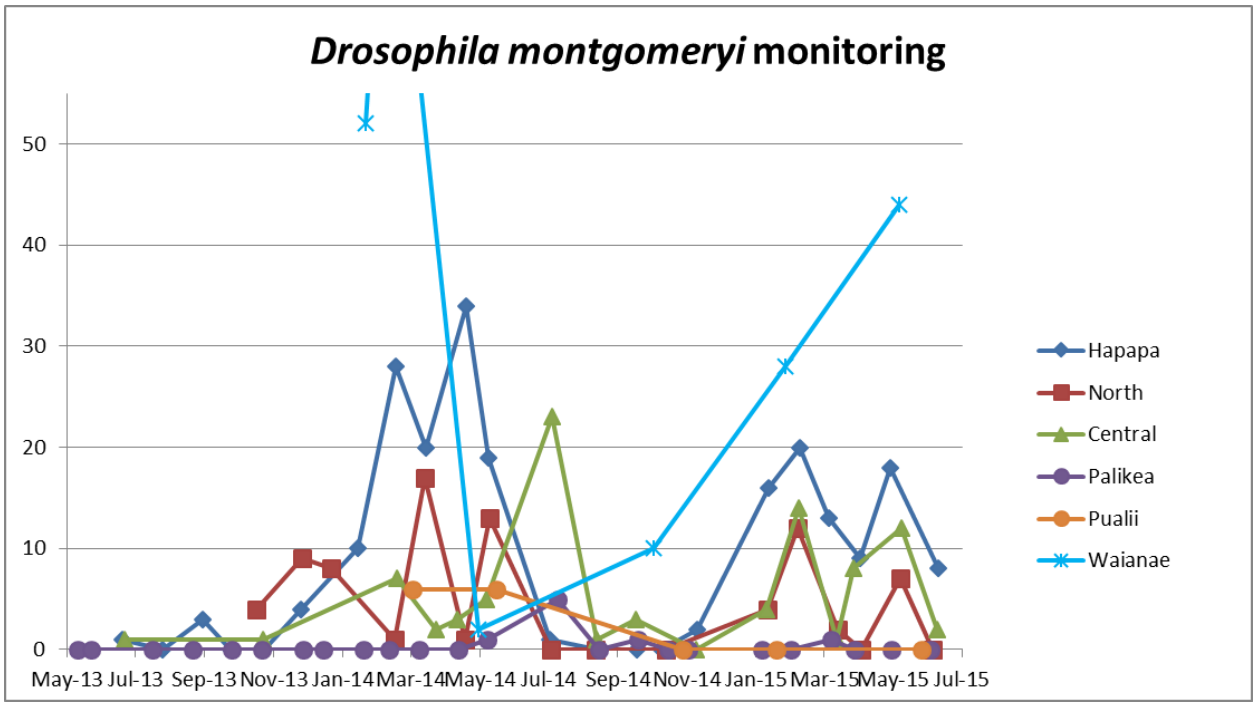


Figure 2. *Drosophila montgomeryi* numbers during monthly monitoring at three sites in Kaluaa PU (Puu Hapapa, North Kaluaa, and Central Kaluaa) and Palikea, and quarterly monitoring at Waianae and Pualii. Y axis is the maximum number observed across the entire site on the survey day (see Survey Methods, section 5.2).

currently occurring among *U. kaalae*, it will not remain a viable population of *D. montgomeryi* without management intervention. Nevertheless, it is an area of high-quality native habitat, both in the immediate vicinity and further downslope in the gulch. It may be a potential reintroduction site after host plant restoration.

Palikea

Despite continuous monitoring here since May 2013 (targeting *D. substenoptera*, which is consistently found in the area), *D. montgomeryi* was not detected until May 2014. Three of the four records of *D. montgomeryi* here have been of single individuals, indicating that the population remains low. The area where they were found is already a target for weed management and restoration, and has high potential for management to benefit *D. montgomeryi*. *Urera kaalae* is absent, but *U. glabra* has already begun to increase naturally as weed control has reduced alien cover, and outplanting has significantly boosted the population.

Site	Days	Max No.
Kaluaa - Central	7	14
Kaluaa - North	7	12
Puu Hapapa	8	20
Pualii	3	0
Palikea	8	1
Waianae	3	44
Kawaiu	1	0
Makaha	1	0
Pahole	2	0
Ekahanui	1	0

Table 1. Survey effort for *D. montgomeryi* across all potential sites in 2015 reporting period, in survey days. "Max No." is the highest number of flies observed in a single day.

Waianae Kai

The largest known population of *D. montgomeryi* occurs in the northeastern subgulches of Kumaipo stream, Waianae Valley. Three sites have been discovered so far, all at the base of Mt. Kaala and consisting of small patches (~0.5 ha) of diverse native forest constrained by alien-dominated vegetation above and below. Only *U. glabra* is present, indicating that *D. montgomeryi* can thrive on it alone (*U. kaalae* was also found in nearby South Kumaipo Gulch as recently as 1995, but no longer occurs in the valley). All are located on or just below steep slopes that are vulnerable to landslides, which may preclude fencing as a matter

Figure 3. Habitat restoration for *D. montgomeryi* at Palikea. Each orange flag marks a *Urera glabra* outplant.

of practicality. The middle gulch, where *D. montgomeryi* has been most abundant and currently the only known site for the critically imperiled *D. kinoole*, is recovering from boulder damage from ongoing severe erosion of the ridge to the north. The fly population has steadily increased since the damage occurred between February and May 2014, although *D. kinoole* has not been seen since then. Unusually, many *D. montgomeryi* at this site are consistently observed resting on branches but few were attracted to baits; counts reflect the total observed. Gulches to the west of the known sites were surveyed and found to contain no *Urera*; however, the area to the east in Hiu Gulch has yet to be checked, and there may be additional sites in the area.

Lihue

The original rediscovery of *D. montgomeryi* was at Schofield West Range, South Haleauau Gulch near Puu Kalena in 2008. This site was revisited once in late 2013 and again in mid-2014, but none were found. Access is difficult and it is probably still inhabited by the species, given the usual population fluctuations seen at other sites.

Other sites

Five additional sites are currently known for *Urera* in the Waianae range: Kawaiu Gulch, Pahole Gulch, Makaha, Ekahanui, and Palawai. All were surveyed this year (5 survey days) except the last, which was visited once during the 2014 reporting year. No *D. montgomeryi* have been found at any of these so far.

Figure 4. Distribution of *Drosophila substenoptera* observations in 2015 and earlier records from 2013-14.

Habitat restoration

This was the first year of active habitat management for *Drosophila montgomeryi*. Approximately fifty *U. glabra* grown from cuttings were planted at each of North Kaluaa, Central Kaluaa, Pualii, and Palikea between December 2014 and March 2015. Following observations that wild plants tended to be clustered by sex and are probably mostly clones, particular effort was made to ensure that male and female plants were placed close to each other. All sites are exhibiting high survivorship and good growth. Observations of some individuals suggests that pruning of tip shoots may promote extremely vigorous growth of side branches and ultimately larger, more robust trees.

5.3.2 *Drosophila substenoptera*

Surveys for this species have focused on finding new populations. Based on collection records, it requires moderately tall, non-boggy wet forest with its host plants, *Cheirodendron* sp. (olapa) and *Polyscias* (=*Tetraplasandra*) *oahuensis* (ohe mauka), a habitat which is relatively uncommon since these trees tend to occur most abundantly in short-stature forest near summit crestlines. Currently, there are three known PUs for *D. substenoptera* – Palikea, Kaala-Kalena, and Opaeula (Figure 4). PU trends are only graphed for Palikea as the other two PUs have insufficient numbers of survey days. At other sites *D. substenoptera* is highly sporadic, typically occurring as single individuals observed only once during a day. This rarity has undoubtedly hampered our ability to detect it at new sites.

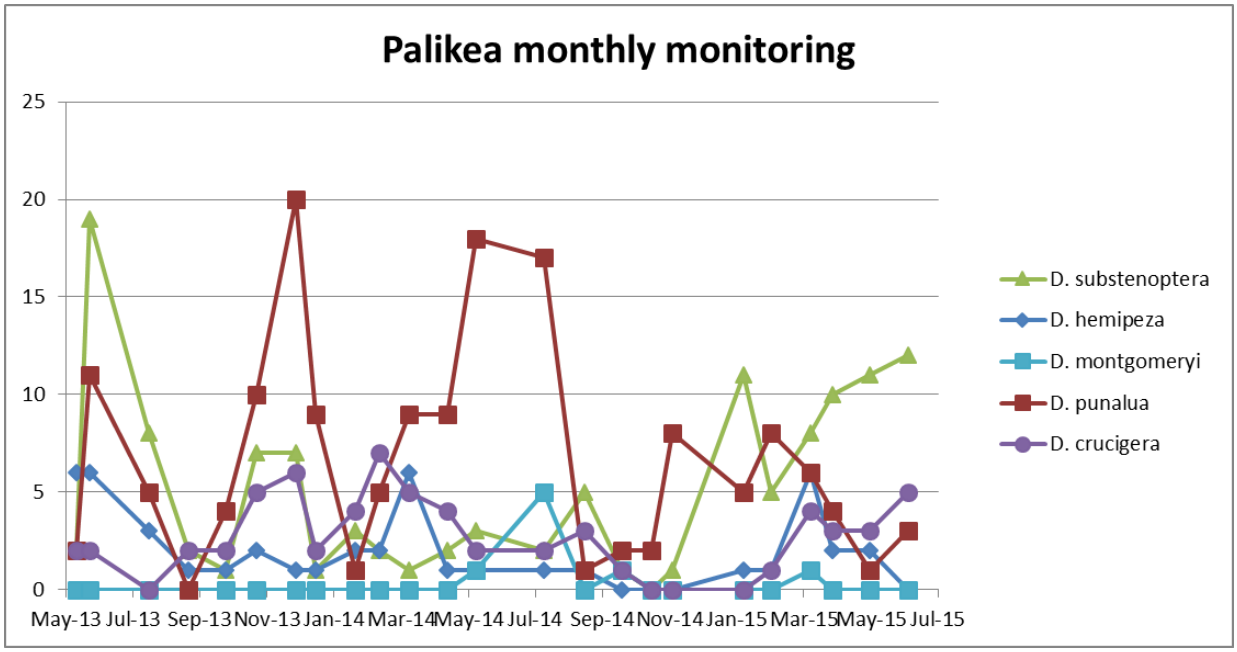


Figure 5. Monthly monitoring results for all species at Palikea, from May 2013 to July 2015.

Waianae Range

Monthly monitoring in the northern portion of Palikea MU has been ongoing since May 2013 (24 survey days total, 8 in the current reporting period). Aside from a large flush in late May 2013, numbers of *D. substenoptera* and another endangered species, *D. hemipeza*, have been consistently low, but they have always been present. Abundance showed no clear correlation among seasons or across the species found there. (Figure 5). At the Kaala-Kalena PU, one individual was observed along the crestline just north of the South Haleauau "Trinerve Gulch". Near the summit of Kaala, sites on the western, northern, and southeastern faces were surveyed; one individual was found at the first, but none were seen at the others.

Koolau Range

In December 2013, a single *D. substenoptera* was observed at Lower Opaeula MU, the first record of the species in the Koolau range since 1972. In 2015, it was sighted again in the same area. Surveys at Upper Opaeula and Kaluanui did not find any of this species. Historically, *D. substenoptera* was more widespread and abundant on this side than in the Waianae range. However, collection effort has been limited due to the difficulty in accessing areas of intact habitat for this species. OANRP surveys in the Koolaus for *D. substenoptera* have been relatively few due to higher priorities elsewhere, and concentrated in only a few sites. Finding additional Koolau populations is a high priority for this species; Helemano, Poamoho, and Kaukonahua have yet to be surveyed. Lower Opaeula and Koloa will continue to be checked given the extremely high quality of habitat there and low observation rate at sites where *D. substenoptera* is known to be present. Appropriate breeding habitat is surprisingly limited given the wide distribution of *Cheirodendron* on other islands under similar climatic conditions, and often occurs only on steep slopes or in the bottom of drainages that are weedy and difficult to access.

Site	Days	Max No.
Palikea	8	12
Kaala	5	1
Lihue	1	1
Lower Opaeula	2	1
Upper Opaeula	1	0
Koloa	3	0
Kaluanui	1	0

Table 2. Survey effort for *D. substenoptera* across all potential sites in 2015 reporting period, in survey days.

Figure 6. Distribution of *Drosophila obatai* observations in 2015 and earlier records from 2013-14, with known *Chrysodracon* spp. sites and all survey points in the Waianae range.

5.3.3 *Drosophila obatai*

Drosophila obatai was rediscovered in Manuwai Gulch MU in 2011, 40 years after the previous record in 1971. It breeds in rotting stems of *Chrysodracon* (=*Pleomele*) spp. (halapepe), which suffers from very low reproduction rates but remains widespread in the northern Waianae range thanks to its longevity. With the new sites found this year, it is now known from seven sites in four potential PUs, although three of these PUs are within 1,200 m of each other and could potentially form one contiguous population. While it almost certainly was contiguous until recently (possibly up to ~50 years ago), native forest in general and *Chrysodracon* in particular is now much more fragmented, and moving between patches of host trees more difficult for the flies.

Surveys for *D. obatai* in 2015 were relatively limited due to a focus on outplanting for *D. montgomeryi* and other projects. *Drosophila obatai* was only found at Manuwai; they were not found at two sites within SBW (the Coffee Gulch and Guava Gulch branches of Pulee Gulch), and one in Central Makaleha had only a single *Chrysodracon* tree and was not suitable habitat. The Makaleha area consists of a series of large, steep valleys with remnant dry and mesic forest that have been little surveyed recently. Future surveys will focus on this area.

Site	Days	Max No.
Manuwai	2	1
Lihue - Pulee	3	0
Central Makaleha	1	0

Table 3. Survey effort for *D. obatai* across all potential sites in 2015 reporting period, in survey days.

Map removed to protect rare resources. Available upon request

Figure 7. Observations of six non-target rare *Drosophila* species during the 2014 survey season.

5.3.4 Other Rare *Drosophila*

During the course of surveys, six additional rare *Drosophila* were found in management units where *D. montgomeryi* and *D. substenoptera* occur (Figure 7). *Drosophila nigribasis* and *D. oahuensis* were also found on Schofield Barracks.

Non-Target Rare *Drosophila* Observed During Surveys, Oct. 2014–Jul. 2015

Species	Sites	Total Obs.	Max. No.
craddockae	Lower Opaeula	2	1
divaricata	Kaluaa, Ekahanui	25	6
flexipes	Manuwai, Pualii	1	1
hemipeza	Palikea, Hapapa	14	6
nigribasis	Kaala	11	6
oahuensis	Kaala, Kaluanui, Opaeula	12	6

Drosophila craddockae is closely related to *D. pullipes* of Hawaii and *D. grimshawi* of Maui Nui. Like the former, it is a specialist on *Wikstroemia* spp., an unusual host. While its host is abundant, *D.*

craddockae is rarely observed, and has been found only sporadically during our surveys. Only two were seen, one each at Lower Opaeula and Koloa. The latter is a new site record for the species.

Drosophila divaricata is closely related to the more common *D. inedita*, but can be easily distinguished by its much larger size and slightly different wing pattern. The host plant is unknown. It has generally been rare, but was observed regularly in North and Central Kaluaa in 2015. There were also records from Puu Hapapa and Ekahanui.

Drosophila flexipes breeds in fermenting sap fluxes of *Sapindus oahuensis* (lonomea). Although this tree is relatively common in remnant mesic and dry forest, it often occurs at lower elevations where ants prevent *Drosophila* from persisting. Only one was found in 2015, at Manuwai; it was not seen at Pualii, where it was recorded previously.

Drosophila hemipeza is the only listed endangered species on Oahu that is known to be extant but does not occur on Army lands or OIP/MIP action areas, although it historically occurred at Kahuku Training Area and West Makaleha Gulch adjacent to Makua. It has been consistently found at Palikea MU but always in low numbers for several years. In 2014, a single individual was found at Puu Hapapa on two separate occasions, the first records of this species outside Palikea since 1974, and two more were seen in 2015. It has been reared from *Cyanea*, *Lobelia*, and *Urera*, all of which are present at both sites.

Drosophila nigribasis breeds in *Cheirodendron*; it is related to *D. substenoptera* but appears to favor wetter habitats. In our surveys, it is restricted to Koloa and the vicinity of Kaala summit.

Drosophila oahuensis is also a *Cheirodendron* breeder, and appears to span the habitat range of *D. nigribasis* and *D. substenoptera*, including both the near-summit area of Kaala and wet-mesic sites such as North Haleauau Gulch in Lihue. Although most observations this year came from Kaala, many more individuals were seen than previously.

Drosophila craddockae, widespread but extremely rare and sporadic.

Drosophila divaricata, restricted to Honouliuli in the southern Waianae range.

Drosophila hemipeza, very similar to *D. substenoptera* and also often seen waving its wings.

CHAPTER 6: RODENT MANAGEMENT

OANRP has managed MIP and OIP species that are subject to rodent predation with various strategies since 1997. This chapter discusses rodent control methods utilized over the past reporting year and highlights recent changes. Specifically, this chapter has five main sections: Section 6.1 provides an overview of the current rodent control program and discusses recent changes; Section 6.2 discusses recently installed Goodnature® A24 automatic rat trap grids at Kahanahaiki and Ohikilolo; Section 6.3 provides results of an investigation into tracking tunnel data; Section 6.4 discusses on-going trap trials at Palikea and Ekahanui; and Section 6.5 lays out future plans for rat control.

6.1 OANRP RODENT CONTROL PROGRAM SUMMARY

OANRP manages rats threatening some rare species only seasonally (e.g., *Chasiempis ibidis* or Oahu Elepaio during the nesting season), while other species are protected year-round (e.g., *Achatinella mustelina*.). The methods of rodent control that OANRP currently utilizes for rodent control are limited to using kill-traps (Victor® traps, Ka Mate™ traps, and Goodnature® A24 traps) and predator-proof fences.

Rat control in 2015 consisted of deploying small Victor® snap trap and Goodnature® A24 trap grids around resources, maintaining large-scale trapping grids consisting of Victor® or Ka Mate™ traps, and installing and maintaining large-scale trapping grids of Goodnature® A24 traps. More Goodnature® traps will be installed across MUs and around additional population units over the next year. OANRP contracted Pono Pacific to conduct rat control during Elepaio nesting season (December – June) at Ekahanui, Kahanahaiki, Moanalua, Palehua, and Schofield Barracks West Range (SBW). Pono Pacific is also contracted to conduct year round rat control at Ekahanui and Palikea.

In October 2015 a new predator control contract will be awarded for a five year period. Control levels at most sites will increase with number of traps and size of grids. The contractor will also be responsible for checking tracking tunnels at Palikea, Ekahanui, Kahanahaiki, and Makaha. Year round control using A24s will be conducted by the contractor at Kahanahaiki and Makaha. Prior to this contract the OANRP field teams were conducting this control, and now they will be able to focus efforts on other units and management actions.

Table 1. Rat control strategies to be utilized by OANRP in 2015-2016.

MU/Area	Primary Spp. Protected	Control Method	Description	Trap Type	# Traps	Deployment	Check Interval
East Makaleha	*A. mustelina*	Trapping Grid	Two small grids	Victor® w/out boxes	40	Year-round	4-6 weeks
				A24 Automatic traps	20		
Ekahanui† *i*	*A. mustelina*	Trapping Grid	Many small grids	Victor® w/out boxes	47	Year-round	4-6 weeks
				A24 Automatic traps	30		
	C. ibidis	Trapping Grid	Large-scale grid	Victor® w/ & w/out boxes[i]	620	Annual: Dec-June	2 weeks

MU/Area	Primary Spp. Protected	Control Method	Description	Trap Type	# Traps	Deployment	Check Interval
Kahanahaiki †+	*A. mustelina*	Predator-proof fence	Constructed 1998	--	--	Year-round	--
	A. mustelina, Cyanea superba	Trapping Grid	Large-scale grid	A24 Automatic traps	170	Year-round	4 weeks
Kamaohanui	*A. mustelina*	Trapping Grid	One small grid	Ka Mate™ A24 Automatic traps	47 10	Year-round	6 weeks
Kapuna	*Hesperomannia oahuensis*	Trapping Grid	Two small grids	A24 Automatic traps	5	Seasonal	6 weeks
	Schiedea nuttallii				4		
Koiahi	*A. mustelina*	Trapping Grid	One small grid	A24 Automatic traps	8	Year-round	6 weeks
Makaha Unit I	*A. mustelina, H. oahuensis, C. superba*	Trapping Grid	Large-scale grid	A24 Automatic traps	110	Year-round	4 weeks
Makaha Unit I	*H. oahuensis*		Two small grids	A24 Automatic traps	13	Seasonal	6 weeks
				Victor® w/out boxes	24		
Makaha Unit II	*Cyanea grimesiana*		Large-scale grid	A24 Automatic traps	80	Year-round	6 weeks
Manuwai	*Delissea waianaeensis*	Trapping Grid	One small grid	Victor® w/out boxes Ka Mate™ A24 Automatic traps	14 11 8	Seasonal	6 weeks
Moanalua†	*C. ibidis*	Trapping Grid	Many small grids*	Victor® w/out boxes	300	Annual: Dec-June	2 weeks
Ohikilolo	*A. mustelina, Pritchardia kaalae*	Trapping Grid	Many small grids	Victor® w/ boxes	47	Year-round	6 weeks
				A24 Automatic traps	53		
Palehua†	*C. ibidis*	Trapping Grid	Many small grids*	Victor® w/out boxes	200	Annual: Dec-June	2 weeks
Palikea	*A. mustelina*	Predator Exclosure	Constructed 2012	--	--	Year-round	--
Palikea-Mauna Kapu	*A. mustelina*	Trapping Grid	One small grid	Victor® w/ boxes	15	Year-round	6 weeks
Palikea†	*A. mustelina*	Trapping Grid	Large-scale grid	Ka Mate™	250	Year-round	2 weeks
SBW Haleauau‡†	*A. mustelina*	Trapping Grid	One small grid	Victor® w/out boxes	28	Year-round	6 weeks

MU/Area	Primary Spp. Protected	Control Method	Description	Trap Type	# Traps	Deployment	Check Interval
	H. oahuensis	Trapping Grid	One small grid	Victor® w/out boxes	3	Seasonal	6 weeks
				A24 Automatic traps	3		
	C. ibidis	Trapping Grid	Many small grids*	Victor® w/out boxes	450	Annual: Dec-June	2 weeks
				A24 Automatic traps	50	Annual: Dec-June	4 weeks
W. Makaleha	*C. grimesiana*	Trapping Grid	One small grid	Victor® w/out boxes	28	Year-round	6 weeks
Waianae Kai	*Neraudia angulata*	Trapping Grid	One small grid	Victor® w/out boxes	20	Seasonal	6 weeks
Waieli-Hapapa	*A. mustelina*	Trapping Grid	One small grid	Victor® w/out boxes	35	Year-round	6 weeks
		Predator-proof fence	Constructed 2011	--	--	Year-round	--

* *Each managed Elepaio (*C. ibidis*) territory has 12 traps installed ~12 m apart in trees.*
† *Contracted Pono Pacific to maintain rat grids during Elepaio nesting season.*
‡ *N. Haleauau snail sites are included during Elepaio nesting season.*
i *The majority of traps have been removed from the wooden boxes and placed in trees.*
\+ *Victor® snap traps discontinued to run A24s.*

OANRP is continually researching and reassessing rat control methods to determine the most effective strategies for the protection of natural resources.

6.2 A24 GRID AT KAHANAHAIKI

In 2015, OANRP managed a large scale grid of A24s at the Kahanahaiki Management Unit (MU). This MU has had various rat control conducted in previous years, ranging from small grids of bait stations to large scale Victor® snap trap grids. Kahanahaiki has long been a testing ground for new management techniques and was the first area with ecosystem scale rat control. It was decided to install the A24 grid in Kahanahaiki so that the results could be compared to other rat control strategies used there in the past. Additionally, easy access at this location allows for frequent monitoring and adjustments.

The Kahanahaiki grid is designed for large-scale lethal trapping for rats (*Rattus* spp.) across the MU. The overall goal is to reduce rat activity within an MU to a level that benefits the endangered plants, *A. mustelina* (Oahu tree snail), native insects, and the native ecosystem as a whole.

In 2014, OANRP installed a grid of 119 Goodnature® A24 automatic rat traps across the 26 ha Kahanahaiki MU, equating to 4.6 A24s per ha. The A24 grid was used in 2015 instead of maintaining the prior snap trap grid of 464 Victor® snap traps, equating to 17.8 Victor snaps per ha. The A24 grid was laid out using 50x100m spacing with some traps placed at 25x100m based on prior snap catch data. From past snap catch data we have observed, the gulch area in general accounts for more rat catches than other areas of the MU, so additional traps were placed here based on this information.

A24s were checked monthly, requiring 3 personnel. The A24s were checked for presence of carcasses, re-baited with Goodnature® preservative peanut butter and each CO_2 canister was tested. Due to a limited number of counters, only 17 of the 119 traps were fitted with counters to monitor hits.

A total of 38 tracking tunnels were monitored inside the grid and 24 tunnels were monitored at a nearby site (Kapuna Gulch, within Pahole Natural Area Reserve) as a control with no active trapping being conducted. Tunnels were monitored one month prior to installation of the A24s and then monthly thereafter for both sites. Kahanahaiki has been monitored since 2009 and monitoring results have been included for comparison (Figure 1). Tunnel data show that percent rat activity at the Kapuna site remains high year round, and in the 2014-2015 season, Kahanahaiki was approaching control site levels.

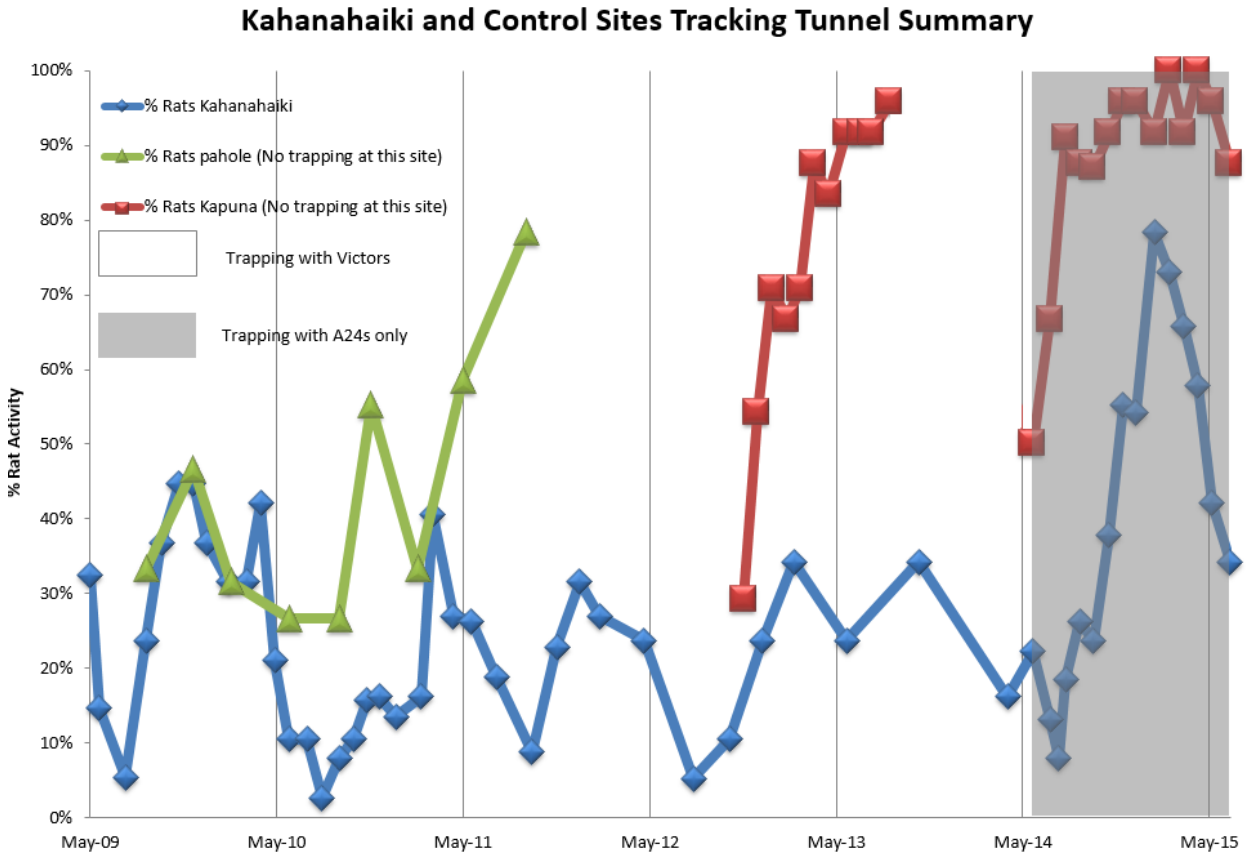


Figure 1. Percent of rat activity each month at Kahanahaiki and two control sites Kapuna and Pahole.

Diphacinone-50 Hand Broadcast Pilot Project

Since 2012, OANRP halted rodenticide use because of a change in the Special Local Needs (SLN) label that makes bait-station application unfeasible in the steep, rugged terrain where the work is conducted. Relying solely on traps has not been effective in keeping populations below the targeted 10% tracking in monitoring tunnels, particularly during the period of peak rat abundance (typically Fall/Winter). In an attempt to combat this problem in Hawaiian habitats, OANRP will make an effort to determine the effectiveness of a "one-time" two-application hand-broadcast (applications spaced approximately 5-7 days apart) and canopy baiting of rodenticide bait (Diphacinone-50) during a period of high rat abundance, October 2015, within Kahanahaiki. The hand broadcast application will involve OANRP staff walking a grid of trails while evenly distributing rodenticide bait; canopy baiting involves placing bait, held in small cloth bags, into trees within the grid. These application methods comply within the

Diphacinone-50 label (EPA Registration No. 56228-35). The hand broadcast method of rat control was assessed in the Programmatic Environmental Assessment for the Final Implementation Plan for Oahu Training Areas, March 2010, FNSI June 2010. USDA National Wildlife Research Center (NWRC) will provide the monitoring associated with this study (e.g., bait application according to label, efficacy of this rat-reduction method, and non-target impacts). See Appendix 6-1 for OANRP Diaphacinone-50 Hand Broadcast Study.

Other Management Considerations for 2016

One of the OANRP goals for the A24s is to eventually reduce the trap monitoring interval from monthly to quarterly. Because this is a multi kill trap and costs more than traditional traps, a balance of staff time and trap cost needs to be achieved to meet program objectives. One of the ways to accomplish this is by increasing the bait longevity and attractiveness in the A24s at Kahanahaiki. A study developed to do this involves constructing custom counters that record the date and time of each hit. This will allow us to determine how effective the bait is over a three month period and if the monitoring interval affects number of hits. From bait trials in previous years, we have found that the Goodnature Preservative peanut butter has been more attractive and outlasted all other bait alternatives and thus will be used for the trial.

6.3 COMPLETED TRIALS AT PALIKEA AND EKAHANUI

Although the significant amounts of data and research conducted on traps and bait in New Zealand is helpful for implementation in Hawaii, OANRP has documented difficulties and conditions that are not experienced in New Zealand. For example, bait removal by slugs and other invertebrates is a major issue that is not experienced to the same degree in New Zealand. Additionally, it is possible that black rats (*R. rattus*) in Hawaii spend more time in trees than black rats in New Zealand (Peters, pers. comm. 2013). Two questions OANRP asked over the past years is whether or not rat control is improved by housing snap traps inside a protective box (typically placed on the ground) or whether uncovered snap traps mounted directly to trees is more effective. It is thought that perhaps the rats would encounter the traps more easily if they were in trees while the slugs would not encounter them as easily, reducing bait loss. DOC's best practice includes housing Victor® traps inside wooden boxes placed on the ground in order to exclude non-target species, guide target species, prevent accidental triggering, and maintain the integrity of the trap from weather (NZ DOC 2005).

During 2014 a trial was conducted at Ekahanui to assess if putting Victor® traps uncovered in trees is better than putting Victor® traps in trees with two different trap coverings: wooden boxes or greenhouse plant pots. This study also looked at catch of non-targets to determine whether covered traps will catch fewer non-targets relative to uncovered traps while maintaining the same efficacy for rats. The entire Ekahanui grid covers an area of 177 acres (72 ha). The grid consists of 620 Victor® snap traps that are housed in protective wooden boxes on the ground or placed in trees without boxes; there are 225 traps on the perimeter of the MU and 394 traps in the interior of the MU, all spaced 25 meters apart. For this trial, only a subset of traps (150) were used. 80 Victor® traps were placed in trees with no covering, 36 were placed in boxes in trees, and 34 were placed in greenhouse plant pots in trees. Traps were checked every two weeks and catches were recorded.

From July to October, a total of 105 rats were caught using the 3 different treatments. Uncovered traps recorded a higher total number of rat catches than covered traps, but this difference was not statistically significant ($p = 0.8748$). Uncovered traps also caught more birds (*Leiothrix lutea* and *Copsychus malabaricus*) than covered traps, but this difference was not statistically significant ($p = 0.1893$). The different trap covers (wooden boxes and plastic 2 gallon tree pots) did not show a significant difference in the number of rat catches ($p = 0.1613$).

During 2014 a trial was conducted at Palikea to compare two different trap types, Victor® versus Ka Mate™, and to conduct a cost benefit analysis. The Palikea grid covers an area of 21 acres (9 ha). The grid consists of 180 Ka Mate™ traps: there are 98 traps on the perimeter of the MU spaced 12.5 meters apart and 82 traps in the interior of the MU spaced 25 meters apart along trails. Ka Mate™ traps were deployed in order to experiment with that style of trap and compare the trapping efficacy to Victor® snap traps. On June 5, 2014, staff replaced every other Ka Mate™ trap with a Victor® trap uncovered in a tree, for a total of 91 Ka Mate™ and 84 Victor® traps. Both trap types were then baited every two weeks using small pieces of coconut and observations were recorded. Peanut butter was not used for this trial as Ka Mate™ traps require the use of hard bait for proper trap function. Ka Mate™ traps are set by wedging coconut underneath the trigger. The bait is held in place by tension and the trap cannot trigger until the bait is removed. Victor® traps are set by placing the coconut securely on the yellow pan in-between the plastic triangle or by smashing into the little box on the trigger.

A total of 165 rats were caught across both traps during the 4 months of deployment and no differences were observed between trap types ($p = 0.5365$), with Ka Mate™ traps recording a total of 75 catches and Victor® snap traps recording a total of 90 catches. However, the proportion of traps recorded as 'Snapped with no bait' (no rat was caught, but trap was triggered) was marginally higher for Ka Mate™ traps than Victor® traps ($p = 0.0934$). There were no significant differences between trap types in terms of bird catch rates ($p = 0.2697$), with a total of 9 birds caught in the Victor® snap traps and 2 birds in the Ka Mate™ traps.

6.4 FUTURE PLANS

Large scale grids of A24s may prove to be more cost effective and beneficial for MU wide rat control compared with large scale grids of Victor® traps; however, additional methods of control may be needed in combination with traps, such as hand broadcasts of Diphacinone-50. OANRP will use the Diphacinone-50 pilot project findings, counter trials and tracking tunnel results from Kahanahaiki to determine future rat control at other MUs. Over the next year OANRP will utilize all trapping methods in combination at some sites to see if more effective control is achieved.

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CHAPTER 7: INVERTEBRATE CONTROL PROGRAM

Summary

This chapter describes the status and outcome of actions carried out under the direction of the Oahu Army Natural Resource Program (OANRP) Research Specialist which, this year, focused on preparing documents for the five year review of the Sluggo Special Local Needs (SLN) permit by state and federal agencies. This is a molluscicide critical to protecting native plants from slug predation, but which carries a risk of harming non-target native snails if used improperly. We carried out research to determine the effect of slug control on the survival of the endangered plant species: *Delissea waianaeensis* and *Cyanea superba* ssp. *superba* (hereafter referred to as *C. superba*) while monitoring slug numbers in the field. We describe results from that experiment here. We also describe the extent of our on-going slug control program and the plant species protected through these efforts.

We continue to survey for and assist in the control of two incipient invertebrate pests which have not yet naturalized: the Coconut Rhinoceros Beetle (*Oryctes rhinoceros*) and the Little Fire Ant (*Wasmannia auropunctata*), as well inspecting high risk areas for invasive ants (Hymenoptera, Formicidae). The status of those efforts are reported here.

We completed work on the control of the invasive moss *Sphagnum palustre*. This work was published as a Pacific Cooperative Studies Unit Technical report: #192. Joe, S.M. 2015. Controlling the invasive moss *Sphagnum palustre* at Ka'ala, Island of O'ahu. 18 pp (http://manoa.hawaii.edu/hpicesu/techrep.htm).

7.1 SUMMARY OF SLUG CONTROL ACTIONS OCTOBER 2014 TO JUNE 2015

Background: Slugs can cause dramatic declines in the survival of rare native Hawaiian plants (Joe & Daehler 2008). Control of slugs using the certified organic molluscicide Sluggo® (registered trademark omitted from the rest of this document) was shown to encourage seedling germination and recruitment of certain rare plant species (Kawelo *et al*. 2012) in particular those within the Campanulaceae. In 2010, Sluggo was approved for forest use by the Hawaii Department of Agriculture (HDOA) under a Special Local Needs (SLN) permit. We solicited, and received, letters of support from agencies which use this product for rare plant conservation. We included these, as well as our research since 2010 (http://manoa.hawaii.edu/hpicesu/dpw_slug.htm) pertaining to slug control and compiled it into a single application packet for Sluggo SLN renewal (the current permit expires in October 2015). This application included research demonstrating the efficacy of Sluggo applied at half the label rate (this is the rate we use currently) and results from rare snail surveys showing no evidence that any were harmed due to slug control. The application is currently under review by HDOA. Whether the SLN is renewed for another five years will determine whether we can continue to protect rare plants from slug depredation.

This SLN has made large scale slug suppression possible around rare plants in the wild. In response, OANRP has expanded its slug control program every year since the SLN approval in 2010. In 2014-2015 we controlled slugs to order to protect eight species in eight Management Units (MUs) across an area equal to 4.26 acres, a 33% increase in area from the previous year (3.2 acres). Rare plant species which received Sluggo treatments at a rate of 1 kg Sluggo per 405 m^2 per month appear in Table 1.

Table 1. List of rare plant species treated monthly with Sluggo. New or expanded areas receiving slug control this year are shown in bold.

MU	Plant species treated (Population Reference Code)	Treatment area (m^2)	Sluggo required per treatment (kg)
Ekahanui	*Cyanea grimesiana* subsp. *obatae* (EKA-C) , *Delissea waianaeensis* (EKA-D), *Phyllostegia mollis* (EKA-D), *Schiedea kaalae* (EKA-D)	4,232	10.4
Palikea	*C. grimesiana* subsp. *obatae* (PAK-A & PAK-B), *C. superba* subsp. *superba* (PAK-A)	2,220 **(+ 706)**	5.4 **(+ 2)**
Kahanahaiki	*C. superba* subsp. *superba* (MMR-E & MMR-H), *S. nuttallii* (MMR-E), *S. obovata* (MMR-C & MMR-G)	1,650	4
Upper Kapuna	*S. kaalae* (KAP-A)	706	2
West Makaleha	*C. longiflora* (LEH-B), *S. obovata* (LEH-A & LEH-C)	1,196	3
Makaha	***C. longiflora* (MAK-B), *C. grimesiana* subsp. *obatae* (MAK-B), *S. obovata* (MAK-A), *S. nuttallii* (MAK-B)**	**2,000**	**4.5**
Kaluaa and Waieli	***D. waianaeensis* (KAL-C), *S. kaalae* (KAL-B)**	**1,600**	**4**
Pahole	*S. nuttallii* (PAH-D & PAH-E), *C. superba* subsp. *superba* (PAH-A)	3,000	7.25

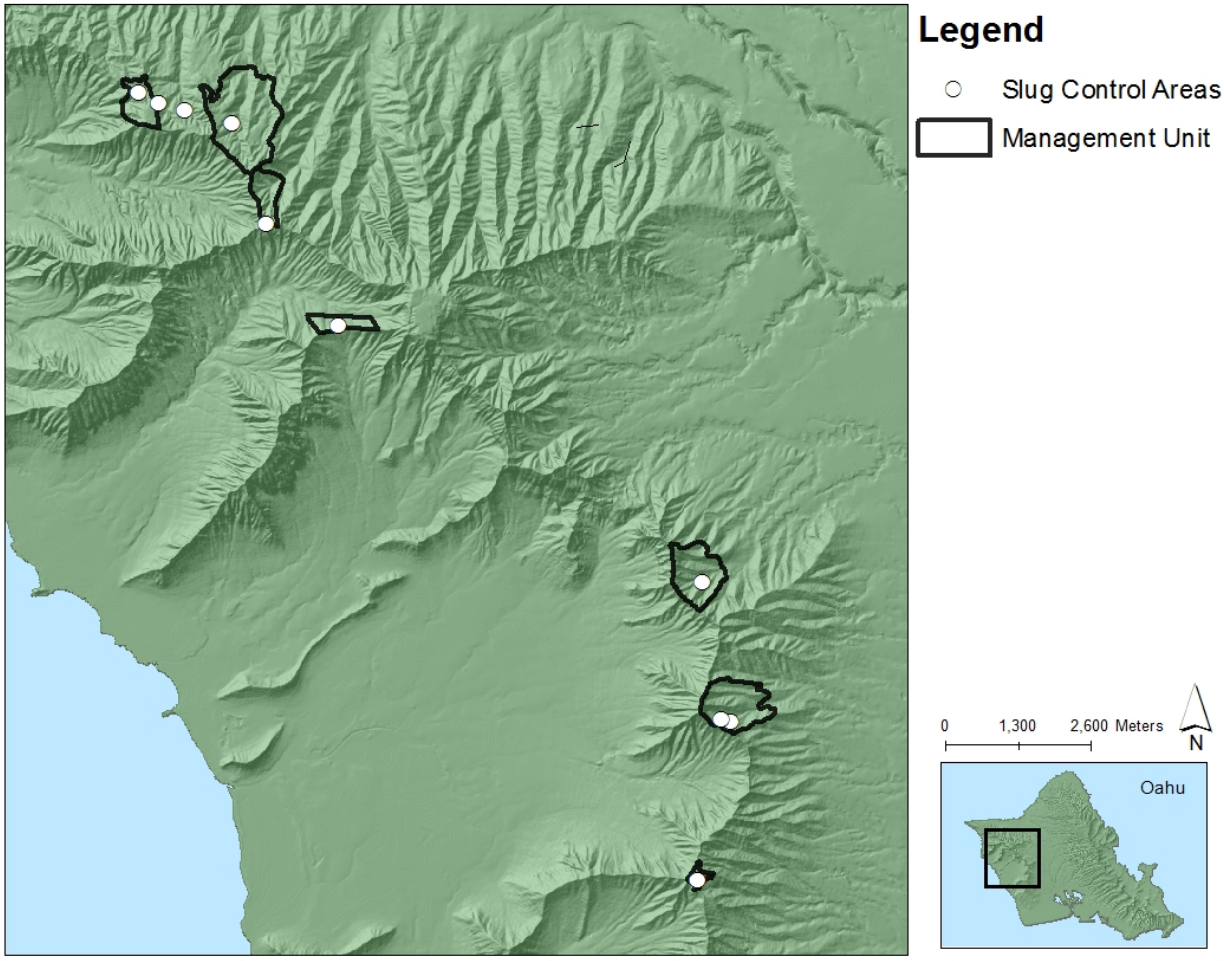

Figure 1. Locations of rare plant species within Management Units (MUs) undergoing slug control.

7.2 *DELISSEA WAIANAEENSIS* & *CYANEA SUPERBA* RESPONSE TO SLUGGO APPLICATION

Background: The purpose of this study was to evaluate whether slug control facilitates seedling emergence and survival (following a seed sow) of *Delissea waianaeensis* and improves survival of *Cyanea superba* seedlings (grown in chamber prior to outplanting) in Ekahanui MU. Natural seedling recruitment from the soil seed bank was also recorded. The soil seed bank did not contain any of the test species. *Cyanea superba* has never been found in this area historically, and the single plot placed in an area with mature *Delissea* has not received seed since June 2014 which is unlikely to be viable. Additionally, we planted *Lactuca sativa* (lettuce) to see whether this highly palatable food would be grazed by slugs. The purpose of the lettuce was to investigate whether slug abundance (as measured with pitfall traps) can be tied to plant herbivory. That data, however, is still under analysis and will not be presented here. The field study began on Feb. 17 and concluded May 28, 2015.

Methods: We established 9 paired plots within Ekahanui MU (Fig. 2). These were circular plots with a total area of 176 m^2. This size was necessary so that the Sluggo treated plots had a sufficient buffer to prevent incursion (determined to be 100 m^2 at West Makaleha if Sluggo was applied every two weeks). At the center of these, we cleared (all plants removed to bare soil) a 1 m^2 area divided into four, 0.25 m^2 quadrants where test species were sown (*D. waianaeensis*) or outplanted (*C. superba* and lettuce) (Fig. 3). There was also a quadrant (referred to as soil seed bank) where natural regeneration of any plants was recorded. All 1 m^2 areas received 1 liter of water on a weekly basis. One plot of each pair was randomly assigned to receive slug control once every two weeks (the 'treatment' group) while the other received no slug control (the 'control' group). Slug abundance was measured using baited pitfall traps (McCoy 1999) consisting of four 9-oz. glass jars per plot, placed in holes so that their openings were level with the soil surface and baited with six oz. of beer (Pabst Blue Ribbon). Traps were oriented within each plot so as to sample as much area as possible (Fig. 3). Plots were at least 10 m away from its pair and 20 m away from the next pair of plots. Not all seed and plants went into plots at the same time. A timeline of these activities appear in Table 2.

Table 2. Timeline of when plants and seed were added to each plot.

Date (M/DD)	Activity	Note
2/17	Five lettuce plants planted in each plot.	Plants were one month old and grown from Manoa lettuce seed in the greenhouse.
2/17	950 *D. waianaeensis* seeds sown into each plot	Seeds were from fruit collected June 2014 from Ekahanui, however, fruit was fermented and it may have made for a poor collection. The fruit was processed and sown nonetheless.
2/24	15-20 *Cyanea superba* seedlings planted into each plot	Plants were two months old and grown in a growth chamber. The number planted varied because some seedlings were destroyed in the transplanting process. Plants were from two founders (MMR-A-3 & MMR-A-4). Care was taken to use the same founders for each plot pair.
3/03	1000 *D. waianaeensis* seeds added to seed sow quadrant	Seeds were from collections made in 2004-2005 from Ekahanui. Initial viability for these batches ranged from 76-94% and viability was not expected to have declined below this range.

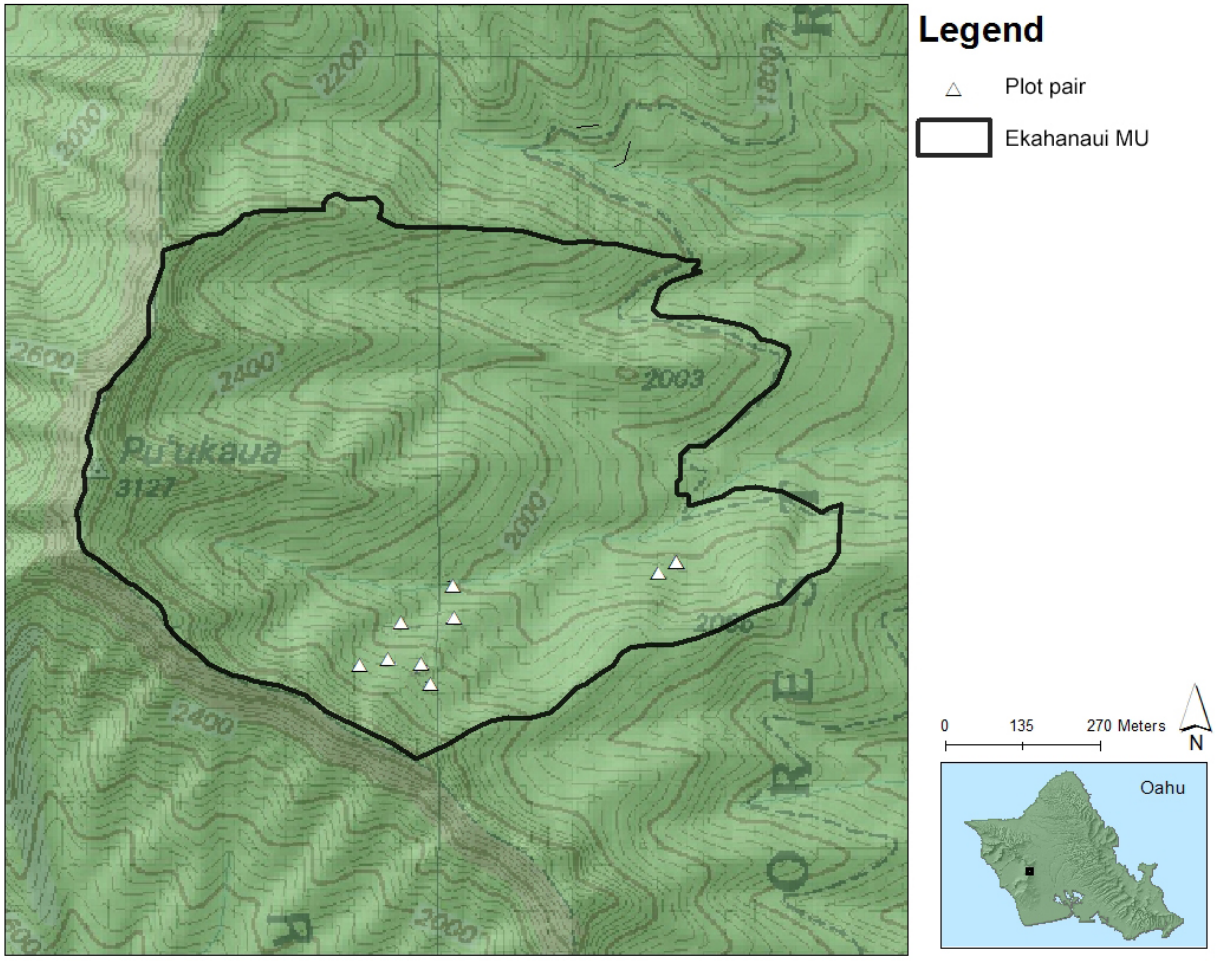

Figure 2. Location of the 9 plot pairs.

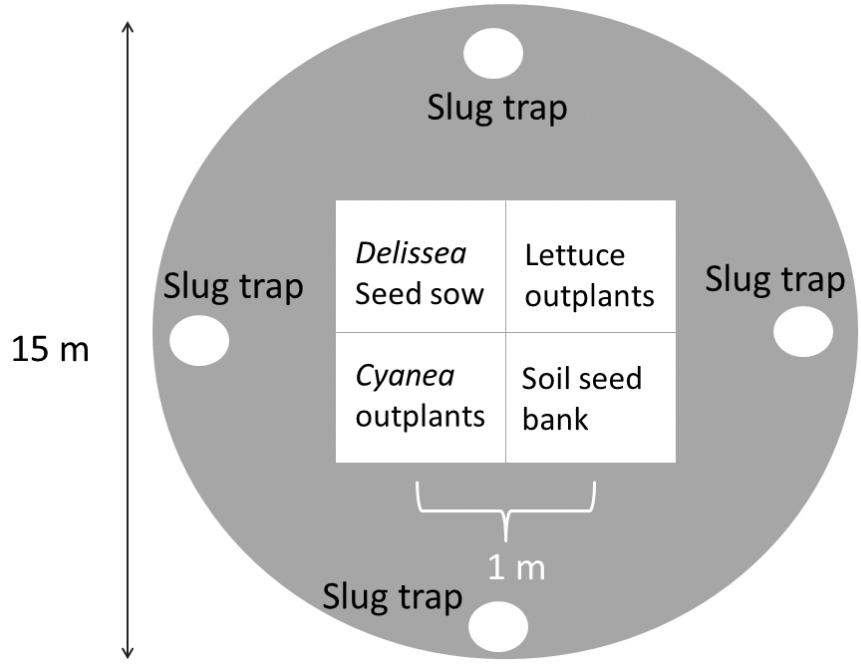

Figure 3. Diagram of a single plot. Objects within the plot are not scaled proportionally to one another. For example, the one meter outplanting area is enlarged relative to the entire plot. Treatment plots receive Sluggo across the entire area shaded in grey. The center 1 m^2 area was watered weekly.

Data collection & Analysis*:* This research was carried out in a paired-plot design. Therefore, control data (from the no Sluggo plot) was subtracted from its treatment plot *pair*. Though there were 18 plots total, there were only nine plot pairs ($n = 9$). Analysis post-treatment relied upon *differences* between the plot pairs at a single monitoring event. A result of 0 indicated no difference between plots, a positive number indicated an increase in the treatment relative to the control and a negative number, the opposite. For *D. waianaeensis* the data collected were a total count of the number of seedlings emerging following a sow of 1,950 seeds (Table 2). Because very young plants can be hard to confirm as being *D. waianaeensis*, this number was equal to the seedlings counted in the sown quadrant minus the number counted in the soil seed bank quadrant from the same plot. *Cyanea superba* survival was calculated as the number of plants alive (at a given time) divided by the original number of plants outplanted multiplied by 100. Regeneration from the soil seed bank was simply a complete count of all plants emerging following clearing of the plot at the start of the study. Slug abundance was calculated as the mean number of slugs from the four pitfall traps within a plot at a single time.

Results & Discussion:

Slug abundance: Slug abundance was significantly higher in the control vs. the treatment plots (General Linear Model (GLM), $F_{1,104} = 46.58$, $p = 0.000$), though not at all time periods (Figure 4). Slugs were most abundant early in the study, becoming steadily scarcer as time progressed. This is not surprising as slug numbers have been observed to decline with declining moisture and increasing temperatures, both of which occur as Hawaii transitions from the wet season (Nov-March) to the dry season (April-October).

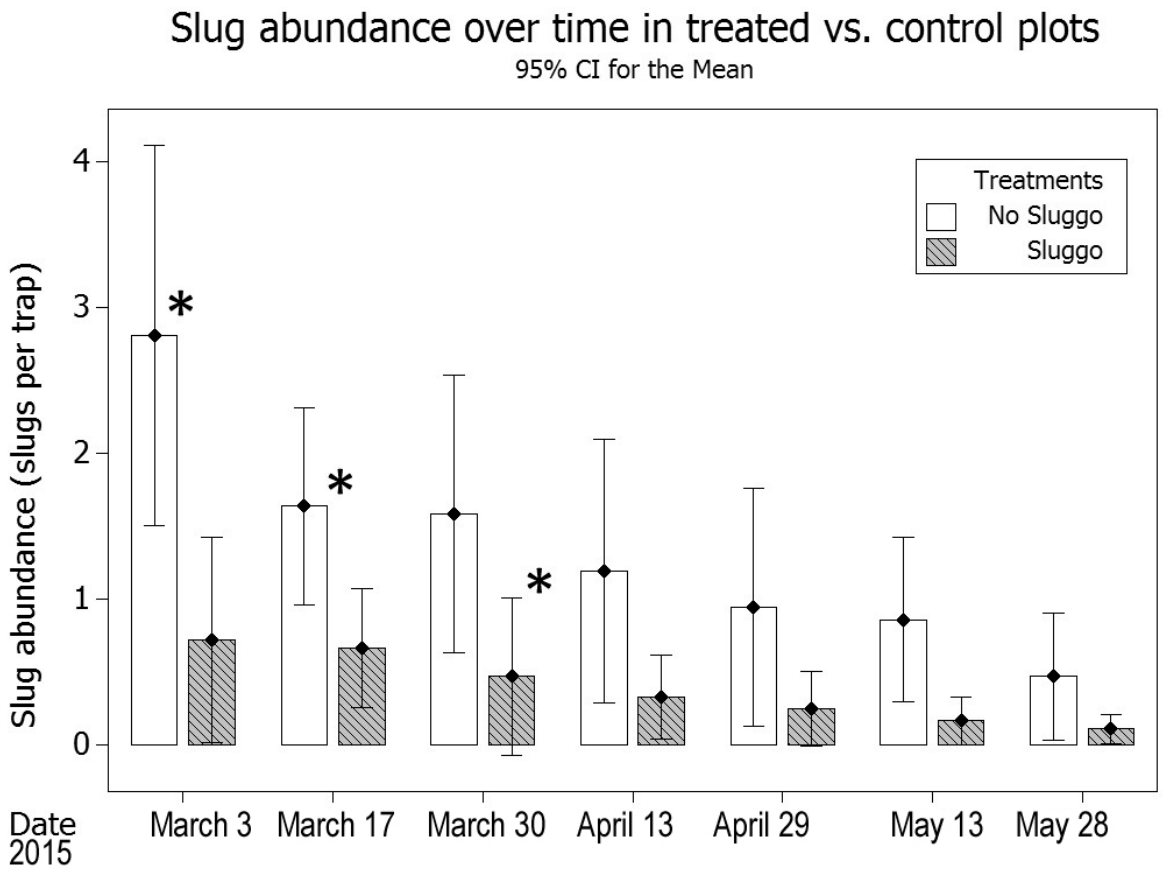

Figure 4. Slug abundance was significantly higher in untreated plots then in the treated plots prior to April 13. Asterisks indicate a significant difference between groups as indicated by post hoc comparisons using a Tukeys HSD.

Delissea waianaeensis* Seed Sow*: Differences in seedling emergence between the plot pairs over time is shown in Figure 5. Notice that the average difference between treatment and control plots begins as positive and declines to zero over time. This suggests that the effects of slug control may have resulted in slightly higher emergence of *D. waianaeensis* early in the season and played little or no role later in the season. Despite this observation, the effect of slug control was not significant when using March data separately (paired-T test, $p = 0.09$). Indeed, this can be seen in the error surrounding the means in Figure 5. Zero is always included within the error at all times indicating no difference between the treatment and its control pair. Overall, mean seedling emergence from the treated plots was higher: 8.5 seedlings (± 6) vs. 5 (± 2) in the untreated plots (Figure 6) however this effect was not significant and did not endure over the three month period.

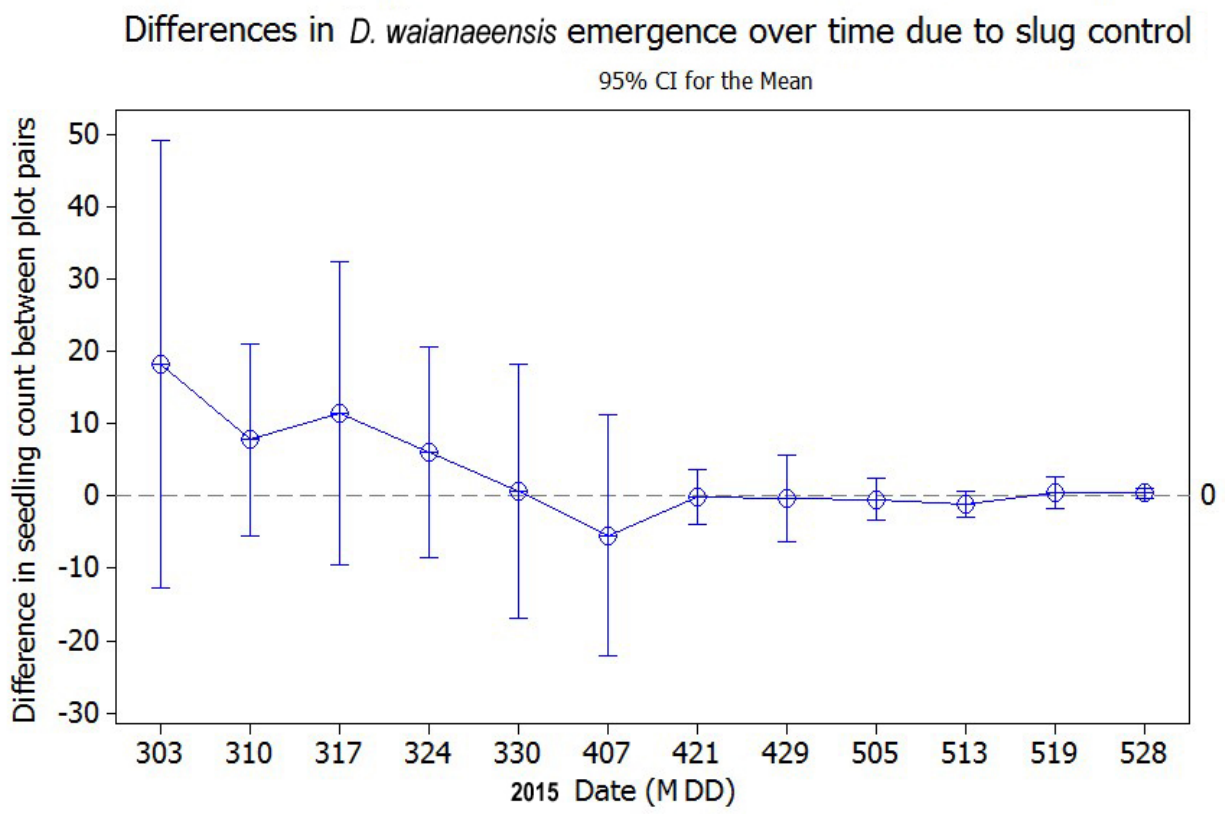

Figure 5. Graph showing a trend slightly positive emergence of plants in the slug control group during March. At no time did the difference between the treatment and control plots deviate significantly from zero.

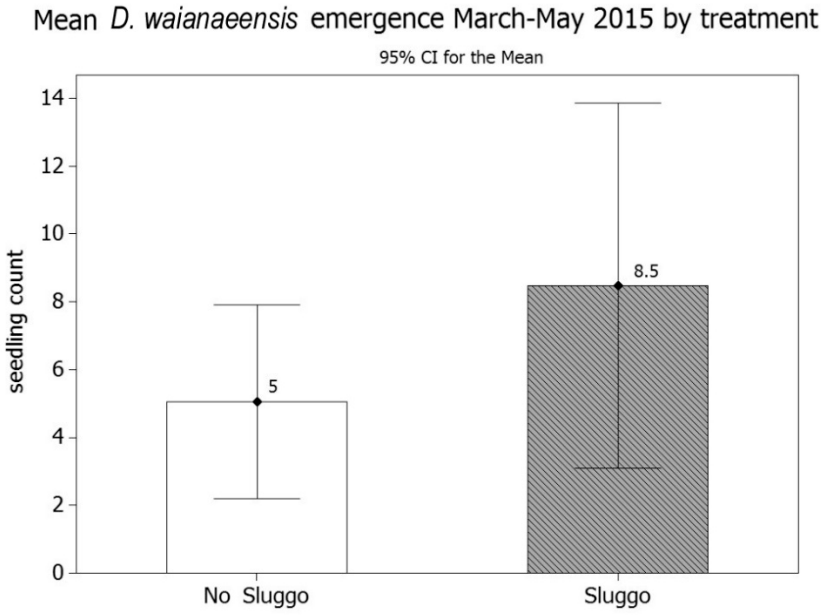

Figure 6. Graph showing the mean seedling emergence from the *D. waianaeensis* seed sow plots. Though the Sluggo treatment showed slightly higher emergence, this was not significant.

***Cyanea superba* Outplanting**: Survival of outplants over time by treatment is shown in Figure 7. Like the *D. waianaeensis*, treatment appeared somewhat effective earlier in the season with both treatments declining to approximately 18% survival by the conclusion of the study. A paired T-test using data from each monitoring event (using a Bonferroni adjustment for multiple comparisons) shows no significant difference between groups overall ($p = 0.194$).

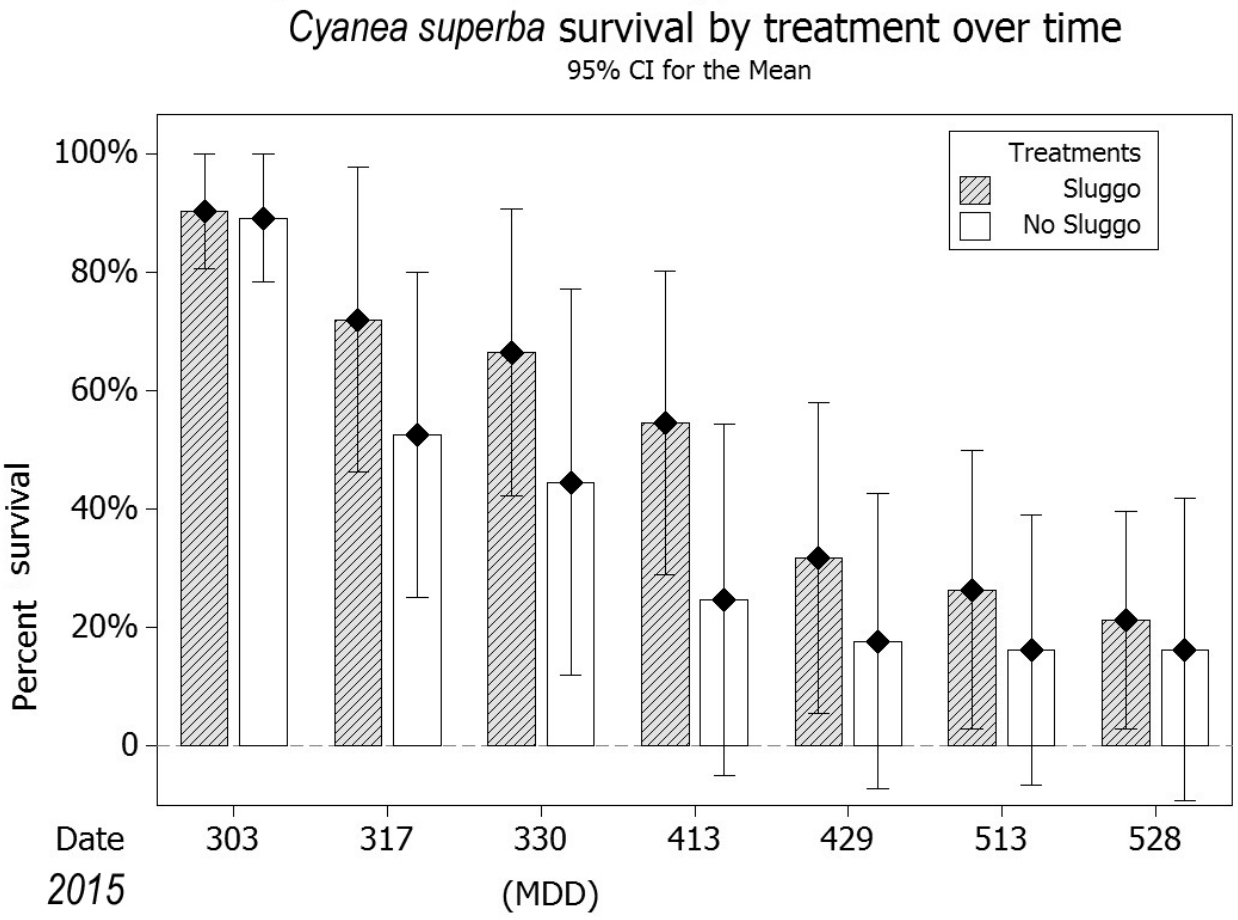

Figure 7. Graph showing survival of *C. superba* outplants in treated and untreated plots. No significant differences in groups were evident.

Soil Seed Bank: Seedling recruitment from the soil seed bank was significantly higher in the treated vs. untreated plots (Fig. 8). Though the species identity of these seedlings were unknown, based on the dominant vegetation in Ekahanaui, it is reasonable to assume the majority are weeds.

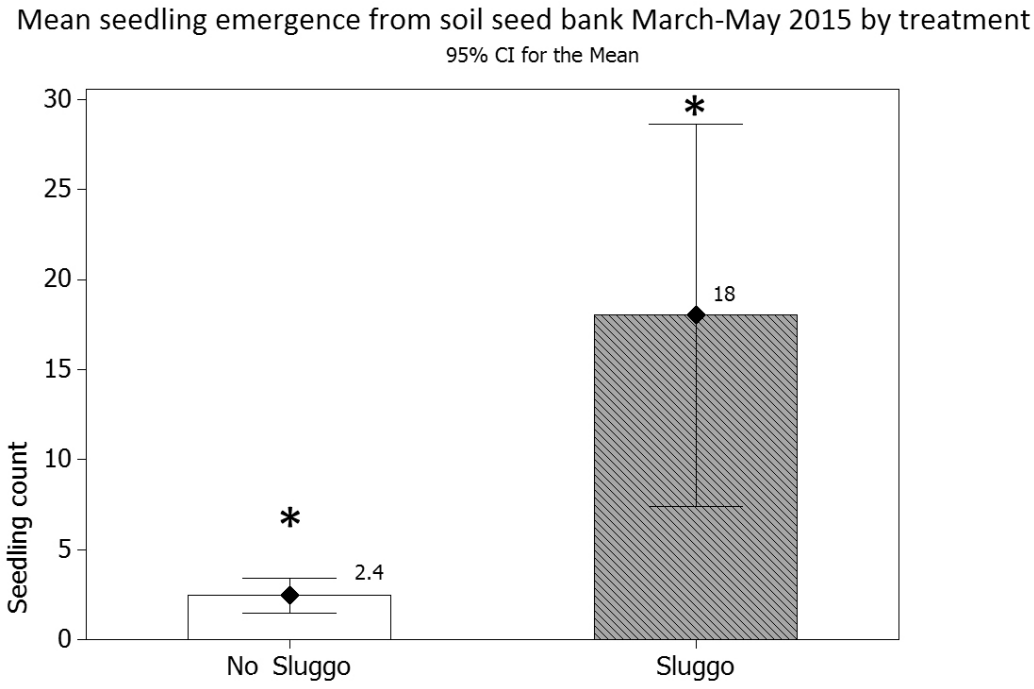

Figure 8. Graph showing significantly higher recruitment of seedlings in the treated plots (T-Test: *T*-Value = -2.92 $p = 0.005$).

Conclusions: Though not significant, slug control generally resulted in positive increases in *D. waianaeensis* seed emergence (Fig. 6) and *C. superba* survival early in the season (Fig. 7). By the conclusion of the study, differences between the treatment and control plots contracted towards zero. This likely occurred because of the slugs were only significantly higher in the control plots in March while conditions dried to the point where plants died. It is likely that any benefits conferred by slug treatment early in the season were negated by drier conditions later. Our finding of significantly greater regeneration of seedlings from the seed bank suggests that slugs are grazing seedling generally and that the number of test seedlings used were too small to see any effect. Additionally, it also could be that the buffer was insuffiecntly large and slugs came into the treatment plots.

Sluggo application significantly depressed slug abundance in treated plots but had less effect as the season progressed (Fig. 4). Again, this is likely due to abiotic conditions.

Regeneration of seed from the existing seed bank increased in the treatment areas. Though most of this regeneration is assumed to be weed species, common, fast growing natives would also benefit from Sluggo application.

7.3 SURVEY OF INVASIVE ANT SPECIES

Background: In Hawaii, ants are most likely to become established around disturbed areas frequented by humans such as bathrooms, campgrounds, fence lines, helipads, and roads (OANRP 2010).

As stated in previous reports (OANRP 2011) OANRP conducts annual surveys of invasive ants in high-risk areas using a standard protocol developed by University of Hawaii entomologists (OANRP 2010). These areas include trailheads, cabins and landing zones, where accidental introductions of ants are more likely to occur as well as in areas where rare resources may prove vulnerable to ant attack.

As of the writing of this document, the summer ant survey season is halfway complete. With the exception of the Nike site, Kaluakauila and the OANRP Baseyards, all surveys took place after June 2015 and will be included in next year's report. Included in Table 3 (below) are results from the annual ant surveys. Asterisks indicate new ants found during the most recent survey. Species are considered 'low risk' or 'high risk' according to a Pacific Invasive Ant Key developed by Saurnat (2008).

Management Unit	Ants recorded prior to 2014	Ants recorded October 2014 - June 2015	Action needed?
Pahole mid-elevation nursery (Nike site)	*Solenopsis papuana, S. geminata, Ochetellus glaber, Anoplolepis gracilipes, Cardiocondyla obscurior, Tetramorium bicarinatum*	*Solenopsis papuana, Plagiolepis alluaudi*, Technomyrmex albipes**	No action needed. Following repeated treatments, two high risk species, *Anoplolepis gracilipes* and *S. geminata*, have not been detected since 2013. The two new species detected this year are both low risk species and already widely established
Kaluakauila	*A. gracilipes, Cardiocondyla emeryi, O. glaber, Paratrechina bourbonica, Pl. alluaudi, S. papuana, Pheidole megacephala*	*S. papuana, A. gracilipes, Technomyrmex albipes**	No action needed. New species detected is a low risk species while others are widely established at that location
East and West OANRP baseyards	*A. gracilipes, Pl. alluaudi, Ph. megacephala*	*A. gracilipes, Ph. megacephala*	Species present are widely established, however treatment for both using Terro (for *A. gracilipes*) and Amdro (for *P. megacephala*) took place at regular intervals to keep numbers low

Table 3. List of ant species found in each MU. New records for 2015 are indicated with an asterisk.

Since its first record on Oahu in December 2013, OANRP has been surveying high risk areas to prevent *Wasmannia auropunctata* (the Little Fire Ant or LFA) from establishing on Schofield Army Base. LFA is sampled using vials baited with peanut butter aand left in shady spots on the ground or in trees for at least one hour, then collecting any ants approaching the bait. Wheather conditions must favorable for ant foraging for the survey to be valid (*e.g.* no rain, warm temperatures). With the excpetion that we use vials rather than chopsticks, our methodology follows that reccomended by HDOA in their Spot the Ant, Stop the Ant campaign (http://stoptheant.org/report-little-fire-ants/). No LFA was detected during any of these surveys (Table 4).

A policy for preventing the little fire ant from establishing at Army controlled lands is being routed for signature by the Garrison Commander. Once in place, this policy will require that landscaping plants be sourced from LFA free nurseries and that the responsibility for eradication of LFA, if introduced, is with contractors. This financial hook will hopefully prevent contractors from using contaminated nurseries as plant sources.

Location	Date surveyed	Ants detected
New housing area on junction of Lyman and Iolani Road, Schofield Barracks	March 30, 2015	*Ph. megacephala*
Garden store PX, 903 Cadet Sheridan Road, Schofield Barracks	March 30, 2015	*Ph. megacephala*

Table 4. Results from LFA surveys on Schofield Baseyard.

7.4 COCONUT RHINOCEROS BEETLE (CRB) TRAPPING

Background: CRB was first detected on Oahu in December of 2013. OANRP currently maintains 18 CRB traps spread throughout Wheeler, Schofield and Wahiawa with a single trap at Dillingham (Fig. 9). These are placed near palms and at mulch sites and are checked once every two weeks. Lures are replaced every two months. OANRP have maintained these traps since Feb. 2014. No CRB have been detected at any traps during these period. All information is relayed to HDOA and integrated into CRB distribution maps on Oahu.

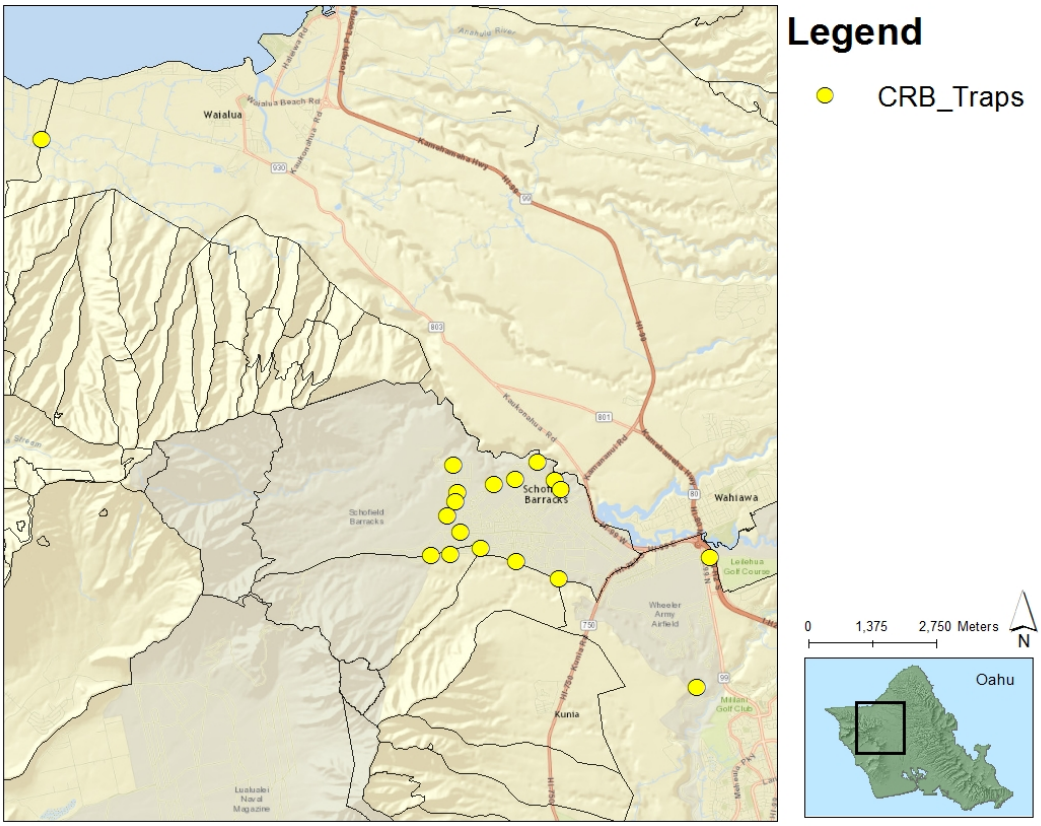

Figure 9. Locations of CRB traps maintained by OANRP.

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