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Second Annual Report for the Kenai Industrial Park Round-Leaved Chaff Flower (*Achyranthes splendens* var. *rotundata*) Habitat Conservation Plan July 1, 2015 – June 31, 2016

Prepared for

CIRI Land Development Company and AKC Leasing Corporation

Submitted to

State of Hawai‘i, Division of Forestry and Wildlife

Prepared by

SWCA Environmental Consultants

Revised September 2016

SECOND ANNUAL REPORT FOR THE KENAI INDUSTRIAL PARK ROUND-LEAVED CHAFF FLOWER (*ACHYRANTHES SPLENDENS* VAR. *ROTUNDATA*) HABITAT CONSERVATION PLAN JULY 1, 2015 – JUNE 31, 2016

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1. INTRODUCTION

In February 2014, CIRI Land Development Company received an incidental take license, pursuant to Chapter 195D of the Hawai‘i Revised Statutes, to allow for the incidental take of round-leaved chaff flower (*Achyranthes splendens* var. *rotundata*), a federal- and state-listed endangered species, at the proposed Kenai Industrial Park (KIP) site. To obtain the incidental take license, CIRI developed a habitat conservation plan (HCP) to offset project impacts to round-leaved chaff flower individuals by implementing measures that would protect and perpetuate the species as a whole (SWCA Environmental Consultants [SWCA] 2013). The proposed compensatory mitigation measures implemented as a result of the HCP would create new populations of round-leaved chaff flower on the Kalaeloa Unit of the Pearl Harbor National Wildlife Refuge (NWR) from the genetic stock (seeds and cuttings) of the individuals at the KIP project, as well as from an additional nearby seed source.

This report, which is the second annual report, describes the activities, observations, and results continuing during Year 1 and moving into Year 2 of the HCP implementation at the Kalaeloa Unit from July 1, 2015, to June 31, 2016. During this time, maintenance and monitoring occurred at the mitigation site as required in the HCP, with 15 horticultural (qualitative) monitoring events and four botanical (quantitative) monitoring events. Photographic documentation was ongoing during this time. The monitoring program is designed to document mitigation success and to inform the need for remedial and adaptive management measures. Monitoring was led by Project Manager and Botanist Tiffany Bovino Agostini (until May 2016), Project Manager Jaap Eijzenga, Botanist Danielle Frohlich, and Field Technician Bryson Luke. All maintenance was conducted by Hui Kū Maoli Ola and supervised by Project Horticulturalist Matt Schirman.

2. DESCRIPTION OF THE MITIGATION SITE

The KIP mitigation site is on preserved lands at the Kalaeloa Unit of the Pearl Harbor NWR. The mitigation site is approximately 3.2 kilometers (2 miles) from the KIP project site. The Kalaeloa Unit was established during Barber Point Naval Air Station base-closure proceedings in 2001 to protect and enhance the habitat for the endangered coastal dryland plants round-leaved chaff flower and ‘Ewa Plains ‘akoko (*Euphorbia skottsbergii* var. *skottsbergii*).

The mitigation site is on a dry coastal plan. The Natural Resources Conservation Service classifies soils at the site as Coral Outcrop (Foote et al. 1972). Coral Outcrop includes coral or cemented calcareous sand, with small areas that contain a thin layer of soil material. Kiawe (*Prosopis pallida*), koa haole (*Leucaena leucocephala*), and buffelgrass (*Cenchrus ciliaris*) are the dominant non-native plants within the Kalaeloa Unit. Approximately 10.1 hectares (ha) (25 acres) of the 15.1-ha (37.4-acre) Kalaeloa Unit were under active management within designated work units before this mitigation was implemented.

On April 18, 2014, Hui Kū Maoli Ola, SWCA, and the U.S. Fish and Wildlife Service (USFWS) identified four round-leaved chaff flower planting plots utilizing the work units designated by USFWS for restoration through natural regeneration and outplanting of native plants within the Kalaeloa Unit (Figure 1). Two of the planting plots are in Work Unit 1 and two of the planting plots are in Work Unit 5. These plots did not support round-leaved chaff flower individuals before HCP mitigation activities were implemented. Each planting plot is approximately 12 × 12 meters (m) (39.5 × 39.5 feet) or 144 m^2 (1,600 square feet).

On November 25, 2014, Hui Kū Maoli Ola outplanted round-leaved chaff flower plants in Plots 1 and 2, while Plots 3 and 4 were each planted on December 9, 2014.

Four individual plants of round-leaved chaff flower were planted *outside* of the Plots 1–4 on November 25, 2014. These plants were not previously included in the total count of individuals; however, based on discussion with the state in December 2015, these four plants were included in the total plant count as of the 16th horticultural monitoring that took place on January 14, 2016, and are referred to as planting Plot 5. Plot 5 is in Work Unit 5 between Plots 1 and 2 and is approximately 4 × 4 m (13.1 × 13.1 feet) or 16 m^2 (172 square feet).

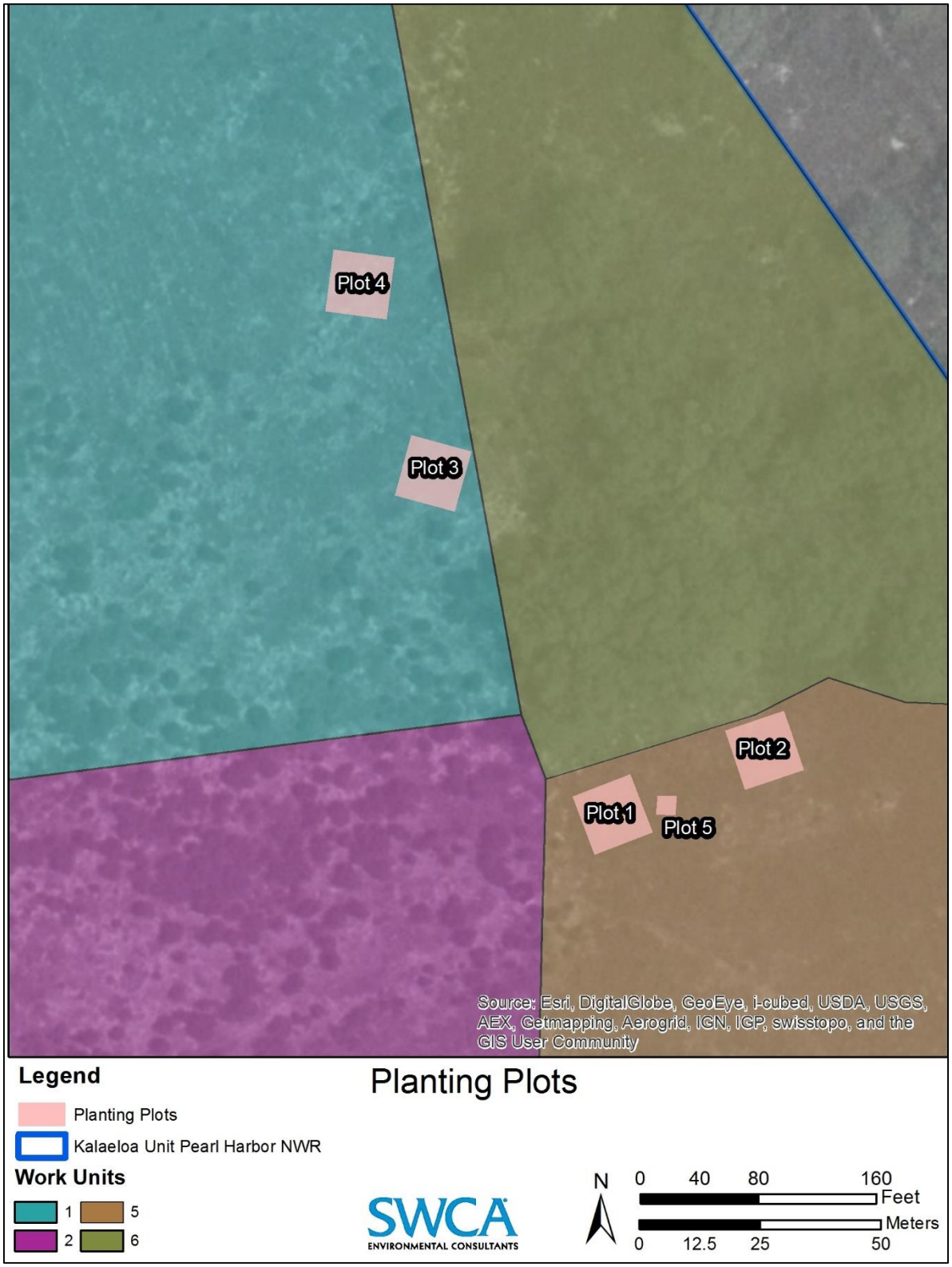

Figure 1. Plots within the mitigation site.

3. METHODS

A timeline for activities associated with implementation of the HCP between July 2015 and the end of June 2016 is summarized in Table 1.

Table 1. Timeline of Mitigation Activities

Year	Activity	Date
1	Horticultural monitoring #7	07/1/2015
	Horticultural monitoring #8	07/16/2015
	Botanical monitoring #2	07/23/2015
	Horticultural monitoring #9	08/14/2015
	Horticultural monitoring #10	08/20/2015
	Horticultural monitoring #11	09/15/2015
	Horticultural monitoring #12	09/28/2015
	Horticultural monitoring #13	10/13/2015
	Botanical monitoring #3	10/14/2015
	Horticultural monitoring #14	11/18/2015
	Horticultural monitoring #15	12/11/2015
	Horticultural monitoring #16	01/14/2016
	Botanical monitoring #4	01/27/2016
	Horticultural monitoring #17	02/16/2016
	Horticultural monitoring #18	03/15/2016
2	Horticultural monitoring #19	04/14/2016
	Horticultural monitoring #20	05/17/2016
	Botanical monitoring #5	06/03/2016
	Horticultural monitoring #21	06/21/2016

3.1. Maintenance

Maintenance activities included weed control, irrigation, pest control, soil amendments, outplant replacement, and outplanting other natives. All maintenance activities were conducted by Hui Kū Maoli Ola under the direction of Project Horticulturalist Matt Schirman.

During the remainder of Year 1, maintenance took place twice a month (as opposed to once) until October 2015 because of the heavy invertebrate pest presence (see Appendix A) and then once a month as scheduled until April 2016. Maintenance for Year 2 occurred once every 2 months from May through the end of June 2016. The project horticulturist provided observations and recommendations following each visit and implemented recommendations as necessary in consideration of the success criteria. Maintenance will continue on a bimonthly basis for the remainder of Year 2 or more frequent if deemed necessary by the project horticulturist. Maintenance activities will occur as necessary for 5 years, or until mitigation goals have been met.

3.2. Monitoring

3.2.1. Horticultural Monitoring

Horticultural monitoring was conducted twice a month during the remainder of the first 6 months of Year 1 (April 2015–September 2015) and continued once a month during the remainder of Year 1 (October 2015–March 2016) and into Year 2 (April 2016–June 2016). The following information was collected during horticultural monitoring:

- *Direct counts of healthy round-leaved chaff flower individuals*: Survival is measured by assessing the presence or absence of living aboveground plant material. Plants are considered living if at least one green leaf or stem is present.
- *Mortality counts of round-leaved chaff flower individuals*: Dead individuals are counted based on the presence or absence of living aboveground plant material. Plants are considered dead if no green leaves or living stems are present.
- *Plant vigor categories*: Vigor of each individual is assigned to one of the following four categories:
    - Dead = No green leaves, stems, or flowers are present.
    - Marginal = Branches have few leaves, or mostly brown or yellow leaves. Plant is severely drought stressed.
    - Moderate = Branches have at least 50% green leaves, plant is drought stressed, and plant may have pests or some discoloration on leaves.
    - Healthy = Leaves are all green, branches are mostly leaved, very few to no pests are seen, and plant is not drought stressed.
- *Phenological stage* (vegetative, reproductive).
- *General description of the status of the plantings.*
- *Plant damage from rodents, insects, and other pests:* Invertebrate pest damage is classified as none, minimal, moderate, or fully infested.
- *Threats.*
- *List of maintenance requirements*.
- *Visual assessment and photographic documentation of native and non-native percentage cover*: Percentage cover estimates and photographs are taken at all four corners of each plot.
- *Visual assessment and chemical analysis of soil conditions*: Using a garden trowel, a single soil sample is collected in each plot from the upper 10 centimeters (4 inches) of the soil profile, or to the maximum depth possible in areas with minimal soil. Roughly 1 cup of soil is placed into a sealable plastic bag, and large stones, sticks, and vegetation are removed from the sample. All samples are taken to the University of Hawai‘i, College of Tropical Agriculture and Human Resources, Agricultural Diagnostic Service Center within 48 hours of collection and analyzed for pH, calcium, magnesium, phosphorus, potassium, and total nitrogen.

Following each horticultural monitoring event, a written memorandum was prepared listing problems (if observed) and recommending remedial measures. These memoranda were sent to Hui Kū Maoli Ola and remedial measures were performed promptly. A letter report identifying maintenance issues and corrective measures was provided to Hui Kū Maoli Ola and to the State of Hawai‘i, Division of Forestry and Wildlife (DOFAW).

3.2.2. Botanical Monitoring

Botanical monitoring was conducted quarterly during Year 1 (two monitoring events took place (July and October 2015) as part of Year 1 and twice a year during Year 2 (January and June 2016). The following information was collected:

- *Direct count of round-leaved chaff flower individuals:* Outplanted and naturally recruited individuals are counted. Each individual is documented with a submeter global positioning system (GPS) device and tagged with a unique number. Photographs are taken of each individual.
- *An assessment of natural regeneration*: All seedlings are counted and numbered to track their success.
- *A list of plant species found within the planting areas*
- *A list of wildlife species noted within the planting areas*
- *Data analysis from monitoring quadrats*: Per the HCP, each planting plot was divided into 1 × 1–m (3.3 × 3.3–foot) quadrats (144 quadrats). Ten quadrats were randomly selected in each plot (at least 5 quadrats are required in the HCP [SWCA 2013]). Percentage cover of each plant species is evaluated in each quadrat using PVC reference frames.
- *Site photography from permanent photo-points:* Photographs are taken from the same location time and taken of each monitoring quadrat.
- *List of maintenance requirements*.

The data from the botanical monitoring events are included in the annual report submitted to DOFAW.

3.2.3. Photographic Documentation

Permanent photo-points were established before plant installation to document baseline conditions of the mitigation site. Photographs were subsequently taken from the same location during each monitoring visit (Appendix B). Photographs were also taken of installation activities and maintenance. Representative photographs of healthy, dead, reproducing, and naturally recruited individuals were taken. During the botanical monitoring, photographs were taken of each individual (identified by given number) as well as of each monitoring quadrat.

4. RESULTS

4.1. Maintenance

To date, maintenance activities have included weed control, irrigation, and pest control. Some level of weed control (by hand pulling) has occurred during each maintenance visit. In addition to general weed control, a 0.6-m (2-foot) buffer is maintained around each outplant to reduce competition, promote growth, and encourage regeneration.

Supplemental watering occurred at the site once in July 2015 and once in June 2016.

Ants, likely the longhorn crazy ants (*Paratrechina longicornis*), were observed in the plots. These ants are known to farm scales and mealybugs. In July 2015 and June 2016, the high presence of mealybugs and pests required the application of a chemical treatment. Safari, one of two pesticides approved by USFWS to be used at the NWR, was applied twice in July 2015 and twice in June 2016 to control the pest infestation.

A summary of the observations and recommendations from the project horticulturalist's site visits is provided in Appendix A.

4.2. Monitoring

In all, 159 plants were initially installed by December 2014 (four individuals that were planted outside of the plots 1-4 on November 2014 were added to the total count as Plot 5 as of the 16th horticultural monitoring that took place on January 14, 2016), and 123 living plants were observed during the last monitoring that took place for this reporting period on June 21, 2016.

Fifteen horticultural monitoring events and four botanical monitoring events took place from July 2015 through the end of June 2016 (see Table 1). The results are summarized below.

4.2.1. Survival

Of the 159 plants initially installed in December 2014 (including four individuals not initially included in the total count), 123 individuals (77%) survived as of the most recent monitoring at the end of June 2016 (Figure 2). In all, 36 plants (23%) have died since installation.

Survival decreased in all plots over time since the last monitoring in the first annual report (June 25, 2015). At the end of June 2016, Plots 5 and 3 had the highest survival rate (100% and four living individuals for Plot 5, and 90% with 27 living individuals for Plot 3); whereas Plots 2 and 4 had the lowest survival rate (71% and 35 individuals for Plot 2, and 71% with 24 individuals for Plot 4), as shown in Table 2.

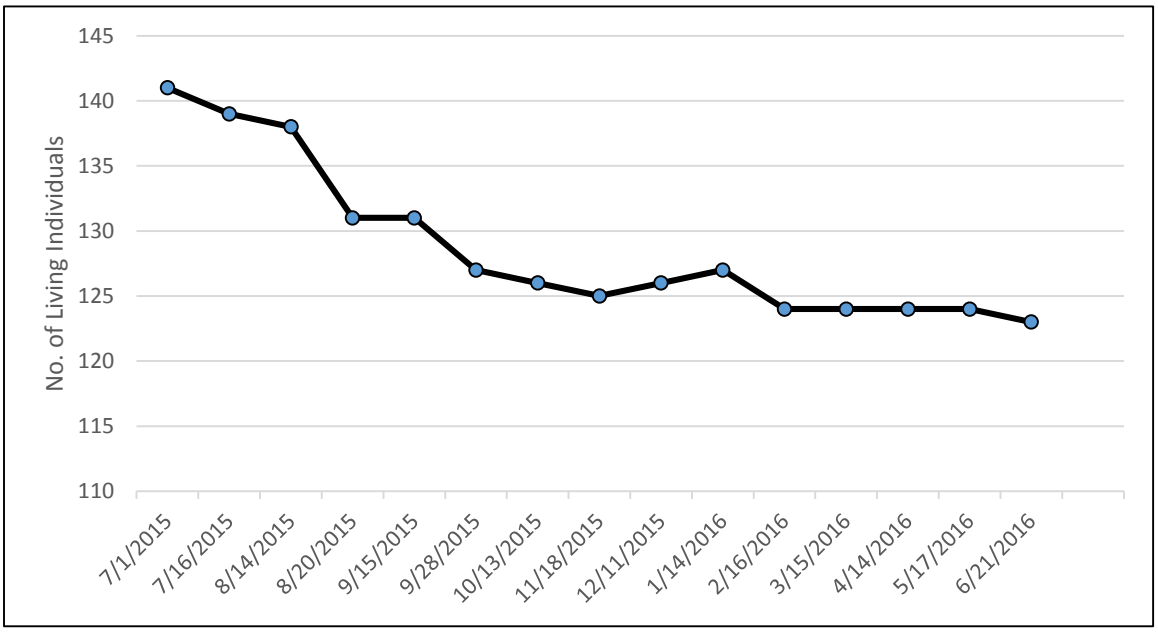

Figure 2. Survival of all round-leaved chaff flower outplants from July 2015 to June 2016.

Table 2. Survival from the First Monitoring for the Second Annual Report (July 1, 2015 until the last monitoring on June 21, 2016)

Plot	Number of Individuals Living (7/1/2015)	Number of Individuals Living (06/21/2016)	Survival (%)
1	37	33	79%
2	47	35	71%
3	28	27	90%
4	29	24	71%
5	–	4	100%
Total	**141**	**123**	71%

4.2.2. Plant Vigor

The plant vigor significantly improved between July and December 2015 from 2% to 69% healthy vigor, and it decreased down to 0% in June 2016 (Figure 3). The decrease is mainly attributed to the drought stress and hot temperatures during the dry season, as well to the return of a heavy mealybug infestation. The percentage of plants considered moderately vigorous fluctuated throughout the monitoring period from 34% in July 2015, jumping to 55% in February 2016, and then falling to 25% in June 2016. Marginal vigor was seen in 58% of all living plants in July 2015, which fell to 0% during the time in which the plants were healthiest in December 2015, and increased again to 53% in June 2016. Representative photographs depicting different vigor categories are shown in Figures 4–6.

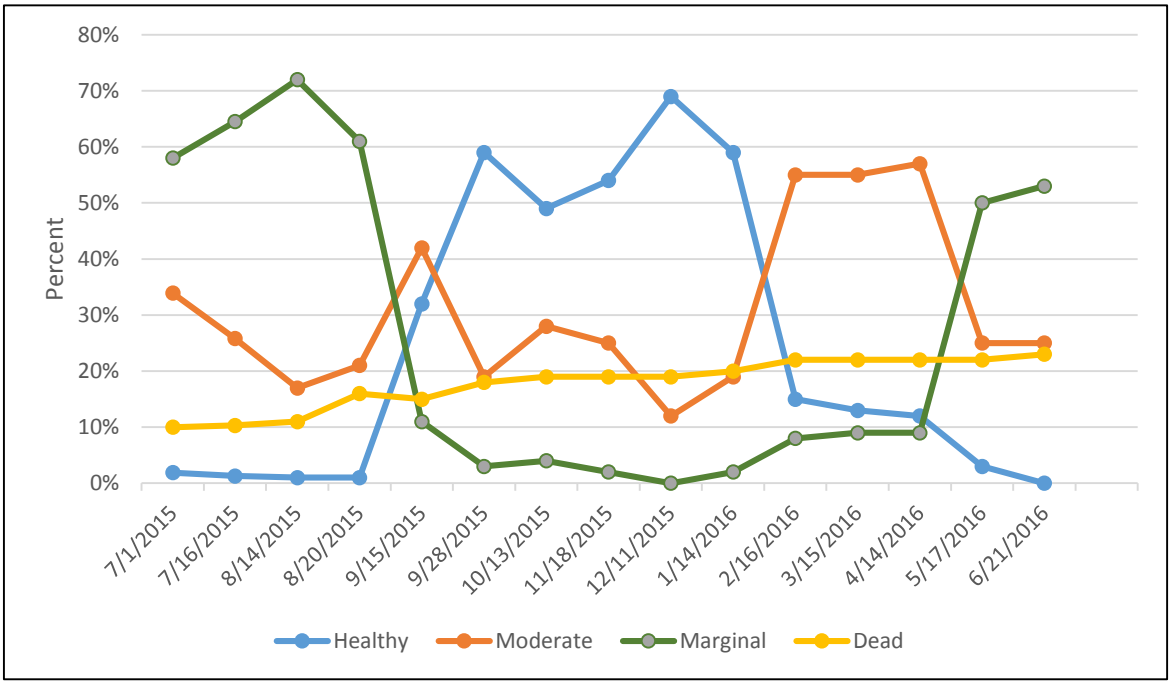

Figure 3. Percentage of plants in the various vigor categories over time.

Figure 4. Representative plants showing healthy vigor.

Figure 5. Representative plants showing moderate vigor.

Figure 6. Representative plants showing marginal vigor (left) and dead plant (right).

4.2.3. Pests

The pest presence initially decreased after the pesticide application during the mealybug infestation in July 2015, and it drastically increased again in March from 24% to 100% in nearly all plots in June (Figure 7). The pests continue to be limited to invertebrate pests, with mealybugs being the dominant species. Other pests include hemispherical scale (*Saissetia coffeae*), black ant (*Ochetellus glaber*), and longhorn crazy ant. No rodent damage has been seen in any of the plots, although there has been a sighting of a small Indian mongoose (*Herpestes javanicus*) and of a mouse sp. (Muridae). Pest presence continues to be predominantly highest in Plot 2 (range = 8%–100% of plants). In general, pest presence has been lowest in Plots 1 and 3 (range = 0%–54% of plants).

Although the results of the pesticide application fall in the reporting period for Year 3, it is worth noting that the severity of the infestation has decreased after the application of the pesticide Safari in June 2016. Similarly, Safari was previously applied in June 2015 during the last mealybug infestation. The results of the pesticide application during the treatment in 2015 can be seen in Figure 7, with the decrease of pest presence from 69% in June to 6% by the end of September.

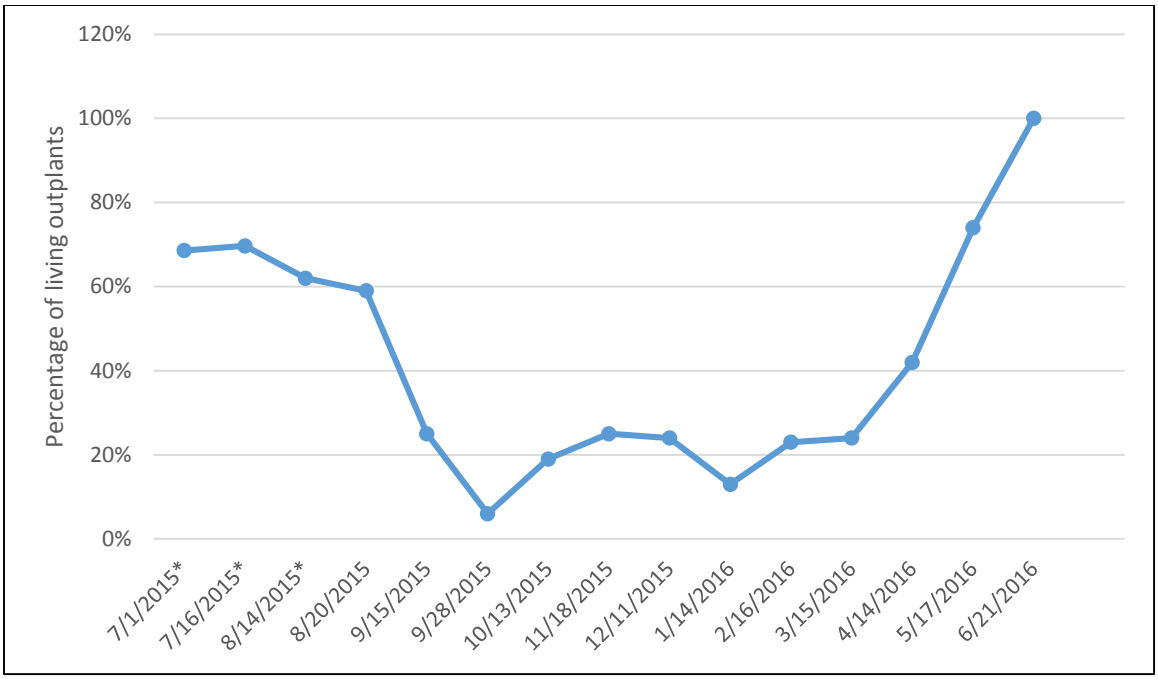

Figure 7. Percentage of all alive plants with pests throughout the monitoring period from July 2015 to June 2016.

*numbers were a percentage of all outplants, both alive and dead

4.2.4. Plant Cover

Plant cover estimates were taken during both the botanical and horticultural monitoring events using different methodologies (see sections 3.2.1 and 3.2.2). During both monitoring types, non-native plant cover was found to be relatively low in all plots, and native percentage cover was generally higher than non-native percentage cover in all plots.

During horticultural monitoring (qualitative approach), estimated cover of native plants ranged from approximately 15% in Plot 5 in January and April 2016 to 48% in Plot 2 in December 2015 (Figure 8). Native cover was predominantly higher in Plot 2 until January, and varied throughout the plots throughout the end of the monitoring period. Non-native cover ranged from approximately 68% in Plot 1 in September 2015 (very high levels of buffelgrass resulting from an unusually wet hurricane season) to 0% in Plot 5 from February through June 2016 (see Figure 8). Non-native plant cover has been consistent throughout Plots 1, 2, and 3, with Plot 5 showing the lowest amount of non-native cover compared to the other plots.

During botanical monitoring (quantitative approach), mean cover of native plants in the permanent quadrats ranged from 6.5% in Plot 4 in October to 31.1% in Plot 2 in January (Table 3). Similar to the horticultural monitoring, native cover has consistently been higher in Plot 2 compared to the other plots. Non-native cover ranged from 0% in Plot 1 in June 2016 to 18.5% in Plot 4 in October 2015. Non-native cover was only higher than native cover in Plot 4 in October 2015. No cover of non-native species was documented in Plot 1 in June 2016, and very minimal cover was recorded in Plots 2, 3, and 4 in June 2016 (Figure 9).

Six native plants were documented in the quadrats during botanical monitoring: round-leaved chaff flower, ʻilima (*Sida fallax*), naio (*Myoporum sandwicense*), ʻuhaloa (*Waltheria indica*), maʻo (*Abutilon incanum*), and kīpūkai (*Heliotropium curassavicum*). All of the round-leaved chaff flower individuals are planted, and the remaining natives are naturally occurring. The round-leaved chaff flower has had the highest amount of cover of any of the native plants, ranging from 6.3% to 11.0% in October 2015, 17.5% to 13.3% in January 2016, and 15.3% to 11.0% in June 2016. For the non-native plants, buffelgrass (*Cenchrus ciliaris*), golden crownbeard (*Verbesina encelioides*), Chinese violet (*Asystasia gangetica*), and koa haole (*Leucaena leucocephala*) have had the highest mean cover values in the quadrats.

Photographs of each quadrat assessed for cover during the botanical monitoring in July 2015, October 2015, January 2016, and June 2016 are provided in Appendix C, D, E, and F, respectively.

Table 3. Mean Cover of Native and Non-Native Species in Plots 1–5 During the Botanical (qualitative) Monitoring Events

Plot	Mean Native Cover (%)				Mean Non-Native Cover (%)			
	July 2015	October 2015	January 2016	June 2016	July 2015	October 2015	January 2016	June 2016
1	8.2%	15.5%	25.3%	13.0%	3.1%	8.8%	2.0%	0.0%
2	11.8%	24.7%	31.1%	11.7%	0.7%	5.8%	2.3%	0.7%
3	3.7%	15.5%	23.8%	22.5%	0.6%	3.6%	3.0%	0.1%
4	5.0%	6.5%	16.7%	13.5%	11.8%	18.5%	4.6%	0.2%

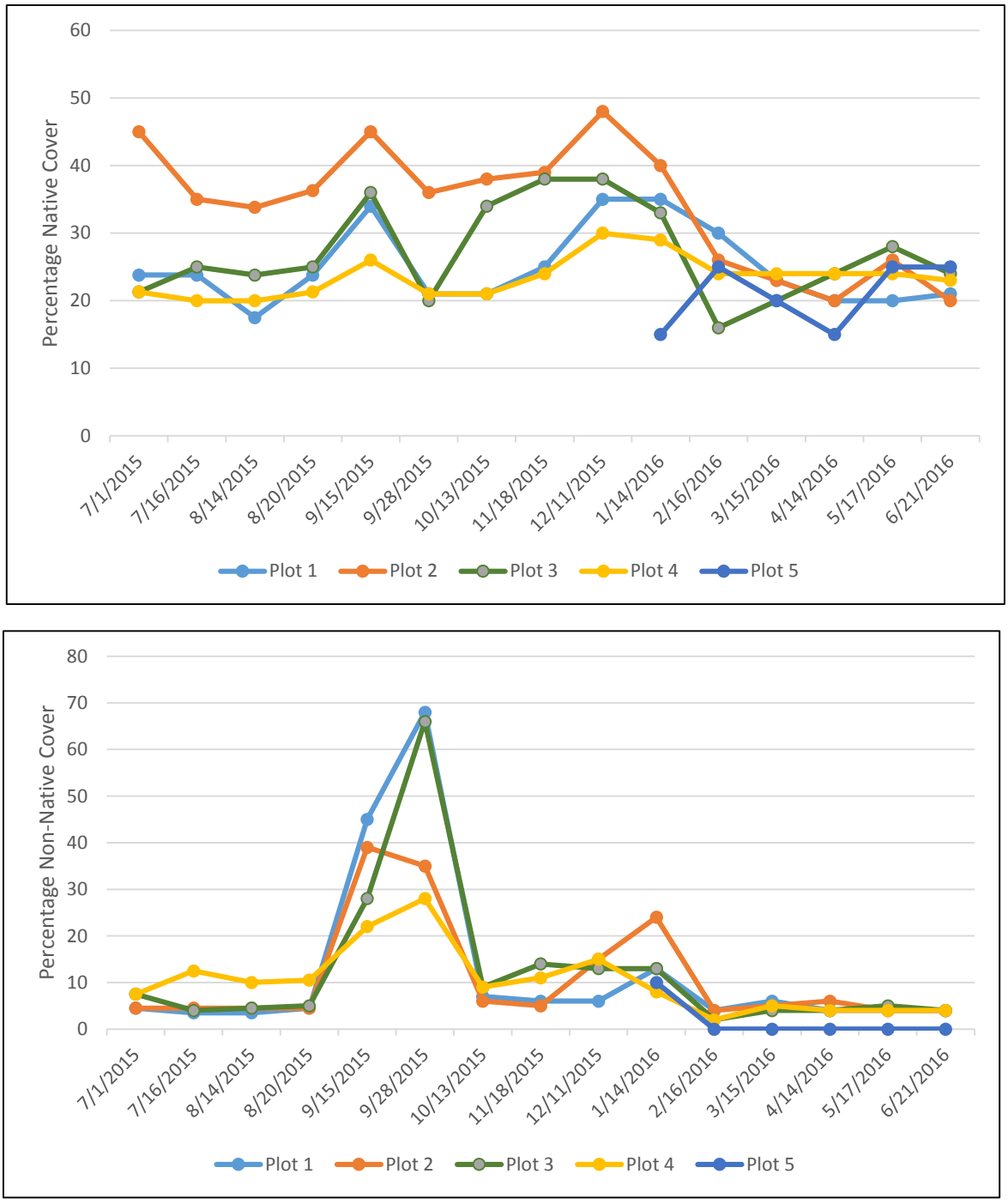

Figure 8. Estimated native (above) and non-native (below) plant cover in Plots 1–4 during horticultural (qualitative) monitoring.

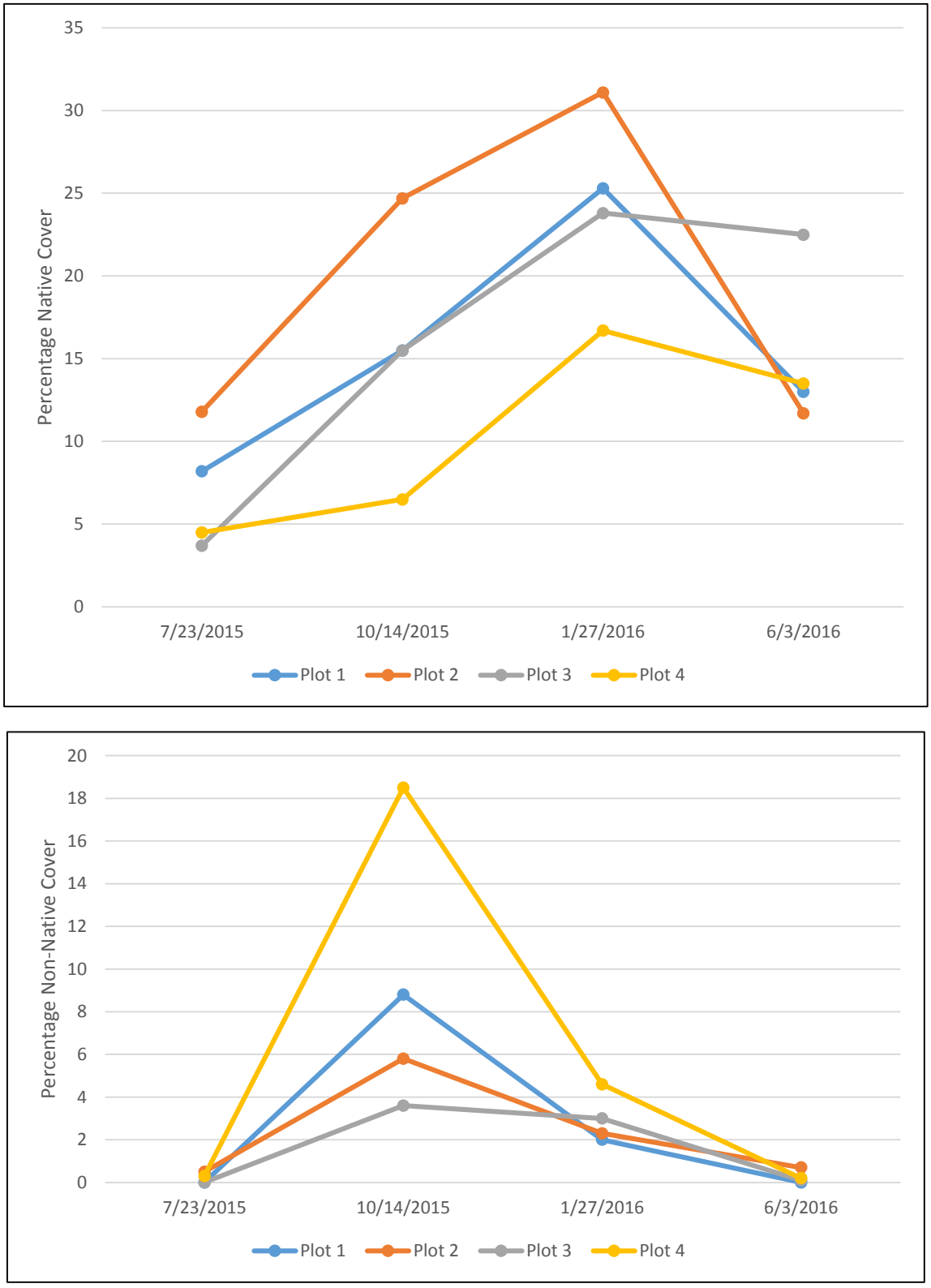

Figure 9. Mean cover of native (above) and non-native species (below) in Plots 1–4 during botanical (qualitative) monitoring in July and October 2015 and January and June 2016.

4.2.5. Natural Regeneration and Reproduction

No natural regeneration of the round-leaved chaff flower has been observed during this monitoring period. This is likely because of the weather, which is too hot and dry for sprouting seedlings. However, all of the outplants were flowering or fruiting from March 2016 through June 2016 (Figure 10), which is not surprising because this species is known to reach a reproductive stage quickly. The species has been reported to fruit in mid-summer to early fall (USFWS 1994). Survival of seedlings that germinate from fallen seed will likely be influenced by the availability of moisture.

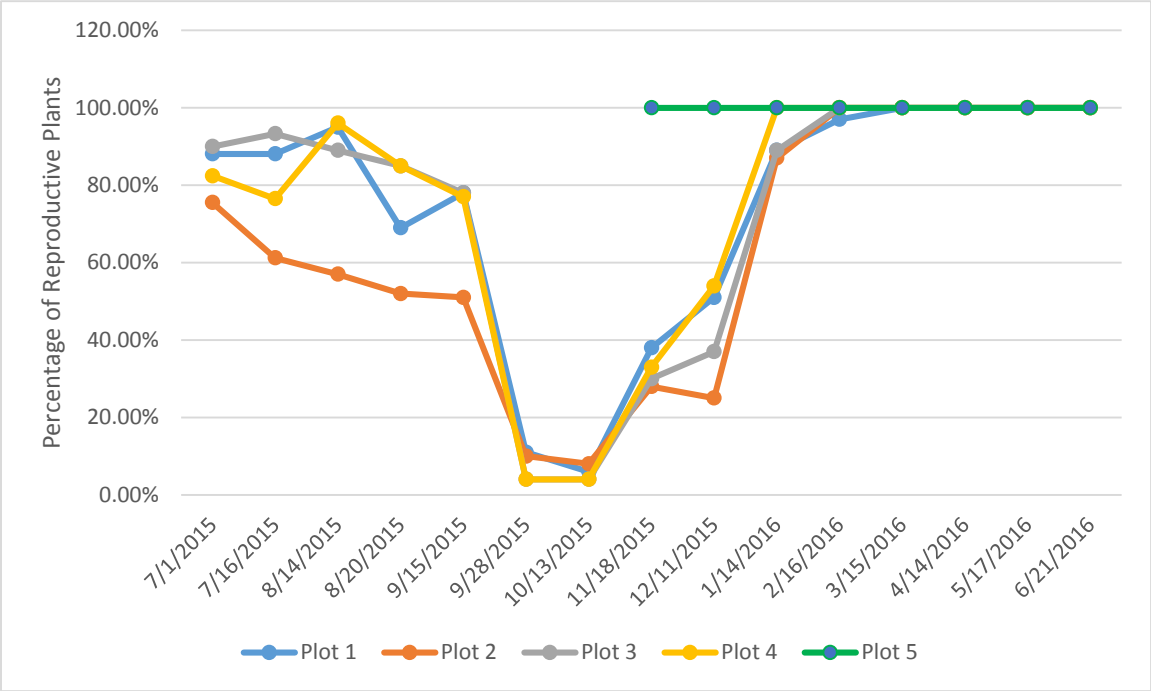

Figure 10. Percentage of living plants that are reproductive in Plots 1–5 over the monitoring period.

4.2.6. Plant Species

In all, 27 plant species have been observed in the plots (Table 4).

Table 4. Plant Species Found within the Plots

Scientific Name	Hawaiian, Common Name(s)	Status*
Abutilon incanum	maʻo, hoary abutilon	I
Acacia farnesiana	klu	X
Achyranthes splendens var. *rotundata*	round-leaved chaff flower	E
Asystasia gangetica	Chinese violet	X
Atriplex semibaccata	Australian saltbush	X
Boerhavia coccinea	red boerhavia	X
Cenchrus ciliaris	buffelgrass	X
Chloris barbata	swollen fingergrass, mauʻu lei	X
Cucumis dipsaceus	hedgehog gourd, teasel gourd	X
Desmanthus pernambucanus	slender mimosa	X
Galinsoga parviflora	–	X
Heliotropium curassavicum	kïpūkai, nena, seaside heliotrope	I
Leucaena leucocephala	koa haole	X
Malva parviflora	cheeseweed	X
Merremia aegyptia	hairy woodrose	X
Melinis repens	Natal red top	X
Momordica charantia	bitter melon	X
Myoporum sandwicense	naio, bastard sandalwood	I
Pluchea carolinensis	sourbush, marsh fleabane	X
Prosopis pallida	kiawe	X
Ricinus communis	castor bean	X
Sida fallax	ʻilima	I
Sonchus oleraceus	sow thistle, pualele	X
Tridax sp.	daisy sp.	X
Urochloa maxima	Guinea grass	X
Verbesina encelioides	golden crownbeard	X
Waltheria indica	ʻuhaloa	I
Total		**27**

* Status: E = endemic (native only to the Hawaiian Islands); I = indigenous (native to the Hawaiian Islands and elsewhere); X = introduced/ alien (plants brought to the Hawaiian Islands by humans, intentionally or accidentally, after Western contact [Cook's arrival in the islands in 1778]).

4.2.7. Wildlife Species

In all, 29 wildlife species have been noted within the plots or in the immediate vicinity during monitoring (Table 5). Nearly all of these are not native to the Hawaiian Islands.

Table 5. Wildlife Observed within the Plots or Immediate Vicinity

Scientific Name	Hawaiian, Common Name(s)	Status*
Invertebrates		
Agraulis vanillae	Gulf fritillary	I
Anax junius	green darner, pinao	I
Apis mellifera	honey bee	X
Coccinellidae sp.	ladybug	X
Pantala flavescens	globe skimmer	X
Delta campaniforme	potter wasp	X
Nezara viridula	stinkbug	X
Ochetellus glaber	black ant	X
Paratrechina longicornis	longhorn crazy ant	X
Phenacoccus solenopsis	cotton mealybug	X
Pieris rapae	cabbage butterfly	I
Saissetia coffeae	hemispherical scale	X
Vespula pensylvanica	yellow-jacket	X
Avifauna		
Acridotheres tristis	common mynah	X
Cardinalis cardinalis	northern cardinal	X
Carpodacus mexicanus	house finch	X
Estrilda astrild	common waxbill	X
Francolinus pondicerianus	grey francolin	X
Geopelia striata	zebra dove	X
Mimus polyglottos	northern mockingbird	X
Paroaria coronata	red-crested cardinal	X
Pavo cristatus	Indian peafowl, peacock	X
Pluvialis fulva	Pacific golden plover, kolea	I
Pycnonotus cafer	red-vented bulbul	X
Streptopelia chinensis	spotted dove	X
Zosterops japonicus	Japanese white-eye	X
Mammalian Fauna		
Felis catus	cat	X
Herpestes javanicus	small Indian mongoose	X
Muridae	mouse sp.	X
Total		**29**

* Status: E = endemic (native only to the Hawaiian Islands); I = indigenous (native to the Hawaiian Islands and elsewhere); P = Polynesian (introduced by Polynesians); X = introduced/ alien (plants brought to the Hawaiian Islands by humans, intentionally or accidentally, after Western contact [Cook's arrival in the islands in 1778]).

4.2.8. Soil Conditions

In most of the plots, only a thin layer of soil occurs over the coral outcrop. The results of soil chemical analysis have been relatively constant throughout the monitoring period and across plots (Figures 11–16).

After consistent soil data results during the monitoring period covered in the first annual report, and after a consultation with soils specialists at the University of Hawai‘i, a discussion with DOFAW (Afsheen Siddiqu/DOFAW personal communication September 22, 2015) led to the decision that only semi-annual chemical analysis of soil is to be conducted under adaptive management unless future results show significant changes from existing conditions.

In total, five soil collections took place during this reporting period. A soil analysis was done for pH, calcium, magnesium, phosphorus, potassium, and total nitrogen.

In general, all of the results were consistent with previous reporting. The pH in the plots stayed between 7.1 and 7.6, which is naturally higher at the site compared to other Hawaiian soils because of the type of parent material and coral. Nitrogen and phosphorous levels are relatively high (see Figures 13 and 14), but they were also consistent with previous reporting with nitrogen being between 0.53 and 2.72 ppm ug/g, and phosphorus ranging between 71 and 347 ppm ug/g. Based on these results, fertilizer application does not appear necessary. Potassium levels ranged between 72 and 1335 ppm ug/g (see Figure 15). Calcium levels continued to be high at the site (see Figure 16) because of the presence of limestone, especially in Plot 4, which has the highest levels of limestone.

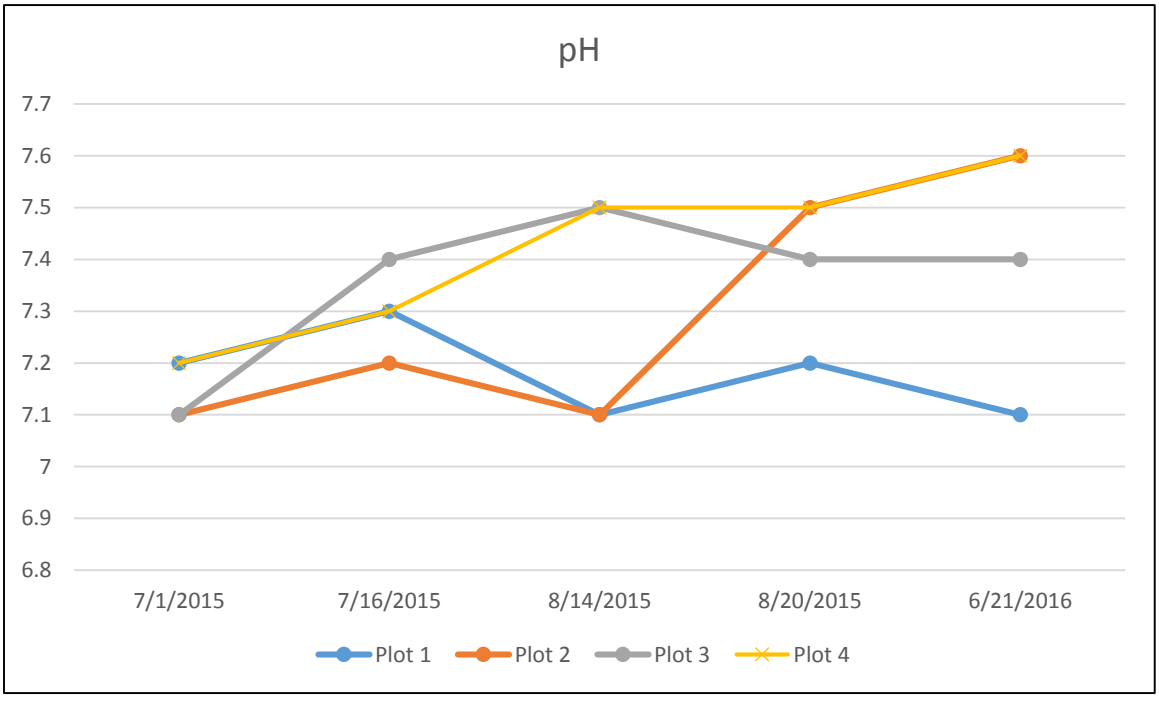

Figure 11. pH values recorded from soil samples taken during the horticultural monitoring events.

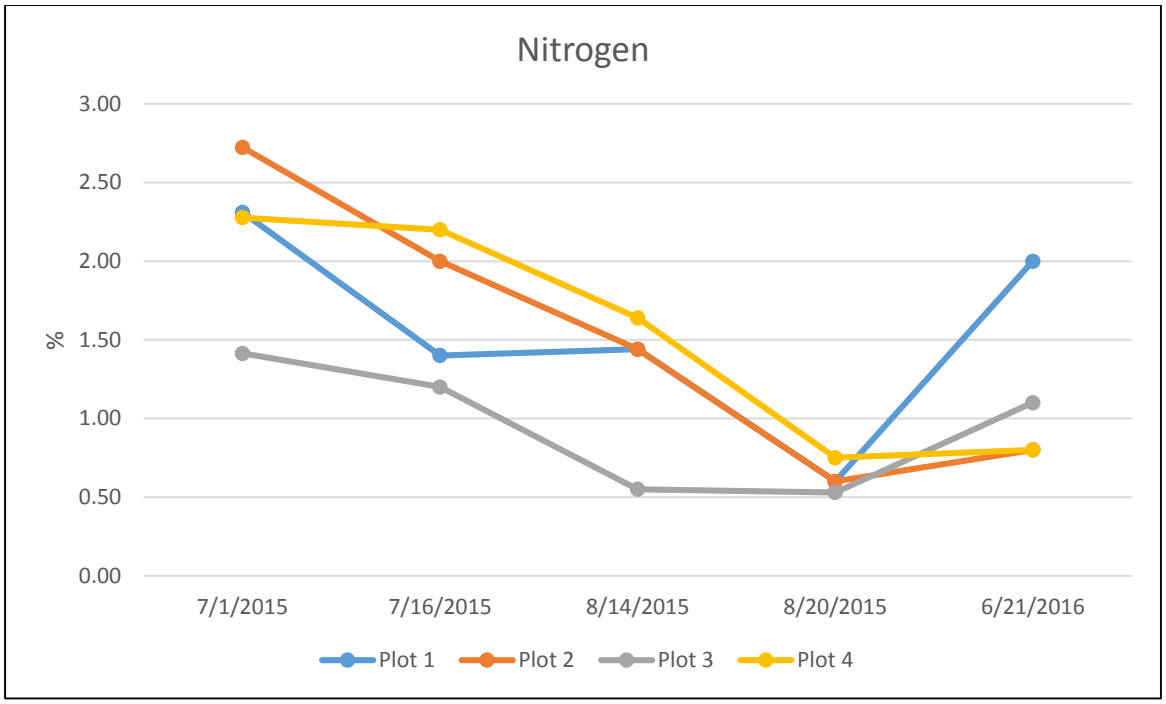

Figure 12. Nitrogen values recorded from soil samples taken during the horticultural monitoring events.

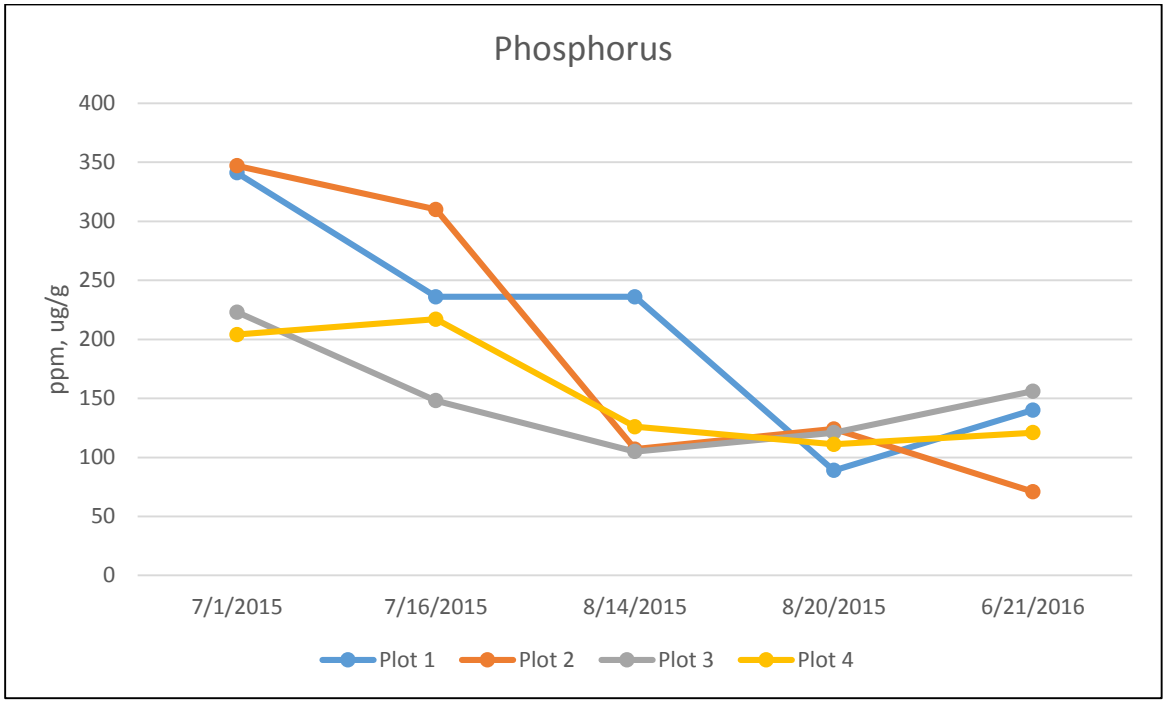

Figure 13. Phosphorous values recorded from soil samples taken during the horticultural monitoring events.

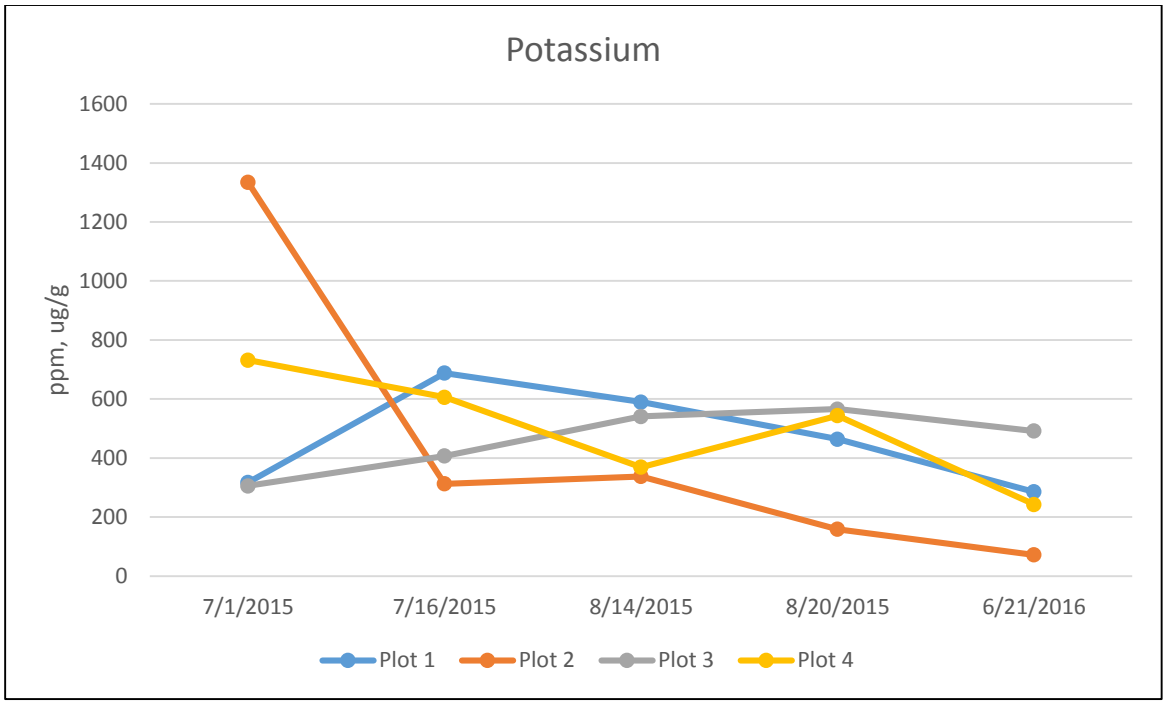

Figure 14. Potassium values recorded from soil samples taken during the horticultural monitoring events.

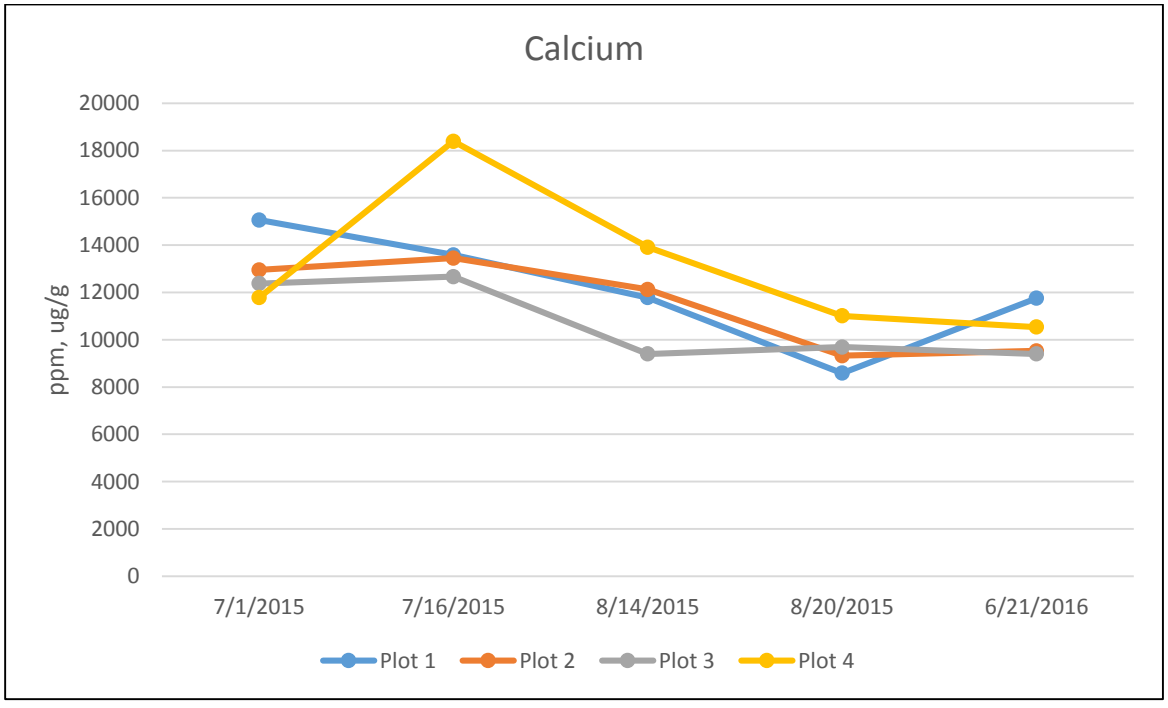

Figure 15. Calcium values recorded from soil samples taken during the horticultural monitoring events.

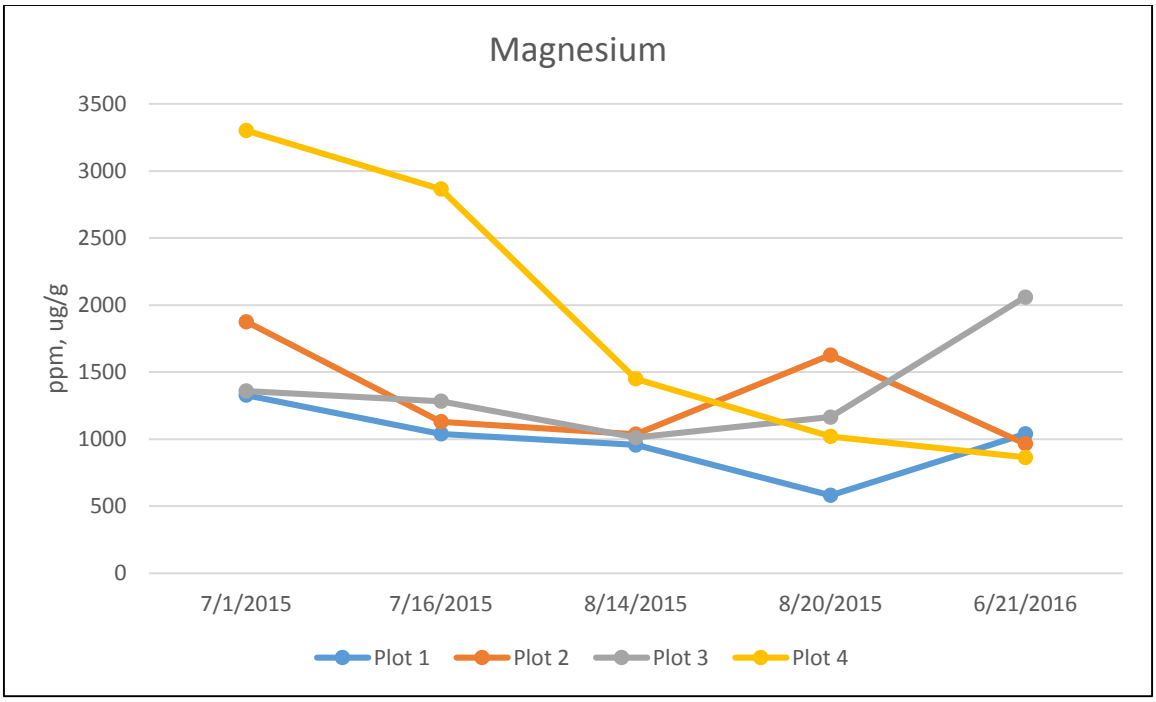

Figure 16. Magnesium values recorded from soil samples taken during the horticultural monitoring events.

5. EVALUATION OF SUCCESS CRITERIA

The goal of the measures of success is to ensure that the outplanted populations of round-leaved chaff flower become established and are stable and viable self-producing populations. The criteria presented below were developed based on consultation with the NWR and in accordance with the goals and objectives presented in the Pearl Harbor NWR comprehensive conservation plan for the Kalaeloa Unit (USFWS 2010). Measures for mitigation success will be determined by the following:

1. Outplanted individual survivorship:
    a. 100% of 120 outplanted individuals will survive by Year 1.
    b. 95% of 120 outplanted individuals will survive by Year 2.
    c. 85% of 120 outplanted individuals will survive by Year 3.
    d. 75% of 120 outplanted individuals will survive by Years 4 and 5.

2. There must be a) recruitment of seedlings that survive through the dry season, in absence of any supplemental watering; and b) seed production by at least 25% of the outplanted lineages by Year 5.

3. Number of seedlings recruited into the mature age class must be greater than the mortality rate of existing adult plants over a 5-year period, with a minimum recruitment of 25% of the number of outplanted individuals over a 5-year period.

4. No fewer than 120 mature plants, which will include plants recruited from the planted lineages, will be established by Year 5.

5. Cover of herbaceous non-native plants (e.g., buffelgrass, khaki weed [*Alternanthera pungens*], and golden crownbeard) will be less than 25% within the planting plots by Year 5.

6. No mature kiawe will be within the planting plots over the 5-year period.

7. Native species cover within the planting plots will be greater than 25% by Year 5.

All success criteria that apply to Year 1 were met on March 2016 with 124 surviving individuals. As of June 2016, all success criteria for Year 2 have been met with 123 surviving individuals. From a total of 159 outplants, 36 (23%) individuals have died since installation. Although this number is high, the surviving round-leaved chaff flower individuals have established themselves as strong and healthy individuals, and it is expected that mortality rate will significantly decrease for the remainder of the monitoring period.

Furthermore, cover of non-native species continues to be low compared to native species. Herbaceous non-native plant cover is less than 25% in all plots based on qualitative and quantitative monitoring. No mature kiawe are present within the plots.

Although recruitment has not been observed to date, it is anticipated to occur during the wet season. The National Weather Service reported below-average annual rainfall at the Kalaeloa Airport rain gauge in 2015, with a total of 11.49 inches (63% of annual average). Rainfall total continued to decline into April 2016, where Kalaeloa Airport recorded only 0.82 inch (11% of average year-to-date rainfall). Monthly rainfall data were unavailable for May and June but were above average for July 2016 (1.1 inches, 196% of average July rainfall) (National Oceanic and Atmospheric Administration/National Weather Service, Weather Forecast Office Honolulu 2016).

6. REMEDIAL MEASURES

Remedial measures that have been recommended and implemented by Hui Kū Maoli Ola and SWCA are summarized in the horticultural letter memoranda submitted to DOFAW. A summary of maintenance activities and notes is also provided in Appendix A. All required remedial measures are performed within 2 weeks of the receipt of the letters.

The following are recommended to meet the success criteria established for Year 2:

- Watering: Because most of the plants are showing signs of drought stress, plants will continue to receive supplementary watering, as needed. Supplemental watering needs to be balanced with USFWS concerns over the cost of water use, as well as the horticulturalist's concerns about attracting more pests with lush growth.

- Pest control: Although mealybugs are being observed in all plots, the severity of the infestation is declining after the application of the pesticide Safari. Plants will continue to be treated chemically and manually, as needed.

- Weed control: Overall, plant competition has been minimal and not determined to be a threat to the survival and success of most outplants during this monitoring period, except during prolonged rain storms when weed growth is excessive and requires additional maintenance visits to maintain the site. A 0.6-m (2-foot) buffer around each outplant will continue to be maintained to reduce competition, promote growth, and encourage regeneration. This buffer will be cleared and maintained by hand.

7. LITERATURE CITED

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Appendix A.

Summary of Maintenance Activities

Table A1. Summary of Maintenance Activities

Maintenance and Monitoring Period	Date of Visit	Comments
Year 1 (once a month monitoring)		
July	07/01/2015	The mealybugs are a big problem. With this species and others like *Nototrichium*, once the infestation gets to this level it is difficult to get it under control. Chemicals do not always work when the population is strong, especially with such a strong ant population. Prev-am was considered the more appropriate pesticide to use in the given environment. It ii not a systemic. Safari was applied to the plots today.
	07/08/2015	Heavily gnarled leaves removed, nodes wiped down with water and sponges. Safari will be re-applied.
	07/22/2015	Bug control.
August	08/05/2015	The 5th was pretty much like the past few visits. Plant vigor is improving and pest damage is declining. The next visit will be tomorrow. After that, if everything goes well, we will be going back to the monthly maintenance. September 16th would be the next service after tomorrow.
	08/19/2015	Activities on the 19th were standard. Weed and bug control with no watering.
September	09/08/2015	Weeding.
	09/28/2015	Major weeding.
October	10/06/2015	Major weeding.
	10/07/2015	Weeding.
	10/13/2015	Collected cuttings for propagation.
November	11/02/2015	Regular maintenance of pulling weeds. Nothing out of the ordinary.
December	12/04/2015	Regular maintenance of pulling weeds. Nothing out of the ordinary.
	12/08/2015	Regular maintenance of pulling weeds. Nothing out of the ordinary.
January	01/15/2016	Monitored the weeds and bugs. Light weeding. Weeds not too bad because it has been dry. Managed plants in the nursery.
February	02/19/2016	Monitored the weeds and bugs. Light weeding. Weeds not too bad because it has been dry. Managed plants in the nursery.
March	03/18/2016	Standard weed maintenance and hand removal of bugs from infected plants.
April	04/15/2016	Standard weed maintenance and hand removal of bugs from infected plants.
Year 2 (once every 2 months monitoring)		
May-June	06/22/2016	Fixed irrigation at the source. Watered all the plots well and applied Safari pesticide.
	06/29/2016	Follow-up application of Safari. Applied Safari a total of 2 times on June 22 and 29. Each time we used 2.5 ounces over the 6,400 square feet.

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Appendix B

Select Permanent Photo-Points

Figure B1. Plot 1 conditions during the 7th horticultural monitoring, 07/01/2015.

Figure B2. Plot 1 conditions during the 9th horticultural monitoring, 08/14/2015.

Figure B3. Plot 1 conditions during the 11th horticultural monitoring, 09/15/2015.

Figure B4. Plot 1 conditions during the 13th horticultural monitoring, 10/13/2015.

Figure B5. Plot 1 conditions during the 15th horticultural monitoring, 12/11/2015.

Figure B6. Plot 1 conditions during the 16th horticultural monitoring, 01/14/2016.

Figure B7. Plot 1 conditions during the 18th horticultural monitoring, 03/15/2016.

Figure B8. Plot 1 conditions during the 20th horticultural monitoring, 05/17/2016.

Figure B9. Plot 1 conditions during the 21st horticultural monitoring, 06/21/2016.

Figure B10. Plot 2 conditions during the 7th horticultural monitoring, 07/01/2015.

Figure B11. Plot 2 conditions during the 9th horticultural monitoring, 08/14/2015.

Figure B12. Plot 2 conditions during the 11th horticultural monitoring, 09/15/2015.

Figure B13. Plot 2 conditions during the 13th horticultural monitoring, 10/13/2015.

Figure B14. Plot 2 conditions during the 15th horticultural monitoring, 12/11/2015.

Figure B15. Plot 2 conditions during the 16th horticultural monitoring, 01/14/2016.

Figure B16. Plot 2 conditions during the 18th horticultural monitoring, 03/15/2016.

Figure B17. Plot 2 conditions during the 20th horticultural monitoring, 05/17/2016.

Figure B18. Plot 2 conditions during the 21st horticultural monitoring, 06/21/2016.

Figure B19. Plot 3 conditions during the 7th horticultural monitoring, 07/01/2015.

Figure B20. Plot 3 conditions during the 9th horticultural monitoring, 08/14/2015.

Figure B21. Plot 3 conditions during the 11th horticultural monitoring, 09/15/2015.

Figure B22. Plot 3 conditions during the 13th horticultural monitoring, 10/13/2015.

Figure B23. Plot 3 conditions during the 15th horticultural monitoring, 12/11/2015.

Figure B24. Plot 3 conditions during the 16th horticultural monitoring, 01/14/2016.

Figure B25. Plot 3 conditions during the 18th horticultural monitoring, 03/15/2016.

Figure B26. Plot 3 conditions during the 20th horticultural monitoring, 05/17/2016.

Figure B27. Plot 3 conditions during the 21st horticultural monitoring, 06/21/2016.

Figure B28. Plot 4 conditions during the 7th horticultural monitoring, 07/01/2015.

Figure B29. Plot 4 conditions during the 9th horticultural monitoring, 08/14/2015.

Figure B30. Plot 4 conditions during the 11th horticultural monitoring, 09/15/2015.

Figure B31. Plot 4 conditions during the 13th horticultural monitoring, 10/13/2015.

Figure B32. Plot 4 conditions during the 15th horticultural monitoring, 12/11/2015.

Figure B33. Plot 4 conditions during the 16th horticultural monitoring, 01/14/2016.

Figure B34. Plot 4 conditions during the 18th horticultural monitoring, 03/15/2016.

Figure B35. Plot 4 conditions during the 20th horticultural monitoring, 05/17/2016.

Figure B36. Plot 4 conditions during the 21st horticultural monitoring, 06/21/2016.

Figure B37. Plot 5 conditions during the 16th horticultural monitoring, 01/14/2016.

Figure B38. Plot 5 conditions during the 18th horticultural monitoring, 03/15/2016.

Figure B39. Plot 5 conditions during the 20th horticultural monitoring, 05/17/2016.

Appendix C

Photographs of Quadrat Assessment from Botanical Monitoring on July 23, 2015

Figure C1. Plot 1, Quadrat 1 (10, 10) from botanical monitoring on 07/23/2015.

Figure C2. Plot 1, Quadrat 2 (1, 10) from botanical monitoring on 07/23/2015.

Figure C3. Plot 1, Quadrat 3 (5, 6) from botanical monitoring on 07/23/2015.

Figure C4. Plot 1, Quadrat 4 (3, 6) from botanical monitoring on 07/23/2015.

Figure C5. Plot 1, Quadrat 5 (11, 9) from botanical monitoring on 07/23/2015.

Figure C6. Plot 1, Quadrat 6 (9, 0) from botanical monitoring on 07/23/2015.

Figure C7. Plot 1, Quadrat 7 (1, 2) from botanical monitoring on 07/23/2015.

Figure C8. Plot 1, Quadrat 8 (3, 9) from botanical monitoring on 07/23/2015.

Figure C9. Plot 1, Quadrat 9 (3, 11) from botanical monitoring on 07/23/2015.

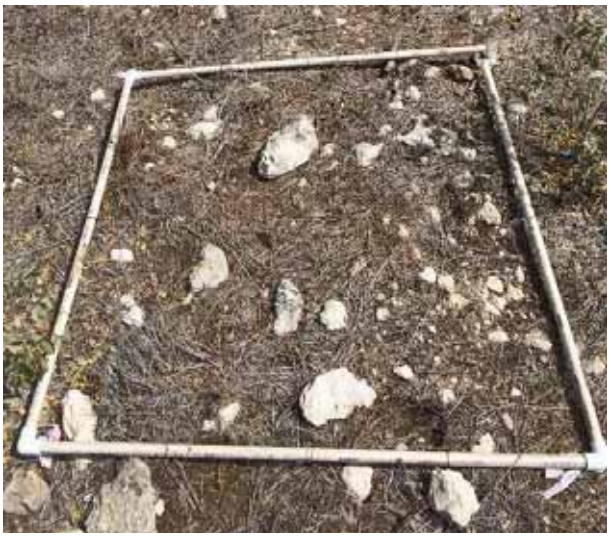

Figure C10. Plot 1, Quadrat 10 (10, 1) from botanical monitoring on 07/23/2015.

Figure C11. Plot 2, Quadrat 1 (4, 11) from botanical monitoring on 07/23/2015.

Figure C12. Plot 2, Quadrat 2 (8, 3) from botanical monitoring on 07/23/2015.

Figure C13. Plot 2, Quadrat 3 (8, 11) from botanical monitoring on 07/23/2015.

Figure C14. Plot 2, Quadrat 4 (0, 0) from botanical monitoring on 07/23/2015.

Figure C15. Plot 2, Quadrat 5 (2, 5) from botanical monitoring on 07/23/2015.

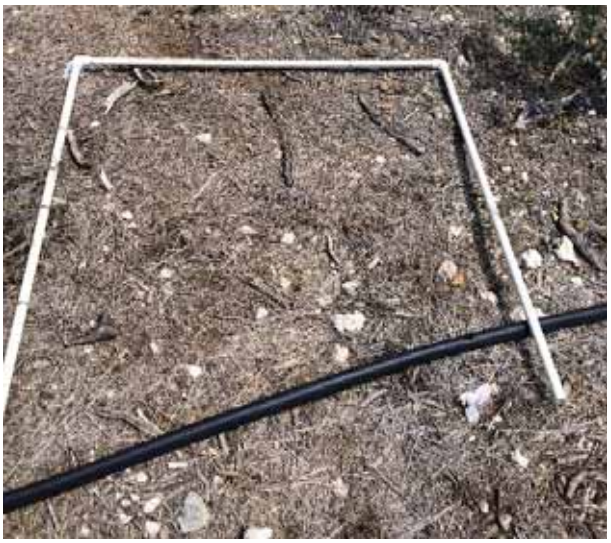

Figure C16. Plot 2, Quadrat 6 (4, 1) from botanical monitoring on 07/23/2015.

Figure C17. Plot 2, Quadrat 7 (9, 0) from botanical monitoring on 07/23/2015.

Figure C18. Plot 2, Quadrat 8 (6, 8) from botanical monitoring on 07/23/2015.

Figure C19. Plot 2, Quadrat 9 (1, 11) from botanical monitoring on 07/23/2015.

Figure C20. Plot 2, Quadrat 10 (6, 4) from botanical monitoring on 07/23/2015.

Figure C21. Plot 3, Quadrat 1 (4, 7) from botanical monitoring on 07/23/2015.

Figure C22. Plot 3, Quadrat 2 (4, 0) from botanical monitoring on 07/23/2015.

Figure C23. Plot 3, Quadrat 3 (10, 11) from botanical monitoring on 07/23/2015.

Figure C24. Plot 3, Quadrat 4 (4, 8) from botanical monitoring on 07/23/2015.

Figure C25. Plot 3, Quadrat 5 (5, 7) from botanical monitoring on 07/23/2015.

Figure C26. Plot 3, Quadrat 6 (2, 0) from botanical monitoring on 07/23/2015.

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Figure C27. Plot 3, Quadrat 7 (11, 1) from botanical monitoring on 07/23/2015.

Figure C28. Plot 3, Quadrat 8 (6, 7) from botanical monitoring on 07/23/2015.

Figure C29. Plot 3, Quadrat 9 (8, 5) from botanical monitoring on 07/23/2015.

Figure C30. Plot 3, Quadrat 10 (10, 7) from botanical monitoring on 07/23/2015.

Figure C31. Plot 4, Quadrat 1 (4, 4) from botanical monitoring on 07/23/2015.

Figure C32. Plot 4, Quadrat 2 (4, 1) from botanical monitoring on 07/23/2015.

Figure C33. Plot 4, Quadrat 3 (9, 0) from botanical monitoring on 07/23/2015.

Figure C34. Plot 4, Quadrat 4 (7, 6) from botanical monitoring on 07/23/2015.

Figure C35. Plot 4, Quadrat 5 (11, 3) from botanical monitoring on 07/23/2015.

Figure C36. Plot 4, Quadrat 6 (9, 6) from botanical monitoring on 07/23/2015.

Figure C37. Plot 4, Quadrat 7 (1, 6) from botanical monitoring on 07/23/2015.

Figure C38. Plot 4, Quadrat 8 (5, 5) from botanical monitoring on 07/23/2015.

Figure C39. Plot 4, Quadrat 9 (7, 0) from botanical monitoring on 07/23/2015.

Figure C40. Plot 4, Quadrat 10 (3, 5) from botanical monitoring on 07/23/2015.

Appendix D

Photographs of Quadrat Assessment from Botanical Monitoring on October 14, 2015

Figure D1. Plot 1, Quadrat 1 (10, 10) from botanical monitoring on 10/14/2015.

Figure D2. Plot 1, Quadrat 2 (1, 10) from botanical monitoring on 10/14/2015.

Figure D3. Plot 1, Quadrat 3 (5, 6) from botanical monitoring on 10/14/2015.

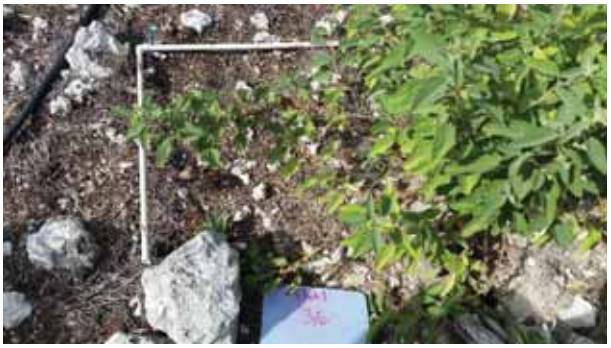

Figure D4. Plot 1, Quadrat 4 (3, 6) from botanical monitoring on 10/14/2015.

Figure D5. Plot 1, Quadrat 5 (11, 9) from botanical monitoring on 10/14/2015.

Figure D6. Plot 1, Quadrat 6 (9, 0) from botanical monitoring on 10/14/2015.

Figure D7. Plot 1, Quadrat 7 (1, 2) from botanical monitoring on 10/14/2015.

Figure D8. Plot 1, Quadrat 8 (3, 9) from botanical monitoring on 10/14/2015.

Figure D9. Plot 1, Quadrat 9 (3, 11) from botanical monitoring on 10/14/2015.

Figure D10. Plot 1, Quadrat 10 (10, 1) from botanical monitoring on 10/14/2015.

Figure D11. Plot 2, Quadrat 1 (4, 11) from botanical monitoring on 10/14/2015.

Figure D12. Plot 2, Quadrat 2 (8, 3) from botanical monitoring on 10/14/2015.

Figure D13. Plot 2, Quadrat 3 (8, 11) from botanical monitoring on 10/14/2015.

Figure D14. Plot 2, Quadrat 4 (0, 0) from botanical monitoring on 10/14/2015.

Figure D15. Plot 2, Quadrat 5 (2, 5) from botanical monitoring on 10/14/2015.

Figure D16. Plot 2, Quadrat 6 (4, 1) from botanical monitoring on 10/14/2015.

Figure D17. Plot 2, Quadrat 7 (9, 0) from botanical monitoring on 10/14/2015.

Figure D18. Plot 2, Quadrat 8 (6, 8) from botanical monitoring on 10/14/2015.

Figure D19. Plot 2, Quadrat 9 (1, 11) from botanical monitoring on 10/14/2015.

Figure D20. Plot 2, Quadrat 10 (6, 4) from botanical monitoring on 10/14/2015.

Figure D21. Plot 3, Quadrat 1 (4, 7) from botanical monitoring on 10/14/2015.

Figure D22. Plot 3, Quadrat 2 (4, 0) from botanical monitoring on 10/14/2015.

Figure D23. Plot 3, Quadrat 3 (8, 6) from botanical monitoring on 10/14/2015.

Figure D24. Plot 3, Quadrat 4 (4, 8) from botanical monitoring on 10/14/2015.

Figure D25. Plot 3, Quadrat 5 (5, 7) from botanical monitoring on 10/14/2015.

Figure D26. Plot 3, Quadrat 6 (2, 0) from botanical monitoring on 10/14/2015.

Figure D27. Plot 3, Quadrat 7 (11, 1) from botanical monitoring on 10/14/2015.

Figure D28. Plot 3, Quadrat 8 (6, 7) from botanical monitoring on 10/14/2015.

Figure D29. Plot 3, Quadrat 9 (8, 5) from botanical monitoring on 10/14/2015.

Figure D30. Plot 3, Quadrat 10 (9, 6) from botanical monitoring on 10/14/2015.

Figure D31. Plot 4, Quadrat 1 (4, 4) from botanical monitoring on 10/14/2015.

Figure D32. Plot 4, Quadrat 2 (4, 1) from botanical monitoring on 10/14/2015.

Figure D33. Plot 4, Quadrat 3 (9, 0) from botanical monitoring on 10/14/2015.

Figure D34. Plot 4, Quadrat 4 (7, 6) from botanical monitoring on 10/14/2015.

Figure D35. Plot 4, Quadrat 5 (11, 3) from botanical monitoring on 10/14/2015.

Figure D36. Plot 4, Quadrat 6 (9, 6) from botanical monitoring on 10/14/2015.

Figure D37. Plot 4, Quadrat 7 (1, 6) from botanical monitoring on 10/14/2015.

Figure D38. Plot 4, Quadrat 8 (5, 5) from botanical monitoring on 10/14/2015.

Figure D39. Plot 4, Quadrat 9 (7, 0) from botanical monitoring on 10/14/2015.

Figure D40. Plot 4, Quadrat 10 (3, 5) from botanical monitoring on 10/14/2015.

Appendix E

Photographs of Quadrat Assessment from Botanical Monitoring on January 27, 2016

Figure E1. Plot 1, Quadrat 1 (10, 10) from botanical monitoring on 01/27/2016.

Figure E2. Plot 1, Quadrat 2 (1, 10) from botanical monitoring on 01/27/2016.

Figure E3. Plot 1, Quadrat 3 (5, 6) from botanical monitoring on 01/27/2016.

Figure E4. Plot 1, Quadrat 4 (3, 6) from botanical monitoring on 01/27/2016.

Figure E5. Plot 1, Quadrat 5 (11, 9) from botanical monitoring on 01/27/2016.

Figure E6. Plot 1, Quadrat 6 (9, 0) from botanical monitoring on 01/27/2016.

Figure E7. Plot 1, Quadrat 7 (1, 2) from botanical monitoring on 01/27/2016.

Figure E8. Plot 1, Quadrat 8 (3, 9) from botanical monitoring on 01/27/2016.

Figure E9. Plot 1, Quadrat 9 (3, 11) from botanical monitoring on 01/27/2016.

Figure E10. Plot 1, Quadrat 10 (10, 1) from botanical monitoring on 01/27/2016.

Figure E11. Plot 2, Quadrat 1 (4, 11) from botanical monitoring on 01/27/2016.

Figure E12. Plot 2, Quadrat 2 (8, 3) from botanical monitoring on 01/27/2016.

Figure E13. Plot 2, Quadrat 3 (8, 11) from botanical monitoring on 01/27/2016.

Figure E14. Plot 2, Quadrat 4 (0, 0) from botanical monitoring on 01/27/2016.

Figure E15. Plot 2, Quadrat 5 (2, 5) from botanical monitoring on 01/27/2016.

Figure E16. Plot 2, Quadrat 6 (4, 1) from botanical monitoring on 01/27/2016.

Figure E17. Plot 2, Quadrat 7 (9, 0) from botanical monitoring on 01/27/2016.

Figure E18. Plot 2, Quadrat 8 (6, 8) from botanical monitoring on 01/27/2016.

Figure E19. Plot 2, Quadrat 9 (1, 11) from botanical monitoring on 01/27/2016.

Figure E20. Plot 2, Quadrat 10 (6, 4) from botanical monitoring on 01/27/2016.

Figure E21. Plot 3, Quadrat 1 (4, 7) from botanical monitoring on 01/27/2016.

Figure E22. Plot 3, Quadrat 2 (4, 0) from botanical monitoring on 01/27/2016.

Figure E23. Plot 3, Quadrat 3 (8, 6) from botanical monitoring on 01/27/2016.

Figure E24. Plot 3, Quadrat 4 (4, 8) from botanical monitoring on 01/27/2016.

Figure E25. Plot 3, Quadrat 5 (5, 7) from botanical monitoring on 01/27/2016.

Figure E26. Plot 3, Quadrat 6 (2, 0) from botanical monitoring on 01/27/2016.

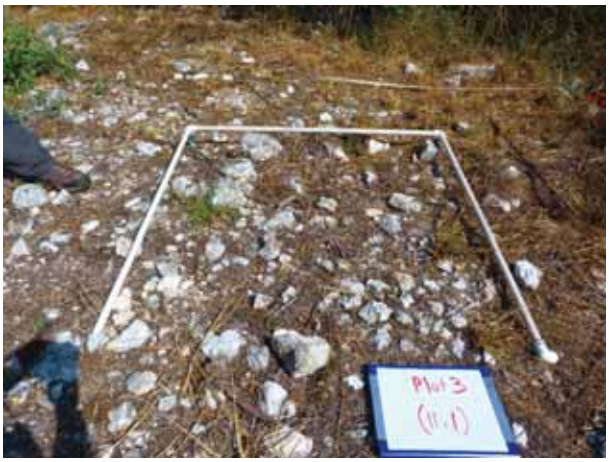

Figure E27. Plot 3, Quadrat 7 (11, 1) from botanical monitoring on 01/27/2016.

Figure E28. Plot 3, Quadrat 8 (6, 7) from botanical monitoring on 01/27/2016.

Figure E29. Plot 3, Quadrat 9 (8, 5) from botanical monitoring on 01/27/2016.

Figure E30. Plot 3, Quadrat 10 (9, 6) from botanical monitoring on 01/27/2016.

Figure E31. Plot 4, Quadrat 1 (4, 4) from botanical monitoring on 01/27/2016.

Figure E32. Plot 4, Quadrat 2 (4, 1) from botanical monitoring on 01/27/2016.

Figure E33. Plot 4, Quadrat 3 (9, 0) from botanical monitoring on 01/27/2016.

Figure E34. Plot 4, Quadrat 4 (7, 6) from botanical monitoring on 01/27/2016.

Figure E35. Plot 4, Quadrat 5 (11, 3) from botanical monitoring on 01/27/2016.

Figure E36. Plot 4, Quadrat 6 (9, 6) from botanical monitoring on 01/27/2016.

Figure E37. Plot 4, Quadrat 7 (1, 6) from botanical monitoring on 01/27/2016.

Figure E38. Plot 4, Quadrat 8 (5, 5) from botanical monitoring on 01/27/2016.

Figure E39. Plot 4, Quadrat 9 (7, 0) from botanical monitoring on 01/27/2016.

Figure E40. Plot 4, Quadrat 10 (3, 5) from botanical monitoring on 01/27/2016.

Appendix F

Photographs of Quadrat Assessment from Botanical Monitoring on June 3, 2016

Figure F1. Plot 1, Quadrat 1 (10, 10) from botanical monitoring on 06/03/2016.

Figure F2. Plot 1, Quadrat 2 (1, 10) from botanical monitoring on 06/03/2016.

Figure F3. Plot 1, Quadrat 3 (5, 6) from botanical monitoring on 06/03/2016.

Figure F4. Plot 1, Quadrat 4 (3, 6) from botanical monitoring on 06/03/2016.

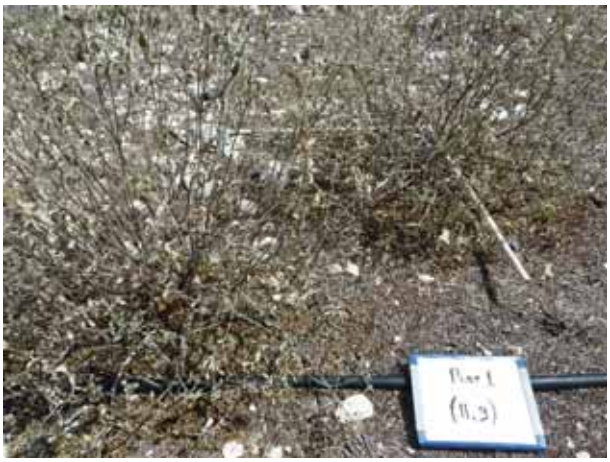

Figure F5. Plot 1, Quadrat 5 (11, 9) from botanical monitoring on 06/03/2016.

Figure F6. Plot 1, Quadrat 6 (9, 0) from botanical monitoring on 06/03/2016.

Figure F7. Plot 1, Quadrat 7 (1, 2) from botanical monitoring on 06/03/2016.

Figure F8. Plot 1, Quadrat 8 (3, 9) from botanical monitoring on 06/03/2016.

Figure F9. Plot 1, Quadrat 9 (3, 11) from botanical monitoring on 06/03/2016.

Figure F10. Plot 1, Quadrat 10 (10, 1) from botanical monitoring on 06/03/2016.

Figure F11. Plot 2, Quadrat 1 (4, 11) from botanical monitoring on 06/03/2016.

Figure F12. Plot 2, Quadrat 2 (8, 3) from botanical monitoring on 06/03/2016.

Figure F13. Plot 2, Quadrat 3 (8, 11) from botanical monitoring on 06/03/2016.

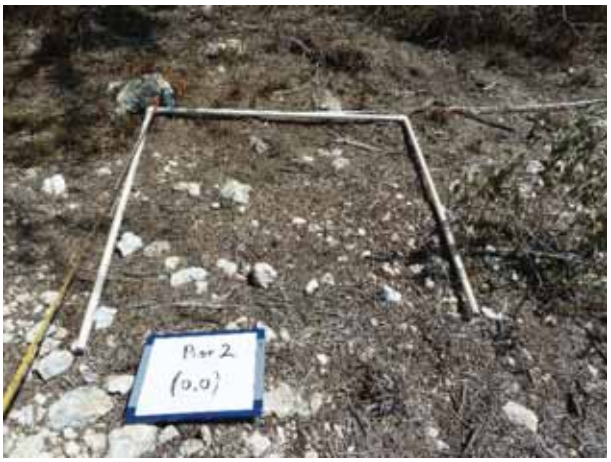

Figure F14. Plot 2, Quadrat 4 (0, 0) from botanical monitoring on 06/03/2016.

Figure E15. Plot 2, Quadrat 5 (2, 5) from botanical monitoring on 06/03/2016.

Figure F16. Plot 2, Quadrat 6 (4, 1) from botanical monitoring on 06/03/2016.

Figure F17. Plot 2, Quadrat 7 (9, 0) from botanical monitoring on 06/03/2016.

Figure F18. Plot 2, Quadrat 8 (6, 8) from botanical monitoring on 06/03/2016.

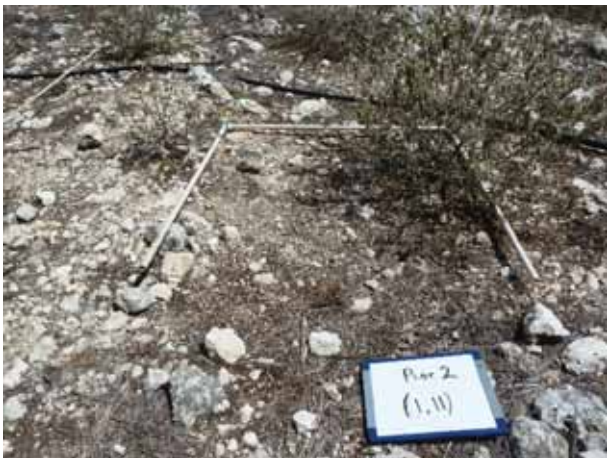

Figure F19. Plot 2, Quadrat 9 (1, 11) from botanical monitoring on 06/03/2016.

Figure F20. Plot 2, Quadrat 10 (6, 4) from botanical monitoring on 06/03/2016.

Figure F21. Plot 3, Quadrat 1 (4, 7) from botanical monitoring on 06/03/2016.

Figure F22. Plot 3, Quadrat 2 (4, 0) from botanical monitoring on 06/03/2016.

Figure F23. Plot 3, Quadrat 3 (8, 6) from botanical monitoring on 06/03/2016.

Figure F24. Plot 3, Quadrat 4 (4, 8) from botanical monitoring on 06/03/2016.

Figure F25. Plot 3, Quadrat 5 (5, 7) from botanical monitoring on 06/03/2016.

Figure F26. Plot 3, Quadrat 6 (2, 0) from botanical monitoring on 06/03/2016.

Figure F27. Plot 3, Quadrat 7 (11, 1) from botanical monitoring on 06/03/2016.

Figure F28. Plot 3, Quadrat 8 (6, 7) from botanical monitoring on 06/03/2016.

Figure F29. Plot 3, Quadrat 9 (8, 5) from botanical monitoring on 06/03/2016.

Figure F30. Plot 3, Quadrat 10 (9, 6) from botanical monitoring on 06/03/2016.

Figure F31. Plot 4, Quadrat 1 (4, 4) from botanical monitoring on 06/03/2016.

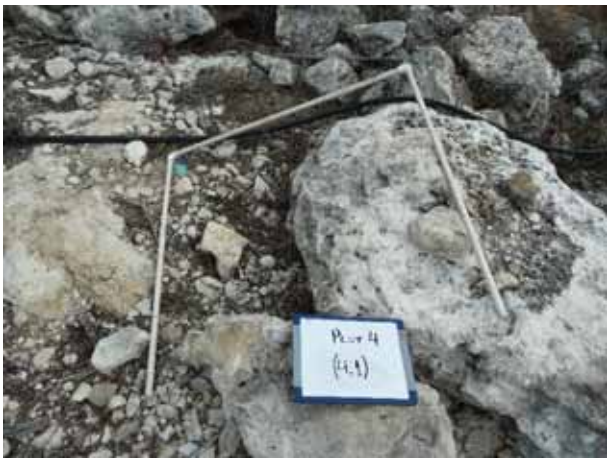

Figure F32. Plot 4, Quadrat 2 (4, 1) from botanical monitoring on 06/03/2016.

Figure F33. Plot 4, Quadrat 3 (9, 0) from botanical monitoring on 06/03/2016.

Figure F34. Plot 4, Quadrat 4 (7, 6) from botanical monitoring on 06/03/2016.

Figure F35. Plot 4, Quadrat 5 (11, 3) from botanical monitoring on 06/03/2016.

Figure F36. Plot 4, Quadrat 6 (9, 6) from botanical monitoring on 06/03/2016.

Figure F37. Plot 4, Quadrat 7 (1, 6) from botanical monitoring on 06/03/2016.

Figure F38. Plot 4, Quadrat 8 (5, 5) from botanical monitoring on 06/03/2016.

Figure F39. Plot 4, Quadrat 9 (7, 0) from botanical monitoring on 06/03/2016.

Figure F40. Plot 4, Quadrat 10 (3, 5) from botanical monitoring on 06/03/2016.