Annual Report for the Kenai Industrial Park: Round-Leaved Chaff Flower (*Achyranthes splendens* var. *rotundata*) Habitat Conservation Plan July 1, 2019 – June 30, 2020

MAY 2021

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

ANNUAL REPORT FOR THE KENAI INDUSTRIAL PARK ROUND-LEAVED CHAFF FLOWER (*ACHYRANTHES SPLENDENS* VAR. *ROTUNDATA*) HABITAT CONSERVATION PLAN JULY 1, 2019 – JUNE 30, 2020

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Submitted May 20, 2021

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1 INTRODUCTION

In February 2014, CIRI Land Development Company (CIRI) 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 federally and state-listed endangered species, at the proposed Kenai Industrial Park (KIP) site. To obtain the incidental take license (ITL), 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.

Subsequent to ITL approval, 2 existing round-leaf chaff flower plants were removed from the Kenai site (in shaded depression in coral). It should be noted that the original HCP indicated that there were 3 plants found at the original plot; however, at the time of the implementation of the HCP only 2 plants remained alive at the site. The HCP indicated that the success criteria would be met at a 30:1 ratio which should have adjusted the total number of plants to satisfy the success criteria at 60 rather than the 120 in the HCP’s success criteria.

This annual report describes the activities, observations, and results continuing during Year 5, through the end of the HCP monitoring period (April 7, 2020), and continuing until the end of the annual reporting year of the HCP implementation at the Kalaeloa Unit (the mitigation site) from July 1, 2019, to June 30, 2020. During this time, maintenance and monitoring occurred at the mitigation site as required in the HCP, with four horticultural (qualitative) monitoring events and one botanical (quantitative) monitoring event. Photographic documentation occurred during each event. The monitoring program is designed to document mitigation success and inform the need for remedial and adaptive management measures. Monitoring was led by SWCA Project Manager Jaap Eijzenga, SWCA Botanist Danielle Frohlich, and SWCA Botanist Alex Lau. All maintenance was conducted by local plant nursery Hui Kū Maoli Ola and supervised by their 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. The Kalaeloa Unit was established during the 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 plain. 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 was 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 at the mitigation site. These plots were identified using work units that the USFWS designated 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 square m (1,600 square feet).

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

Four round-leaved chaff flower individuals were also planted outside of Plots 1–4 on November 25, 2014. These plants were not previously included in the total count; however, based on discussion with the state in December 2015, these four plants were included in the total plant count as of the sixteenth 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 square meters (172 square feet).

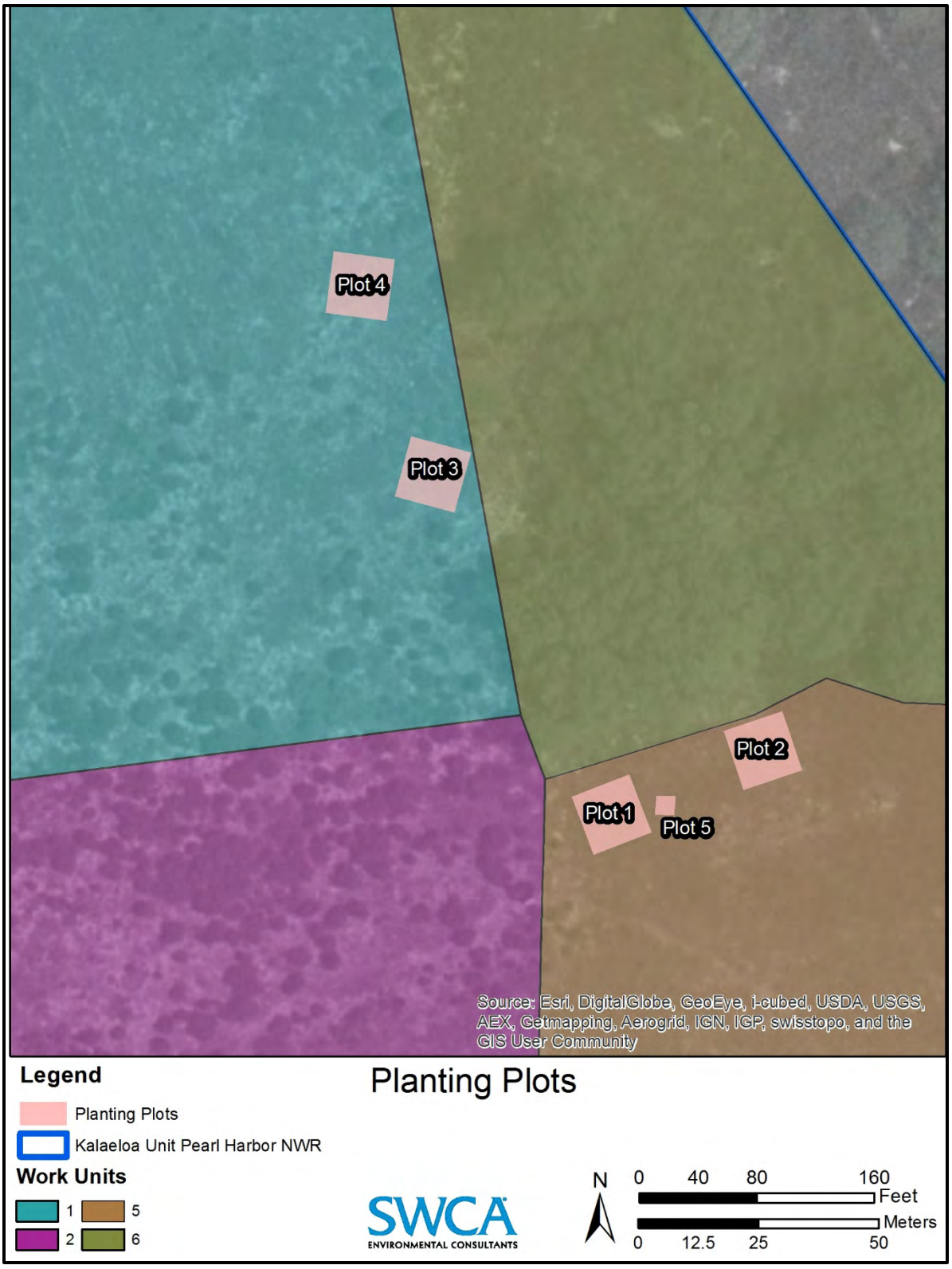

Figure 1. Planting plots in the mitigation site.

3 METHODS

Table 1 presents a timeline for activities associated with implementation of the HCP between July 2019 and May 2020.

Table 1. Timeline of Monitoring Activities

Year	Activity	Date
5	Horticultural monitoring no. 40	07/02/2019
	Horticultural monitoring no. 41	10/09/2019
	Horticultural monitoring no. 42	01/10/2020
	Botanical monitoring no. 12	01/16/2020
6	Horticultural monitoring no. 43	05/06/2020

3.1 Maintenance

Maintenance activities included weed control, pest control, and outplant replacement. Water was unavailable at the site at this time, and none of the outplant replacements survived. All maintenance activities were conducted by Hui Kū Maoli Ola under the direction of the project horticulturalist.

During the remainder of Year 5, maintenance was scheduled to take place quarterly (once every 3 months), but was more frequent, in order to control encroaching weeds throughout the project site. Maintenance activities for this reporting period are summarized in Appendix A. The project horticulturist provided observations and recommendations following each maintenance visit and implemented recommendations as necessary in consideration of the success criteria. 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 (qualitative assessment) was conducted quarterly during the remainder of Year 5 (July 2019–April 2020 [the last monitoring took place in May 2020, instead of April due to scheduling conflicts]). 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*: Phenological stage is classified as vegetative or 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:* Threats include encroaching weeds and water stress.
- *List of maintenance requirements*
- *Visual assessment and photographic documentation of native and non-native percentage cover*: Percentage cover estimates and photographs are taken in four quadrats in each plot.

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). These memoranda were sent to Hui Ku Maoli Ola, and remedial measures were performed promptly (although supplemental watering could not be performed due to lack of water supply at the site).

3.2.2 Botanical Monitoring

Botanical monitoring took place once during this reporting period. The botanical monitoring took place as part of Year 5 in January 2020. Botanical monitoring will take place twice a year (in January and June of each year) through the end of the mitigation period. The following information was collected during botanical monitoring:

- *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 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 is divided into 1 × 1–m (3.3 × 3.3–foot) quadrats (144 quadrats total). Ten quadrats are randomly selected in each plot (at least five quadrats are required in the HCP [SWCA 2013]) and the percentage cover of each plant species is evaluated in each quadrat delineated by polyvinyl chloride pipe reference frames.
- *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.

- *Site photography from permanent photo-points:* Photographs are taken from the same location time of each monitoring quadrat.
- *List of maintenance requirements.*

The data from the botanical monitoring events are discussed solely 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 event (Appendix B). Photographs were also taken of installation activities and maintenance. Representative photographs were taken of healthy, dead, reproducing, and naturally recruited individuals. 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. A 0.6-m (2-foot) buffer is also maintained around each outplant to reduce competition, promote growth, and encourage regeneration.

No supplemental watering has taken place during the last six maintenance visits from this reporting period. Water was unavailable at the mitigation site during this period, which led to none of the replacement outplantings surviving. Water availability will be essential for success of future plantings under adaptive management, and therefore success of the mitigation project.

The persisting presence of mealybugs (species of scale insects in the family Pseudococcidae) and the continued presence of the highly destructive bostrichid beetle (*Amphicerus* sp.) identified in early 2017, have led to one chemical treatment of Safari (one of two pesticides approved by the USFWS to be used at the NWR) at the plots. A gallon and a half of Safari was applied once in Year 5 (July 2019) on infected plants across the plots in the project site.

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

4.2 Monitoring

Four horticultural monitoring events and one botanical monitoring event took place from early July 2019 through early May 2020 (see Table 1). The results are summarized below.

4.2.1 Survival

In all, 159 individual plants were initially planted by December 2014 in Plots 1–4. Four individual plants were planted outside of Plots 1–4 on November 2014, in Plot 5. These four individuals were added to the total count on January 14, 2016 (sixteenth horticultural monitoring event). In order to allow for better data tracking, monitoring data were being reported separately for original plantings and progeny starting from the first reporting period in Year 4 on July 18, 2017. An additional 60 individuals were outplanted at the mitigation site in April 2020, but none of those individuals survived until the horticultural monitoring that followed in May 2020, which is why they are not included in any of the data results. The lack of survival is attributed to the unavailability of water at the time of installation. The efforts at some expense to increase the plant population have been severely hampered by the lack of available water.

For this reporting period, thirteen of the originally outplanted individuals (8%) survived as of the most recent horticultural monitoring on May 6, 2020 (Figure 2). This low survival rate of the original outplants is expected, given this species' short average life span. Plot 3 maintained the highest number of survival at 27% and 8 alive individuals, while plots 4 and 5 had only 6% and 5% survival with two alive individuals in each plot. During the same monitoring in May, the total number of tagged and numbered progeny was 97 (82%) (Figure 3).

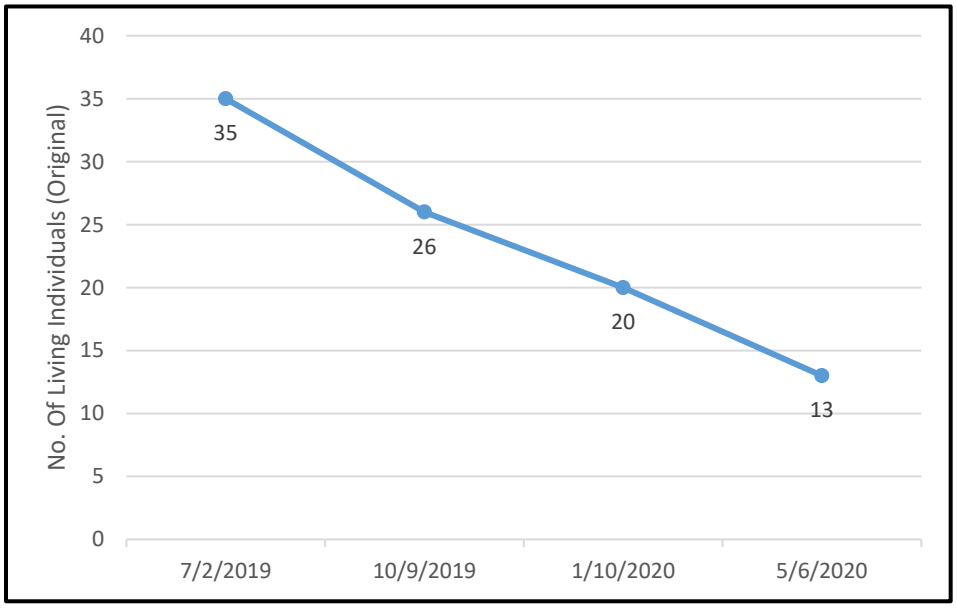

Figure 2. Survival of original plants during the horticultural monitoring events (July 2, 2019, to May 6, 2020).

Overall, the numbers of originally outplanted individuals continued to decrease in all plots over time since the last monitoring event in the fifth annual report (April 10, 2019); however, the overall total number of individuals continued to increase (Table 2), as the number of new progeny recorded between July 2, 2019, and May 6, 2020, increased by 20 individuals (see Figure 3), bringing the total number of

progeny to 97. Plot 3 had the highest number of progeny—34, followed by plots 1 and 2, with 31 and 30 individuals, respectively, and plot 5 with two individuals. Plot 4 has no progeny to date and will continue to be monitored. Survival remains high, with the lowest survival noted in Plot 1 at 67% (see Table 2).

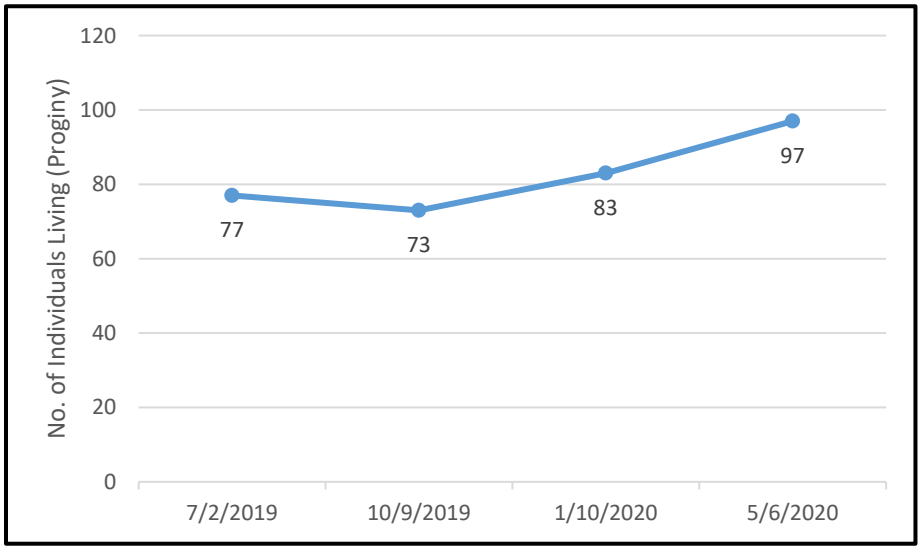

Figure 3. Survival of progeny during the horticultural monitoring events (July 2, 2019, to May 6, 2020).

Table 2. Number of Original Individuals and Progeny between the First and Last Monitoring of the Annual Reporting Period

Plot	Number of Original Individuals Living (07/2/2019)	Number of Original Individuals Living (05/06/2020)	Number of Progeny Living (07/02/2019)	Number of Progeny Individuals Living (05/06/2020)
1	3 (7%)	2 (5%)	38 (86%)	31 (67%)
2	11 (22%)	1 (2%)	12 (100%)	30 (94%)
3	13 (43%)	8 (27%)	26 (96%)	34 (87%)
4	8 (24%)	2 (6%)	–	–
5	0 (0%)	0 (0%)	1 (100%)	2 (100%)
Total	**35 (22%)**	**13 (8%)**	**77 (92%)**	**97 (82%)**

4.2.2 Plant Vigor

The fluctuations in vigor seen during this reporting period in the original individuals and their progeny continued to reflect those seen in previous years (Figures 4 and 5), with the decrease in vigor in the original plants being especially visible as they were reaching the end of their life. These fluctuations can be attributed primarily to the plants approaching the end of their life span, drought stress and hot temperatures during the dry season as well as infestations of mealybug and bostrichid beetle that arise when plants are stressed and weak.

Overall, vigor was low throughout the length of the annual reporting period. Healthy vigor of the original outplants was noted only on one individual (1%) in July 2019 and increased to five individuals (3%) in January 2020. No healthy individuals were recorded in October 2019 and May 2020. The

percentage of original plants considered moderately vigorous decreased throughout the year, starting at 8% in July 2019 and staying at 8% in October2019, decreasing to 5% in January 2020, down to 4% in May 2020. Representative photographs depicting different vigor categories are shown in Figures 6–8.

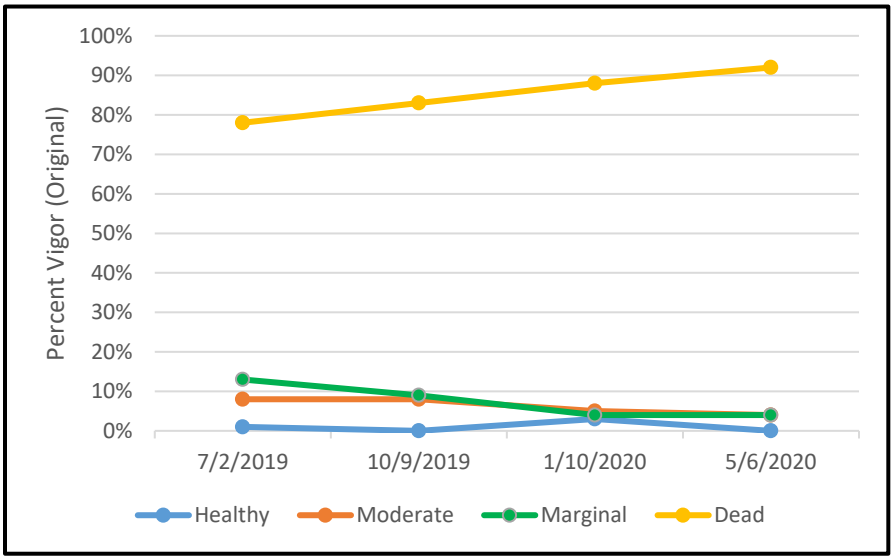

Figure 4. Percentage of original plants in the various vigor categories during the horticultural monitoring events (July 2, 2019, to May 6, 2020).

Vigor in the progeny was also recorded to be low, but overall higher than in the original plants, throughout all monitoring events. The percentage of healthy progeny varied throughout the year, with the highest percentage (29%) occurring in January 2020 and the lowest (2%) in July 2019. The percentage of plants showing moderate vigor stayed relatively the same, ranging from 33% to 48%, from the beginning of the reporting period in July 2019, November 2019, January 2020 to the last monitoring in May 2020.

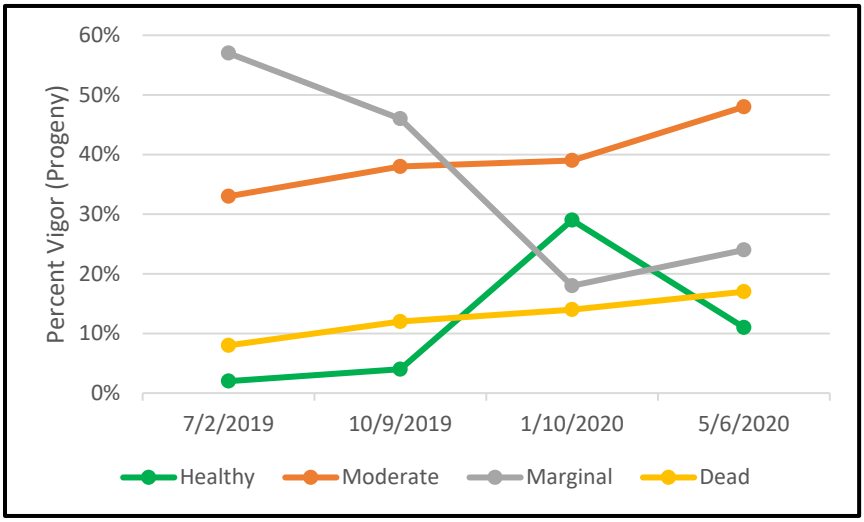

Figure 5. Percentage of progeny in the various vigor categories during the horticultural monitoring events (July 2, 2019, to May 6, 2020).

Figure 6. Representative plants showing healthy vigor.

Figure 7. Representative plants showing moderate vigor.

Figure 8. Representative plants showing marginal vigor (left) and dead plant (right).

4.2.3 Pests

Pest presence was almost identical for both the original outplants and their progeny throughout the reporting period.

Consistent with the previous monitoring reports, pests (mainly mealybug, bostrichid beetle, and ants) continue to be a significant issue for all plots as the seasons change from wet to dry. Pests were the highest in July 2019 with 37 individuals (97%) having pests present, decreased by 5% in October 2019 to 92% (24 individuals), fell down to 50% (10 individuals) in January 2020, and then increased again to 85% (11 individuals) in May 2020.

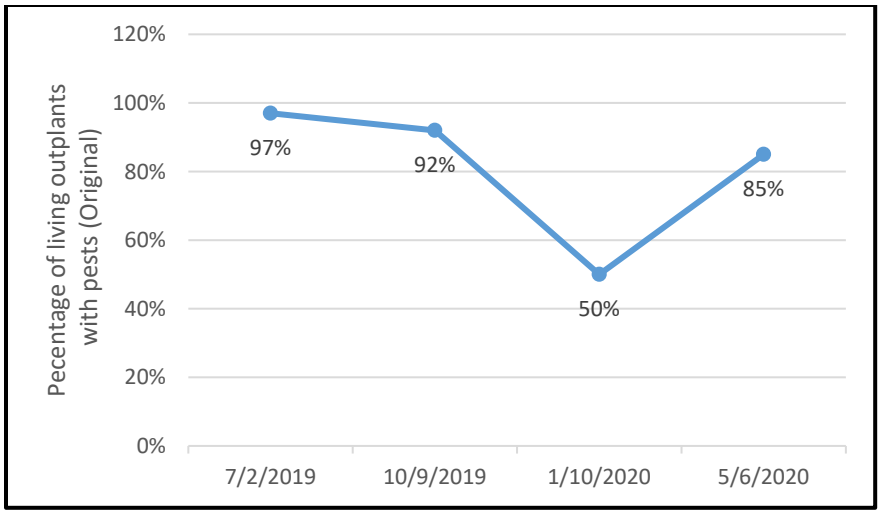

Figure 9. Percentage of all live original plants with pests during the horticultural monitoring events (July 2, 2019, to May 6, 2020).

As seen in Figures 9 and 10, the main difference between the pest presence between the original individuals and the progeny, was the decrease in pests in the progeny in October 2019, with 72% (52 individuals) showing some level of pest presence, compared to the 92% pest presence in the original plants. The remaining numbers slightly differed, with pests noted on 97% (75 individuals) in July 2020, 49% (41 individuals) in January 2020, and 88% (85 individuals) in May 2020.

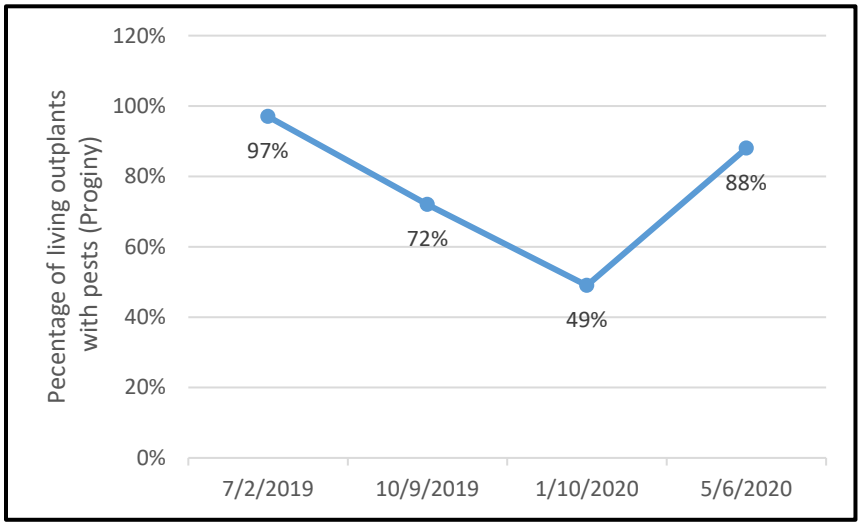

Figure 10. Percentage of all live progeny with pests during the horticultural monitoring events (July 2, 2019, to May 6, 2020).

Presence of the bostrichid beetle continues to be noted throughout the plots, and it continues to contribute to mortality in outplants. It is possible that the plants are dying because they are at the end of their lives and are weakened. The beetle is likely attacking dead or dying branches and introducing a fungus that weakens the plant further (personal communication, K. Magnacca, Bishop Museum, February 14, 2017). Some plants have been noted deteriorating from moderate or healthy vigor to dead within a matter of months after being colonized by this beetle. Mortality-related beetle presence continued to be significant during this reporting period, and pesticide continues to be applied as a

control measure wherever beetles are found. No rodent or other vertebrate damage has been seen in any of the plots.

4.2.4 Plant Cover

Percentage plant cover estimates were taken during both the botanical and horticultural monitoring events using different methods (see Sections 3.2.1 and 3.2.2). During both types of monitoring, non-native and native plant cover varied between the plots, with non-native cover being higher in plot 4 during both types of monitoring events. In those cases, weeding took place soon after the reporting to remedy the issue.

During horticultural monitoring, the estimated percentage cover of native plants ranged from 15% in Plot 5 in July and October 2019, to 67% in Plot 5 at the end of the reporting year in May 2020 (Figure 11). Native cover fluctuated slightly between and within all plots, decreasing during dry periods (July 2019) to between 15% and 50% within the plots, and ranging between 16.5% and 67% in May 2020, with increased rainfall. Plots were regularly weeded, although some of the reporting periods took place before the maintenance crew was out at the site and after a heavy rainfall period, which resulted in non-native cover being higher than the native cover (Figure 12). During these instances, the maintenance crew was notified immediately, and weeding took place to address the overgrowth.

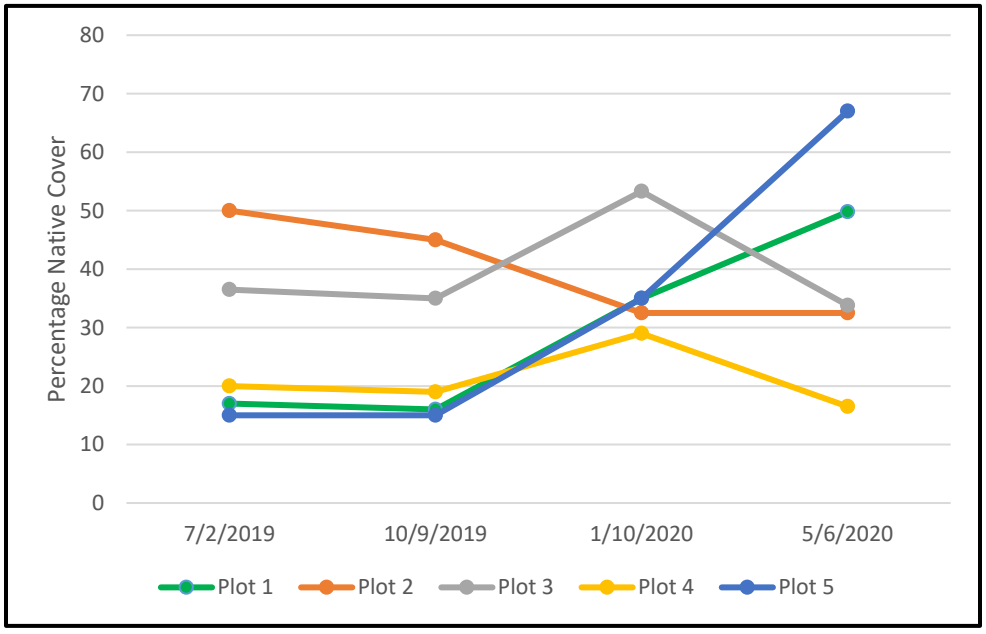

Figure 11. Estimated native plant cover in Plots 1–5 during the horticultural monitoring events (July 2, 2019, to May 6, 2020).

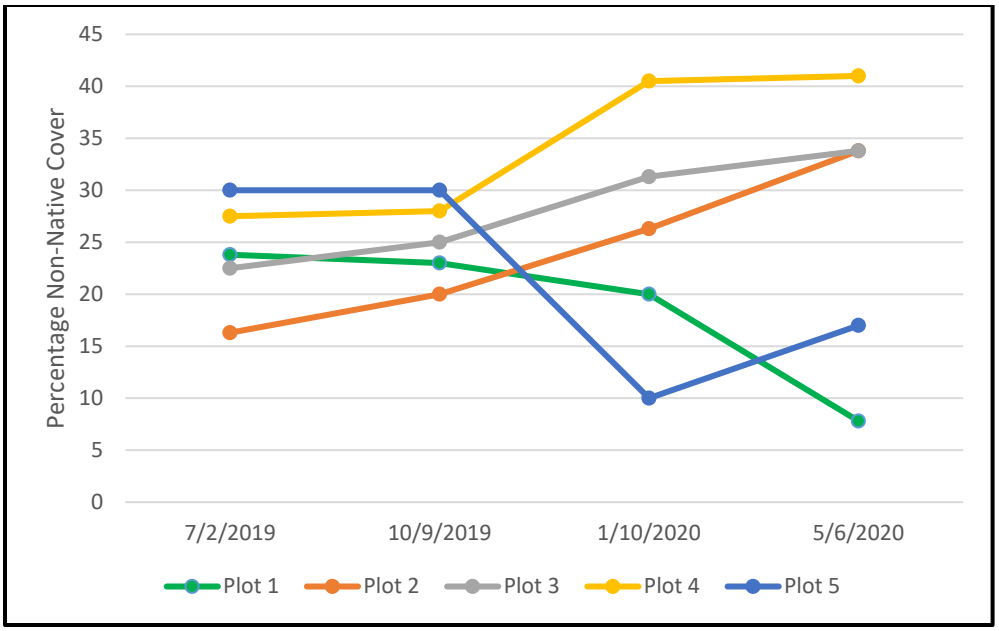

Figure 12. Estimated non-native plant cover in Plots 1–5 during the horticultural monitoring events (July 2, 2019, to May 6, 2020).

One botanical monitoring took place (January 16, 2020) in the reporting year and did not provide sufficient data to warrant statistical analysis. Cover percentages for native and non-native species in each quadrat can be found in Table 3.

Similar to the percentages seen during the horticultural monitoring surveys, native cover was higher in plots 2 (26%) and 3 (38%) compared to non-native cover, which was higher in plots 1 (15.5%) and 4 (20.6%) . With maintenance activities now taking place quarterly, weeding did not take place as often as it did in the previous reporting periods, which may have lead to higher amounts of non-native cover.

Table 3. Mean Cover of Native and Non-Native Species in Plots 1–4 during the Botanical Monitoring Survey on January 16, 2020

Plot	Mean Native Cover (%)	Mean Non-Native Cover (%)
1	7.60%	15.50%
2	26.00%	11.40%
3	38.00%	29.30%
4	16.5%	20.60%

Five native plants were documented during the botanical monitoring: round-leaved chaff flower, ‘ilima (*Sida fallax*), naio (*Myoporum sandwicense*), ‘uhaloa (*Waltheria indica*), and *Jacquemontia sandwicensis*. Plots 2 and 3 have had the highest cover percentage of round-leaved chaff flower. ‘Ilima was present in Plots 2 and 3, ‘uhaloa in Plots 1 and 2, naio in plots 1 and 4 (highest native presence), while *Jacquemontia sandwicensis* was seen only in Plot 4. The non-native plants buffel grass *(Cenchrus ciliaris), Euphorbia hirta,* and Guinea grass *(Panicum maximum)* had the highest overall cover for non-native species. Total average native cover varied in the quadrats between 7.60% and 38%, while non-native cover varied between 11.4% and 29.3%.

Photographs of each quadrat assessed for cover during the botanical monitoring in January 2020 are provided in Appendix C.

4.2.5 Natural Regeneration and Reproduction

The outplants are showing a seasonality with their reproduction, which is consistent with what is known about round-leaved chaff flower phenology (USFWS 1994). Nearly all original individuals were reproductive (100%) during the July 2019, January 2020, and May 2020 horticultural events, with the rare exception of Plot 5 (0%) showing no regeneration during those monitoring events. October 2019 saw the lowest percentage of reproductive individuals, with Plots 2, 3 and 4 showing 86%, 36% and 33%, respectively, while plot 1 had 100% reproductive plants (Figure 13).

Progeny showed the greatest fluctuation in reproductive status, with highest reproduction recorded in July 2019 and May 2020, and the lowest level in October 2019 (Figure 14). Plot 3 has the highest percentage of reproductive individuals, with July 2019 being at 100% and May 2020 at 94%. No progeny have been recorded in Plot 4 and the two progeny noted in Plot 5 were reproductive only in May 2020. New seedlings were monitored, individuals reaching a height of 6 inches were tagged and numbered, and their growth, pest presence, and vigor were tracked. In all, there were an additional 35 new progeny tagged and tracked during this reporting year, and 15 progeny mortalities. At the end of the reporting period in May 2020, there were a total of 97 progeny alive and 22 mortalities.

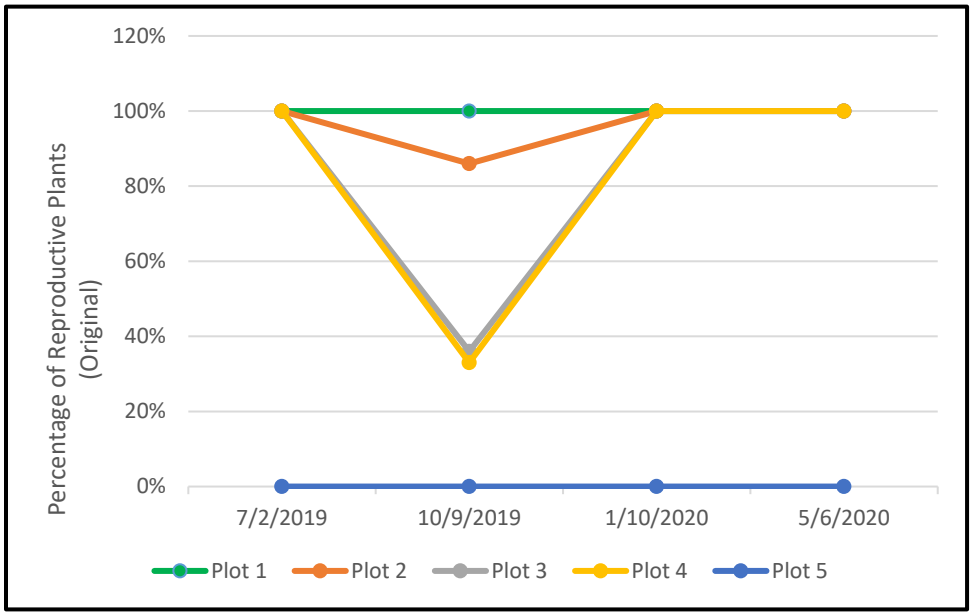

Figure 13. Percentage of reproductive living plants in Plots 1–5 during the horticultural monitoring events (July 2, 2019, to May 6, 2020).

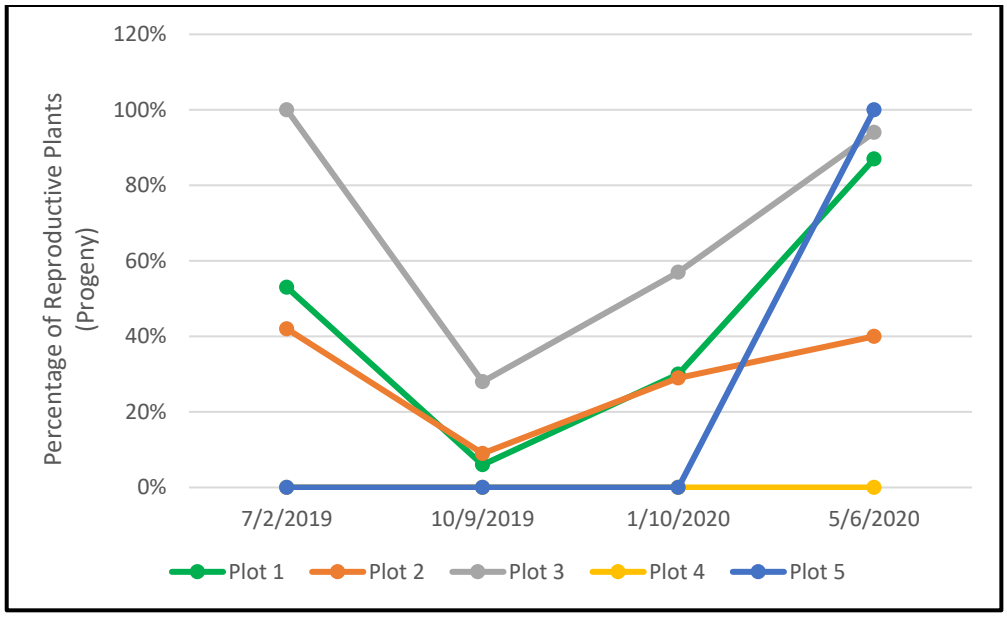

Figure 14. Percentage of reproductive living progeny in Plots 1–5 during the horticultural monitoring events (July 2, 2019, to May 6, 2020).

4.2.6 Plant Species

In all, 19 plant species were observed in the plots during the botanical monitoring event (Table 4).

Table 4. Plant Species Found within the Plots during the Botanical Monitoring Events

Scientific Name	Hawaiian, Common Name(s)	Status*
Achyranthes splendens var. *rotundata*	round-leaved chaff flower	E
Amaranthus viridis	slender amaranth	X
Asystasia gangetica	Chinese violet	X
Atriplex semibaccata	Australian saltbush	X
Boerhavia coccinea	scarlet spiderling	X
Cenchrus ciliaris	buffelgrass	X
Chloris barbata	swollen fingergrass, mauʻu lei	X
Desmanthus pernambucanus	slender mimosa	X
Euphorbia hirta	hairy spurge	X
Euphorbia hypericifolia	graceful spurge	X
Jacquemontia sandwicensis	pāʻū-o-Hiʻiaka	E
Leucaena leucocephala	koa haole	X
Melinis repens	Natal grass	
Myoporum sandwicense	naio	I
Panicum maximum	Guinea grass	
Setaria verticillata	bristly foxtail	X
Sida fallax	ʻilima	I

Scientific Name	Hawaiian, Common Name(s)	Status*
Verbesina encelioides	golden crownbeard	X
Waltheria indica	ʻuhaloa	I
Total		**28**

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

Table 5. Wildlife Observed within the Plots or in the Immediate Vicinity during the Botanical Monitoring Events

Scientific Name	Common Name	Status*
Invertebrates		
Agraulis vanillae	gulf fritillary	X
Amphicerus sp.	bostrichid beetle	X
Anoplolepis gracilipes	yellow crazy ant	X
Apis mellifera	honeybee	X
Crocothemis servilia	Chinese dragonfly	X
Musca domestica	house fly	X
Ochetellus glaber	black ant	X
Pantala flavescens	wandering glider	X
Paratrechina longicornis	longhorn crazy ant	X
Phenacoccus solenopsis	cotton mealybug	X
Pieris rapae	cabbage butterfly	X
Schistocerca nitens	vagrant grasshopper	X
Avifauna		
Columba livia	rock dove	X
Cardinalis cardinalis	northern cardinal	X
Geopelia striata	zebra dove	
Haemorhous mexicanus	house finch	X
Mimus polyglottos	northern mockingbird	X
Paroaria coronata	red-crested cardinal	X
Pycnonotus cafer	red-vented bulbul	X
Pycnonotus jocosus	red-whiskered bulbul	X
Zosterops japonicus	Japanese white-eye	
Mammalian Fauna		
Herpestes javanicus	small Indian mongoose	X
Felis catus	domestic cat	X
Total		**16**

* 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 the soil chemical analysis have been relatively constant throughout the monitoring period and across plots (Figures 15–20).

After receiving stable soil data during the monitoring period covered in the first annual report, consulting with soils specialists at the University of Hawai‘i, and further discussing the data with DOFAW (personal communication, Afsheen Siddiqi, DOFAW, September 22, 2015), it was decided that only semiannual chemical analysis of soil will be conducted unless future results show significant changes from existing conditions.

One soil collection took place on January 16, 2020. A soil analysis was performed for pH, nitrogen, phosphorus, potassium, calcium, and magnesium.

The results of these soil analyses were consistent with previous reporting years. The pH levels in the plots were between 6.9 and 8.1, which is naturally more alkaline compared to other Hawaiian soils because of the dominant presence of coral substrate. Nitrogen and phosphorous levels remain relatively high (see Table X) and are consistent with previous reporting of between 0.41 and 1.61 parts per million (ppm) microgram/gram (ug/g) for nitrogen and between 111 and 133 ppm ug/g for phosphorus. Potassium levels were between 42 and 272 ppm ug/g. Calcium levels continued to be high throughout the site due to the presence of limestone. Magnesium levels were between 807 and 2085 ppm ug/g.

Table 6. Soil conditions within the plots during the Botanical monitoring on January 16. 2020

Plot	pH	Calcium (ppm, ug/g)	Magnesium (ppm, ug/g)	Phosphorus (ppm, ug/g)	Potassium (ppm, ug/g)	Total Nitrogen (%)
1	6.9	12636	1062	133	272	1.61
2	7.7	7655	814	124	42	0.41
3	7.3	8636	807	111	249	0.50
4	8.1	9965	2085	146	142	1.21
5	7.0	11355	1141	125	268	1.18

Notes: ppm = parts per million, ug/g = micrograms per gram

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 seven criteria presented below were developed based on consultation with the Pearl Harbor NWR and in accordance with the goals and objectives presented in the Pearl Harbor NWR comprehensive conservation plan for the Kalaeloa Unit (USFWS 2010). The original measures for mitigation success were to be determined by the following criteria:

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

Success criteria were met again this reporting year (July 1, 2019 – June 30, 2020) with the exception of Criterion 1, which requires that 75% of the original outplants remain at the end of the reporting year. During the last horticultural monitoring on May 6, 2020, 13 of the originally outplanted individuals (8%) were alive, thus, this criterion is not being met. Reports on the life expectancy of round-leaved chaff flower vary, ranging from 2 to 10 years (A Native Hawaiian Garden 2017); however, restoration managers generally agree that this species has a relatively short lifespan, relying on its high reproductive output to perpetuate its populations in the harsh, dry environments in which it is found (personal communication, Matt Schirman, Hui Kū Maoli Ola, July 25, 2017). After survivorship of the original outplants dipped below the level specified in Criterion 1, SWCA and DOFAW agreed to discuss adjusting the survivorship criterion in the HCP to reflect the realities of this species' life history with the Endangered Species Recovery Committee (ESRC) (personal communication, Glenn Metzler, DOFAW, August 17, 2017). In response to this discussion, in a meeting with ESRC and DOFAW on April 26, 2018, SWCA suggested eliminating Criterion 1 because it is not realistic to expect a high percentage of the original outplants to survive 5 years, seeing as the lifespan of this species often falls below this time period. Criterion 4 (no fewer than 120 mature plants, which will include plants recruited from the planted lineages, will be established by Year 5) adequately captures the ultimate goal of the HCP, which is to ensure that round-leaved chaff flower becomes established at the mitigation site and has a stable and viable self-producing population. However, because the HCP specified the mitigation ratio as 30:1, and the actual take was 2 plants, this success criterion should be met at 60 plants. ESRC has agreed with the proposed changes to the success criteria and is working with DOFAW on processing an administrative approval to the HCP. The status of Criterion 4 from reporting data during the last reporting period on May 6, 2020 show that this criterion has not been met, with the most recent numbers, showing a total of 105 alive individuals (13 original plants and 97 progeny). However, based on a 30:1 mitigation ratio with a take of 2 plants, this success criteria should be considered met.

6 LITERATURE CITED

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Appendix A

Summary of Maintenance Activities

Table A-1. Summary of Maintenance Activities

Maintenance and Monitoring Period	Date of Visit	Comments
Year 5 (once every 3 months of monitoring)		
July	7/26/2019	The crew went out last Friday and completed the weeding. They also applied a gallon and a half of Safari on infected plants across the project sites.
October	10/31/2019	Weeding occurred in the plots and buffers.
November	11/01/2019	Weeding occurred in the plots and buffers.
January	01/09/2020	General weed control occurred.
February	02/26/2020	General weed control occurred.
April	04/17/2020	The day we outplanted 4-17-20, we had a crew out there servicing the plants and weeding. Other than that, no other service was performed.

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Appendix B

Select Permanent Photo Points

Figure B-1. Plot 1 conditions during horticultural monitoring no. 40, 07/02/2019.

Figure B-2. Plot 1 conditions during horticultural monitoring no. 41, 10/09/2019.

Figure B-3. Plot 1 conditions during horticultural monitoring no. 42, 01/10/2020.

Figure B-4. Plot 1 conditions during horticultural monitoring no. 43, 05/06/2020.

Figure B-5. Plot 2 conditions during horticultural monitoring no. 40, 07/02/2019.

Figure B-6. Plot 2 conditions during horticultural monitoring no. 41, 10/09/2019.

Figure B-7. Plot 2 conditions during horticultural monitoring no. 42, 01/10/2020.

Figure B-8. Plot 2 conditions during horticultural monitoring no. 43, 05/06/2020.

Figure B-9. Plot 3 conditions during horticultural monitoring no. 40, 07/02/2019.

Figure B-10. Plot 3 conditions during horticultural monitoring no. 41, 10/09/2019.

Figure B-11. Plot 3 conditions during horticultural monitoring no. 42, 01/10/2020.

Figure B-12. Plot 3 conditions during horticultural monitoring no. 43, 05/06/2020.

Figure B-13. Plot 4 conditions during horticultural monitoring no. 40, 07/02/2019.

Figure B-14. Plot 4 conditions during horticultural monitoring no. 41, 10/09/2019.

Figure B-15. Plot 4 conditions during horticultural monitoring no. 42, 01/10/2020.

Figure B-16. Plot 4 conditions during horticultural monitoring no. 43, 05/06/2020.

Figure B-17. Plot 5 conditions during horticultural monitoring no. 40, 07/02/2019.

Figure B-18. Plot 5 conditions during horticultural monitoring no. 41, 10/09/2019.

Figure B-19. Plot 5 conditions during horticultural monitoring no. 42, 01/10/2020.

Figure B-20. Plot 5 conditions during horticultural monitoring no. 43, 05/06/2020.

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Appendix C

Photographs of Quadrat Assessment from Botanical Monitoring on January 16, 2020

Figure C1. Plot 1, Quadrat 1 (10, 10) from botanical monitoring on 01/16/2020.

Figure C2. Plot 1, Quadrat 2 (1, 10) from botanical monitoring on 01/16/2020.

Figure C3. Plot 1, Quadrat 3 (5, 6) from botanical monitoring on 01/16/2020.

Figure C4. Plot 1, Quadrat 4 (3, 6) from botanical monitoring on 01/16/2020.

Figure C5. Plot 1, Quadrat 5 (11, 9) from botanical monitoring on 01/16/2020.

Figure C6. Plot 1, Quadrat 6 (9, 0) from botanical monitoring on 01/16/2020.

Figure C7. Plot 1, Quadrat 7 (1, 2) from botanical monitoring on 01/16/2020.

Figure C8. Plot 1, Quadrat 8 (3, 9) from botanical monitoring on 01/16/2020.

Figure C9. Plot 1, Quadrat 9 (3, 11) from botanical monitoring on 01/16/2020.

Figure C10. Plot 1, Quadrat 10 (10, 1) from botanical monitoring on 01/16/2020.

Figure C11. Plot 2, Quadrat 1 (4, 11) from botanical monitoring on 01/16/2020.

Figure C12. Plot 2, Quadrat 2 (8, 3) from botanical monitoring on 01/16/2020.

Figure C13. Plot 2, Quadrat 3 (8, 11) from botanical monitoring on 01/16/2020.

Figure C14. Plot 2, Quadrat 4 (0, 0) from botanical monitoring on 01/16/2020.

Figure C15. Plot 2, Quadrat 5 (2, 5) from botanical monitoring on 01/16/2020.

Figure C16. Plot 2, Quadrat 6 (4, 1) from botanical monitoring on 01/16/2020.

Figure C17. Plot 2, Quadrat 7 (9, 0) from botanical monitoring on 01/16/2020.

Figure C18. Plot 2, Quadrat 8 (6, 8) from botanical monitoring on 01/16/2020.

Figure C19. Plot 2, Quadrat 9 (1, 11) from botanical monitoring on 01/16/2020.

Figure C20. Plot 2, Quadrat 10 (6, 4) from botanical monitoring on 01/16/2020.

Figure C21. Plot 3, Quadrat 1 (4, 7) from botanical monitoring on 01/16/2020.

Figure C22. Plot 3, Quadrat 2 (4, 0) from botanical monitoring on 01/16/2020.

Figure C23. Plot 3, Quadrat 3 (8, 6) from botanical monitoring on 01/16/2020.

Figure C24. Plot 3, Quadrat 4 (4, 8) from botanical monitoring on 01/16/2020.

Figure C25. Plot 3, Quadrat 5 (5, 7) from botanical monitoring on 01/16/2020.

Figure C26. Plot 3, Quadrat 6 (2, 0) from botanical monitoring on 01/16/2020.

Figure C27. Plot 3, Quadrat 7 (11, 1) from botanical monitoring on 01/16/2020.

Figure C28. Plot 3, Quadrat 8 (6, 7) from botanical monitoring on 01/16/2020.

Figure C29. Plot 3, Quadrat 9 (8, 5) from botanical monitoring on 01/16/2020.

Figure C30. Plot 3, Quadrat 10 (9, 6) from botanical monitoring on 01/16/2020.

Figure C31. Plot 4, Quadrat 1 (4, 4) from botanical monitoring on 01/16/2020.

Figure C32. Plot 4, Quadrat 2 (4, 1) from botanical monitoring on 01/16/2020.

Figure C33. Plot 4, Quadrat 3 (9, 0) from botanical monitoring on 01/16/2020.

Figure C34. Plot 4, Quadrat 4 (7, 6) from botanical monitoring on 01/16/2020.

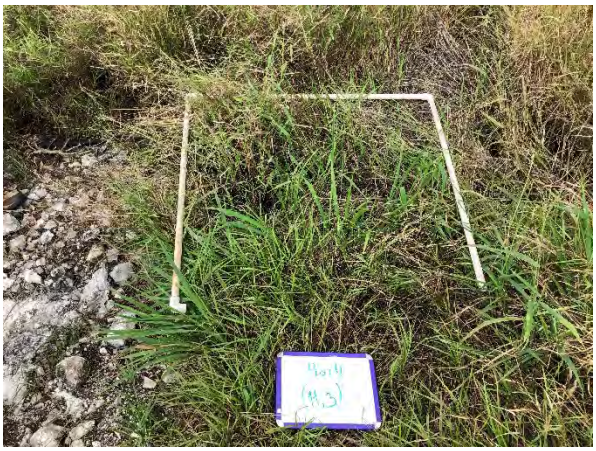

Figure C35. Plot 4, Quadrat 5 (11, 3) from botanical monitoring on 01/16/2020.

Figure C36. Plot 4, Quadrat 6 (9, 6) from botanical monitoring on 01/16/2020.

Figure C37. Plot 4, Quadrat 7 (1, 6) from botanical monitoring on 01/16/2020.

Figure C38. Plot 4, Quadrat 8 (5, 5) from botanical monitoring on 01/16/2020.

Figure C39. Plot 4, Quadrat 9 (7, 0) from botanical monitoring on 01/16/2020.

Figure C40. Plot 4, Quadrat 10 (3, 5) from botanical monitoring on 01/16/2020.

Figure C41. Plot 5, Quadrat (4, 4) from botanical monitoring on 01/16/2020.

Figure C42. Plot 5, Quadrat (4, 0) from botanical monitoring on 01/16/2020.

Figure C43. Plot 5, Quadrat (0, 4) from botanical monitoring on 01/16/2020.