Schiedea obovata

- **Scientific name:** *Schiedea obovata* Sherff
- **Hawaiian name:** None
- **Family:** Caryophyllaceae
- **Federal status:** Listed Endangered October 29, 1991
- **Requirements for MIP Stability**
  - 3 Population Units (PU)
  - 100 reproducing individuals in each PU
  - Stable population structure
  - Threats controlled
  - Complete genetic representation of all PUs in storage
- **Description and biology*:**

– **Habit-** Suberect or ascending, branched shrubs 3-10 dm tall, glabrous throughout except for the leaf margins.

– **Leaves**- Leaves opposite; blades 4-11 cm long, (1.5-) 2.5-5 (-6.8) cm wide, thick and somewhat fleshy, light green becoming yellowish white toward the base and at the apex (youngest yellowish white, sometimes purple tinged), elliptic to broadly elliptic, sometimes obovate or oblanceolate, with 3 principal veins, sometimes also with an inconspicuous looping pair of veins near the margins, margins serrulate, the teeth with antrorsely hooked hairs ca. 0.1-0.2 mm long, apex mucronate; petioles 1-3 (-3.8) cm long, yellowish white.

*Description and biology modified from *Wagner et al. 2005*

Schiedea obovata

- **Description and biology continued*:**

– **Flowers**- Inflorescence pseudoaxillary, with 22-33 flowers, somewhat congested; bracts much smaller than uppermost leaves, usually curled and twisted, lowest pair to 1.4 cm long; peduncles (2-) 5-25 mm long, not elongating much in fruit, the internodes of the lateral inflorescence branches 2-10 mm long; pedicels thinner, 15-30 mm long, elongating mostly just prior to anthesis. Flowers apparently adapted for bird pollination, pendent. Sepals (4-) 5 (-6), often variable on the same plant, 7-8.4 mm long, 5.5-6 mm wide, enlarging to 9-12 mm long and 8-9 mm wide in fruit, white adaxially, the outer ones oblong-elliptic, pale green abaxially, inner ones elliptic to obovate, greenish white with a green midrib, the apex broadly obtuse and usually retuse, the outer ones sometimes with a subapical minute mucro, becoming dark purple and fleshy as fruit matures. Stamens (8-) 10 (-12); filaments 4.4-5 mm long, subequal; anthers 1.9-2.65 mm long, pale reddish purple at anthesis, changing to a darker reddish purple, the pollen gray. Nectary ring bright green, the flap-like extensions weakly connate at the base, thin, translucent, 2.2-2.5 mm long, irregularly 2-toothed to subentire. Styles (4-) 6-7 (-8), often variable in number on the same plant.

– **Fruit**- Capsules 9-12 mm long, ovoid to subglobose.

– **Seeds**- Seeds 1.2-1.5 mm long.

*Modified from *Wagner et al. 2005*

Schiedea obovata

- **Description and biology continued*:**

– **Distribution-** O`ahu, formerly nearly throughout the Waianae Mountains, now restricted to the north end of the Waianae Mountains; rare and scattered on ridges and slopes in diverse mesic forest; 550-800 m.

– **Pollination and dispersal-** Passerine birds have been suspected pollinators due to nectar concentration and amount (Weller et al. 1998), but no birds have been observed visiting this species (Weisenberger 2012). The fleshy dark purple sepals surrounding the mature capsules of the this species (along with *S. trinervis*) are unique in the Caryophyllaceae and may have attracted birds as dispersal agents.

- **Taxonomic background*:** There are 34 species in the endemic genus *Schiedea*. All species have been shown to have arrived from one single colonization. The name *Schiedea obovata* was changed from *Alsinidendron obovatum* after molecular and morphological data from Wagner *et al.* (2005), concluded that *Alsinidendron* formed a monophyletic group within *Schiedea*. *Alsinidendron* has since been subsumed into the Hawaiian endemic genus *Schiedea*. *Schiedea obovata* is differentiated from the closely related *S. trinervis* by its more congested inflorescence, flowers that open fully during anthesis and have greater nectar production, and thicker leaves, the young ones whitish green. It grows in mesic forests at lower elevations than *S. trinervis.* The congestion in the inflorescence of *S. obovata* appears to be primarily due to the reduction of the internodes of the lateral inflorescence branches and to the delayed elongation of the pedicels until just prior to anthesis.

*Modified from *Wagner et al. 2005*

Historic Collections of *Schiedea obovata* Information compiled from Wagner et al. 2005, and Bishop Museum herbarium

Area	Year	Collector	Pop. Reference Code
Kaluaa	1978	Takeuchi	
Keawapilau	1980s	Welton	PIL-A
Makaleha	1978	Gagne & Gagne	LEH-B
Mokuleia	1908-1920	Forbes 1833	
Pahole	1932	Degener et al 5945	PAH-A
Pahole	1934	Onouye	PAH-A
Pahole	1934	St John 14803	
Pahole	1973	Nagata & Obata 1167	PAH-C
Pahole	1975	Herbst & Obata 5360	
Pahole	1987	Perlman & Obata 5800	PAH-A
Pahole	1987	Perlman 6472	PAH-A
Palehua	1911	Forbes 1680	
Palehua	1927	Degener Horner 5930	
Palehua	1929	Russ	
Palehua	1929	St John 9888	
Palehua	1931	Degener Park 5928	
Palehua	1933	Judd	
Palehua	1933	Russ	
Palehua	1934	Wilder	
Palehua	1937	Fosberg 13807	
Palehua	1938	Skottsberg 335	
Palehua	1946	Kerr 37-1	
Palehua	1950	Hatheway et al 87	

Population Units

Manage For Stability Population Units	PU Type	Army Action Area	Population Reference Codes	Management Units for Threat Control
Kahanahaiki to Pahole	Reintroduction	MIP	MMR-A,G; PAH-A,C,D,E	Kahanahaiki Pahole
Keawapilau to West Makaleha	in situ and augmentation	MIP	PIL-A,B,C; LEH-A,B,C	Upper Kapuna West Makaleha
Makaha	Introduction	None	MAK-A,B	Makaha Sub Unit II

There are no remaining *in situ* sites in the Kahanahaiki to Pahole PU. All have been extirpated since the late 1990's (MMR-A, PAH-A, PAH-C). Since then, several hundred outplants have gone into this PU using seeds from those last plants. There are three *in situ* sites remaining in the Keawapilau to West Makaleha PU (PIL-B, LEH-A, LEH-B). These plants have been known and monitored for many years. No other locations have been found since 2006. Reintroductions of the PIL stock have been completed at the PIL-C site. The Makaha PU will be established using outplants grown from the other PUs. There is no historic record of *S. obovata* in Makaha, but was determined to be appropriate habitat in the MIP.

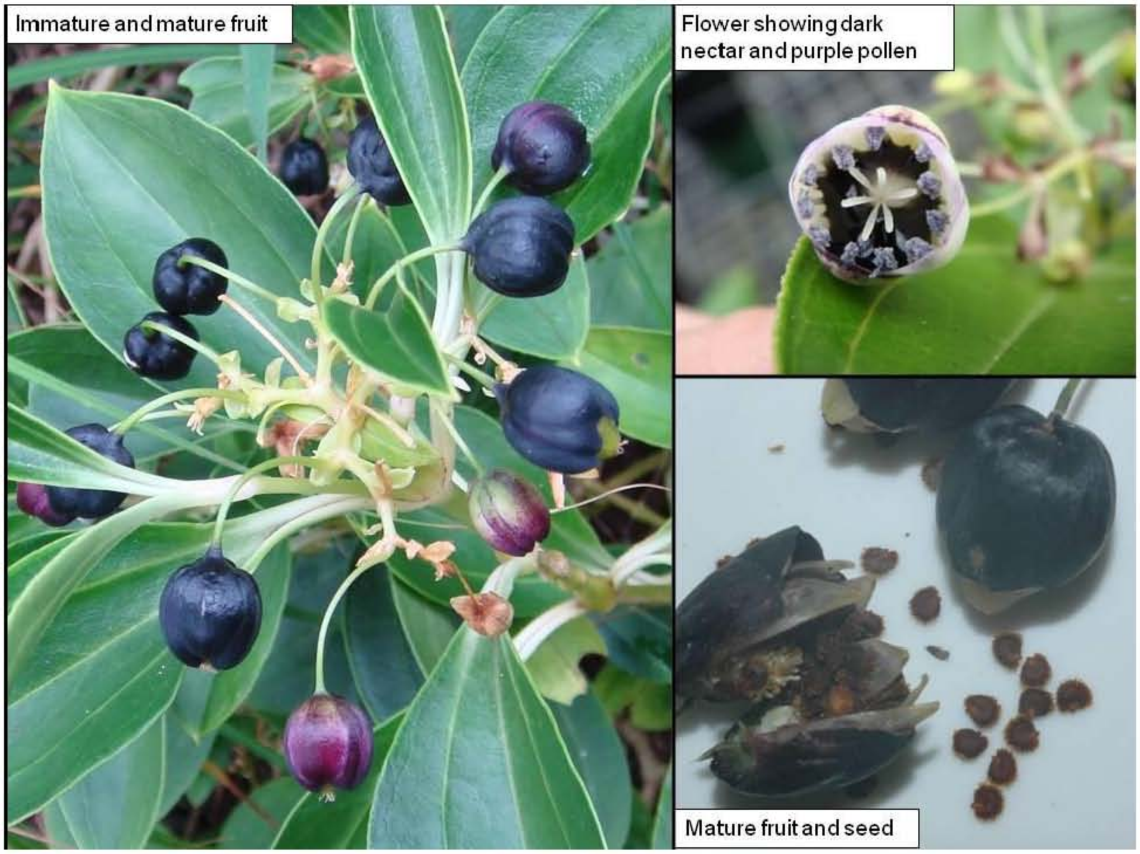
Reproductive Biology Table

	Observed Phenology			Reproductive Biology		Seeds	
Population Unit	Flower	Immature Fruit	Mature Fruit	Breeding System	Suspected Pollinator	Average # Per Fruit (viable)	Dormancy
Kahanahaiki to Pahole	Jan-June	Jan-July	Jan-Sep	Hermaphroditic	Bird or None	~100¥	None*
Keawapilau to West Makaleha	Same	Same	Same	Same	Same	LEH-B: 48± 3	Same

- Peak collection time for mature fruit is spring (April-May)
- Breeding System: Hermaphroditic (facultative autogamy) (Weller et al. 1998) with high selfing rates and very little pollinator visitation (Weisenberger unpubl. data). Passerine birds have been suspected pollinators due to nectar concentration and amount (Weller et al. 1998), but no birds have been observed visiting this species (Weisenberger 2012). As the fruit matures, the calyx lobes persist and become purple and fleshy, while the interior capsule of the fruit is dry. This 'false berry' is very likely to attract fruit-eating birds that may disperse the species' seeds (Carlquist 1970).

¥ Some collections of mature fruit have a lower number of seeds per fruit; likely because fruit are picked after some seeds have dispersed. Fruit from the *in situ* NW Makaleha population (LEH-B) typically produce less seeds per fruit than all other population sites.

* Some collections have delayed initial germination for approximately six months. A physiological mechanism to prevent germination until cooler, wetter winter months may be present. This delay has been documented occasionally across all populations and collections. There is substantial variation in length of time until initial germination between individual plants within the same collection and between different collections of the same plant. Delayed germination may be a mechanism for preventing germination during the hottest months immediately following dispersal.



Immature and mature fruit

Flower showing dark nectar and purple pollen

Mature fruit and seed

Immature & Mature Fruit

Early slug control attempts

Pahole Kahanahaiki

Examples of variation in leaf morphology at each PU


Habitat of wild site at Keawapilau
Wild S. obovata


Habitat at the Keawapilau reintroduction site

Reintroduction Recruits at Pahole

Reintroduction Recruits at Kahanahaiki

Habitat Characteristics

PU	PRC	Elev. (ft.)	Slope	Canopy Cover	Topography	Aspect	Mean Annual Max.Temp. (F)*	Mean Annual Rainfall (mm)*	Mean Annual Rainfall (mm)**
Kahanahaiki to Pahole	MMR-A *in situ*	1880	Vertical	Intermediate	Upper Slope	North	77.00	1561	1334.7
Kahanahaiki to Pahole	MMR-G reintro	2000	Moderate	Intermediate	Upper Slope	North	77.00	1531	1347
Kahanahaiki to Pahole	PAH-A *in situ*	2297	Steep	Closed	Upper Slope	North	75.20	1766	1505.5
Kahanahaiki to Pahole	PAH-C *in situ*	2100	Steep	Intermediate	Upper Slope	North	75.20	1667	1425.9
Kahanahaiki to Pahole	PAH-D reintro	2250	Moderate	Intermediate	Upper Slope	North	75.20	1667	1406.8
Keawapilau to West Makaleha	PIL-A *in situ*	2149	Moderate	Intermediate	Upper Slope	North	75.20	1781	1565.5
Keawapilau to West Makaleha	PIL-B *in situ*	2240	Moderate	Intermediate	Upper Slope	NE	75.20	1880	1612.2
Keawapilau to West Makaleha	PIL-C reintro	2500	Moderate & Steep	Intermediate & Open	Upper Slope & Crest	North	75.20	1880	1612.2
Keawapilau to West Makaleha	LEH-A *in situ*	2598	Steep & Vertical	Intermediate	Upper Slope	North	73.40	2022	1764.8
Keawapilau to West Makaleha	LEH-B *in situ*	2500	Moderate & Steep	Intermediate	Upper Slope	East	75.20	1962	1651.3
Keawapilau to West Makaleha	LEH-C reintro	2760	Steep	Intermediate	Upper Slope & Crest	NE	73.40	2023	1764.8
Makaha	MAK-A reintro	2600	Moderate & Steep	Intermediate	Upper Slope	North	75.20	1921	1857.3
ALL	ALL	1880-2760	Moderate -Vertical	Open-Closed	Upper Slope – Crest	N-E	73.40-77.00	1531-2023	1334-1857

Information was compiled from OANRP observation forms and GIS data unless otherwise noted. *(PRISM 2004) **(Giambelluca et al 2011)

Associated Species Table

PU	PRC	Canopy	Understory
Kahanahaiki to Pahole	MMR-A *in situ*	MetPol, AntPla, PsiCat, SchTer, PsyOdo	BleApp, DooKun, GahGah, AlyOli, CibCha
Kahanahaiki to Pahole	MMR-G reintro	AcaKoa, PsyOdo, MetPol, SchTer, PsiCat, SanFre, AntPla, DioHil	AlyOli, MicStr, MepExa, DiaSan, CarWah, VioCha, OplHir, DooKun, HedTer, ConBon, MelMin, AspKau, PhlAur, AspNid, CocTri, RauSan, ChaMul, ReySan, DieFal, LanCam, PepTet, AspHor, BleApp
Kahanahaiki to Pahole	PAH-A *in situ*	AcaKoa, MetPol, AntPul, GreRob, PsiGua	PasCon, StaDic, BidTor, SchNut, CyaLon
Kahanahaiki to Pahole	PAH-D Reintro	Not Yet Recorded	Not Yet Recorded
Kahanahaiki to Pahole	PAH-E reintro	SchTer, MetPol, LepTam, PsiCat, DodVis, PsyOdo	DiaSan, CliHir, MelMin, LanCam, MicStr, AlyOli, CocTri
Keawapilau to West Makaleha	PIL-A *in situ*	MetPol, MelPed, GreRob, AntPla, WikOah, PsyMar, PsiCat	NepExa, AlyOli, PasCon, OplHir, DiaSan, BidTor, DryGla, BleApp, HedTer, AspHor, PleAur, CliHir, SchNut, CyaLon
Keawapilau to West Makaleha	PIL-B *in situ*	MetPol, AcaKoa, AntPla, SchTer, GreRob, PsiCat	CarWah, MicStr, RubRos, CliHir, BleApp, DooKun
Keawapilau to West Makaleha	PIL-C reintro	MetPol, AcaKoa, PsiCat, SchTer, PsyOdo, NesSan, SyzCum, GreRob	DodVis, BleApp, DooKun, MelMin, LepTam, DicLin, StaDic, MicStr, RubRos, CarWah, BidTor, AlyOli, CopFol, NepCor, NepExaHaw, OxaCor, PsiCat, ElaPal, PsiNud, CreCre, PanNep, CliHir, CocTri, HedTer, WikOah, LanCam, ConBon
Keawapilau to West Makaleha	LEH-A *in situ*	AntPla, PsiCat, MetPol, GreRob	DipPin, AlyOli, CliHir, OdoChi, RubRos, DooKun
Keawapilau to West Makaleha	LEH-B *in situ*	MetPol, PsiCat, AcaKoa, SchTer	MelMin, BidTor, AlyOli, AgeAde, DodVis, PanNep, CarWah
Keawapilau to West Makaleha	LEH-C reintro	PsiCat, MetPol, CopFol, MelClu, ScaGau, AntPla, DodVis	RubArg, BleApp, MelMin, StaDic, RubRos, CliHir, ChrPar, MetPol, PriKaa, PitGla, DicLin, PsiCat, NepMul, MelClu, AntPla, DipSan, PepMem, WikOah, FreArb

Native species and introduced species are listed in order of abundance as observed by OANRP

Map removed, available upon request

Population Structure at outplanting sites

OANRP began to outplant *S. obovata* into the Kahanahaiki to Pahole PU in 1999 and the Keawapilau to West Makaleha PU in 2007. The outplantings consisted of immature plants grown from seeds. The seeds were collected from the last remaining *in situ* plants (MMR-A, PAH-C, LEH-A, PIL-B) and from seed collected by Dr. Stephen Weller and Dr. Ann Sakai from plants in a greenhouse living collection at UC Irvine. The UC Irvine living collection was grown from *in situ* collections of seed from PAH-A and PIL-A. There are now three reintroduction sites that are monitored regularly and have had seedlings and immature recruits: Kahanahaiki (MMR-G), Pahole (PAH-D) and Keawapilau (PIL-C). Each year, each outplant was monitored and assigned to the appropriate age class. Also, all new, recruiting (F1) plants were identified, monitored and assigned to an age class. The recruitment and population structure observed at the main outplanting sites are described below:

• Planting at the Kahanahaiki site (MMR-G) began in 1999 and mature plants in the first and second filial generations (F1s and F2s) were observed within a few years (Fig. 2&3). There was an increase in recruitment observed at the Kahanahaiki reintroduction in February 2010. The increase of recruits may be attributed to increased annual rainfall, increasing number of outplants (Fig.4), or other undetermined factors. Since then, many seedlings transitioned to immatures and the total number of recruits declined (Fig. 2&3). Recruitment is currently increasing. From 2003 to 2011, there were 61 F1's that matured from a total of 210 plants outplanted (Fig.4).

• Planting at the Pahole (PAH-D) site began in 2003 and outplants yielded mature F1s and F2s within a few years (Fig. 5&6). There was an increase in recruitment following the initial reintroduction. However, despite the large number of seedlings, they did not transition into >100 matures for the PU (Fig. 7). A new cohort of many seedlings was observed in 2010.

• Planting at the Keawapilau (PIL-C) site began in 2007 and recruitment was documented three years later (Fig. 8). There are over 500 seedlings and immature plants currently at the outplanting site. No additional plants will be outplanted at this site in the next couple years, but the recruits will be closely monitored.

Population Structure and Planning for Outplanting

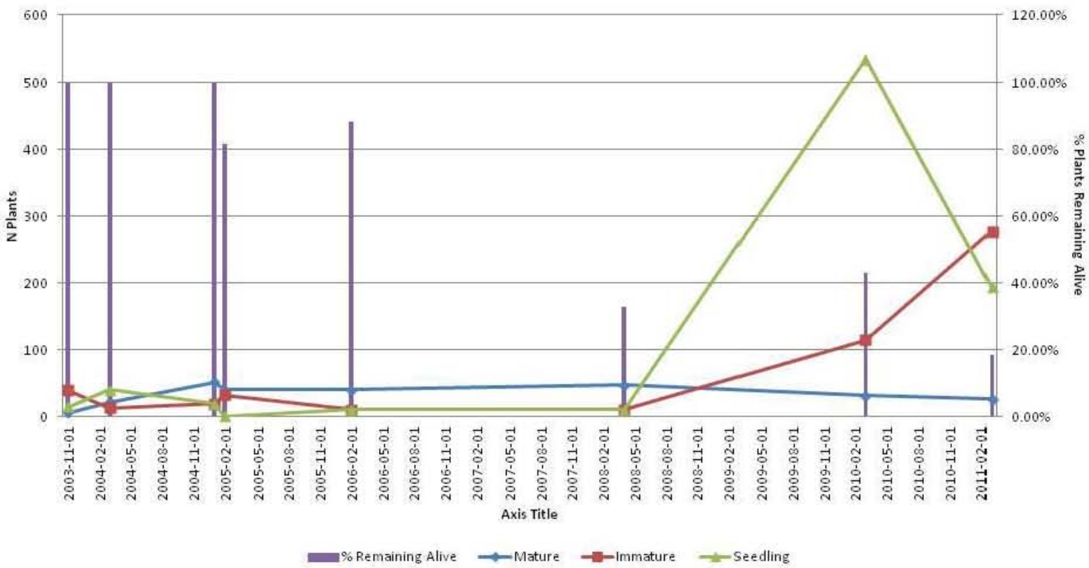
The population structure of the remaining *in situ* sites of *S. obovata* (and many other IP taxa) are unable to serve as examples of stable or increasing populations that support ≥100 mature plants. Therefore, measures taken from monitoring data of the population structure in established outplantings are used to guide future numbers to outplant for all taxa in this situation. Initially, before recruitment has begun in a reintroduction, the survival of mature outplants is used to guide how many plants above the stability goal (100 reproducing plants for *S. obovata*) should be planted to maintain the goal. This first measure is the 'survival ratio' of alive, mature outplants over the cumulative number of outplants. This will help plan for the survival of ≥100 mature outplants. At first, the stability goal is met by having ≥100 mature outplants. However, as the outplants begin to decline, the resulting recruitment must produce enough mature plants to maintain a stable population or additional outplanting may be needed.

As recruitment begins to occur at an outplanting site, and as recruits mature and reproduce, population structure data from annual census monitoring can be used to guide how many outplants are needed to reach, and maintain, the stability goal of ≥100 reproducing plants without additional outplanting. This second measure is the 'replacement ratio' of mature recruits over the cumulative number of outplants.

Once mature recruits are established and reproducing at an outplanting site, a third measure can be incorporated into outplanting planning. Age and/or size-class transition data (vital rates) and a population matrix projection model can be used to predict population growth and anticipate declines below stability goals that could be mitigated with additional outplanting and/or threat control.

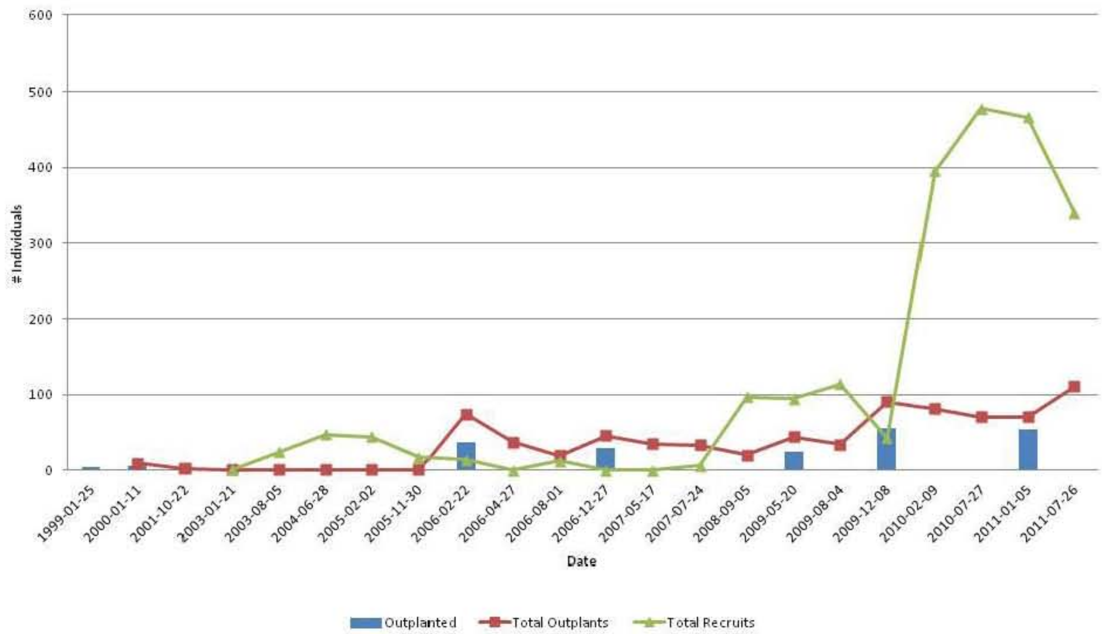
The monitoring data needed to obtain these three measures is described in the Monitoring Plan. Details on how these population structure measures are incorporated into future reintroduction planning for *S. obovata* are discussed further in the Reintroduction Plan Comments.

Population Structure for LEH-B, wild site (Fig. 1)



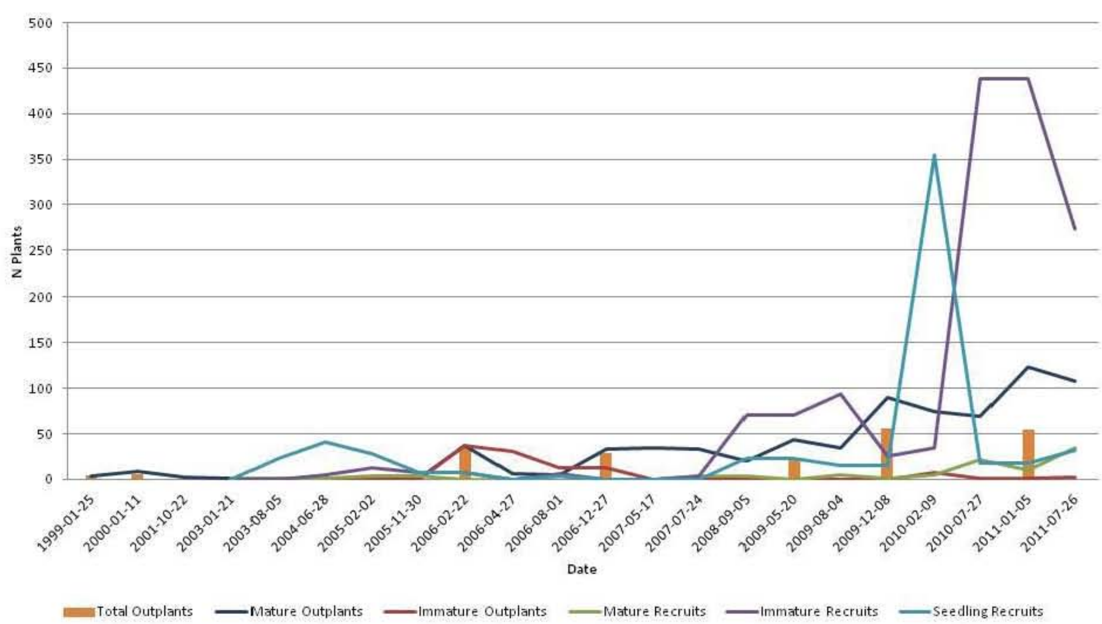
The blue line shows the total number of mature plants observed. The number of immature plants is depicted by the orange line and seedlings by the green line. The purple bars show the percentage of all the tagged, mature plants that are alive at each successive observation date. While the purple bars show that the tagged plants were dying, they were being replaced with new mature plants keeping the total number of matures were moderately constant.

Population Structure: MMR-G (Fig. 2)



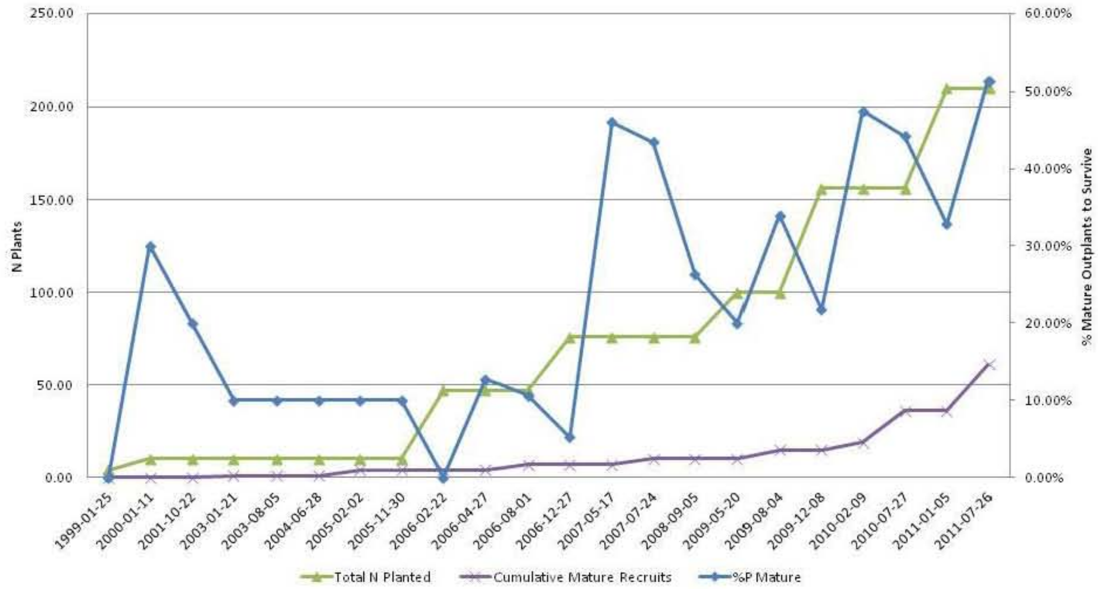
This graph depicts population structure at this reintroduction since 1999. Blue bars represent the total number of plants outplanted on a given day. The orange line shows the total number of live outplants over time; while the green line depicts recruitment with the total number of live recruits (seedling, immature and mature). Both F1 and F2s have been observed at this site.

Population Structure: MMR-G (Fig. 3)



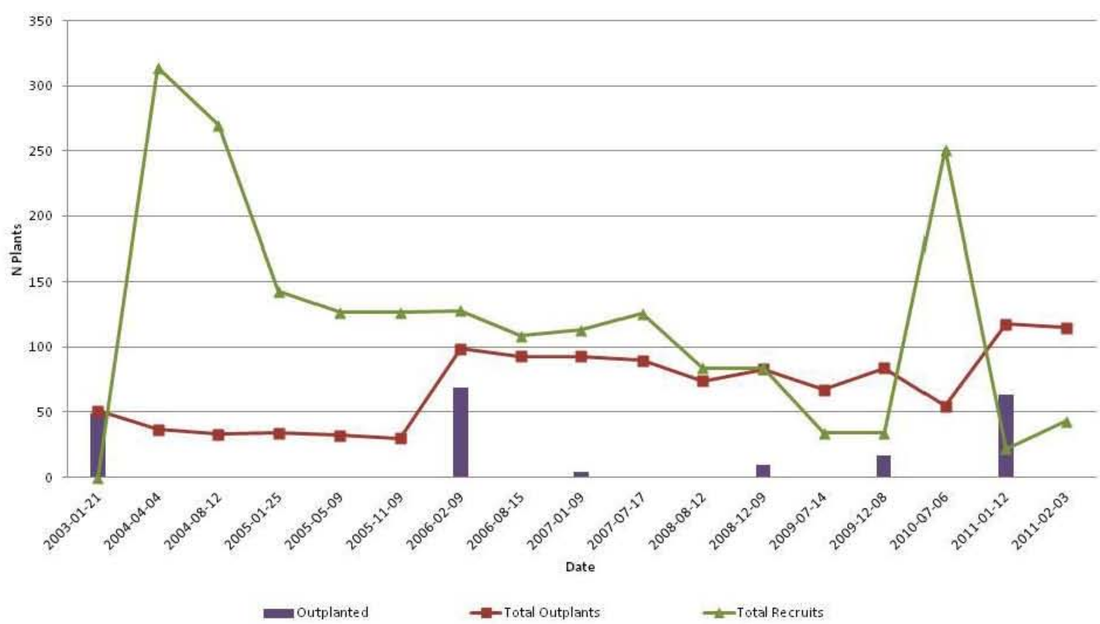
This graph depicts population structure at this reintroduction. Orange bars represent the total number of plants outplanted on a given day. The lines correspond to different size classes of both outplants and recruits. A few mature F1s and F2s resulted from initial outplantings but subsequent plantings have greatly increased the numbers of recruits. Planting will be completed in the coming year.

Survival & Replacement *S. obovata* MMR-G (Fig. 4)

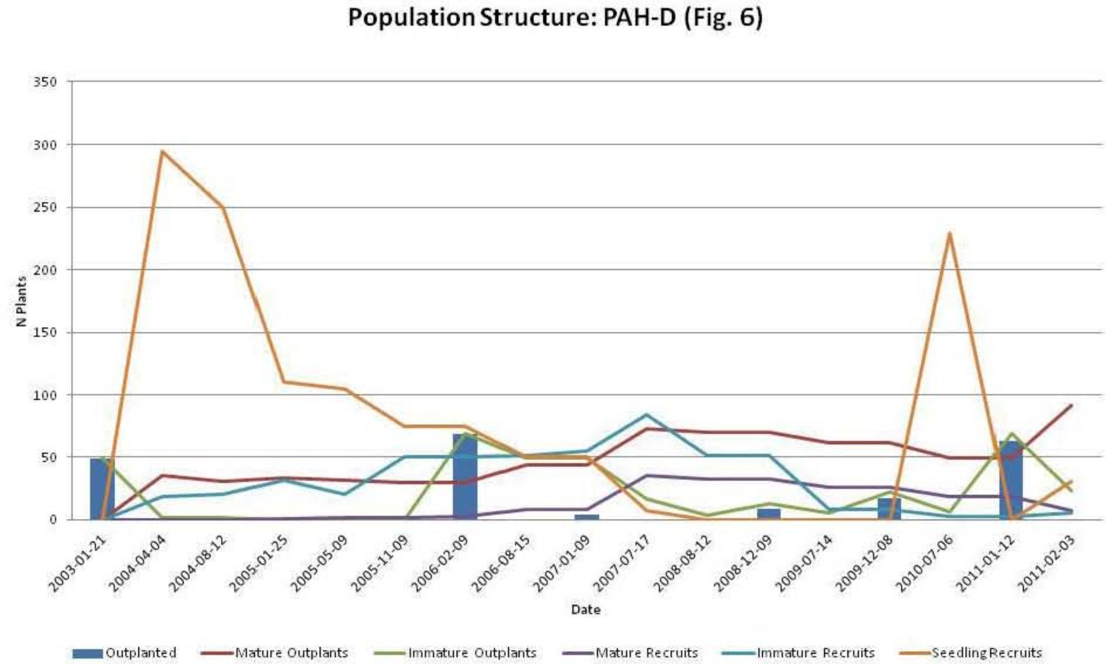


This graph displays the population structure data that are used to guide how many outplants are needed to create a stable population with ≥100 reproducing plants. These measures are discussed in the 'Population Structure and Planning for Outplanting' and 'Reintroduction Plan' sections. The blue line shows the percentage of outplants that matured and are alive. This is Measure 1, the 'survival ratio' and is currently ~50%. The cumulative number of plants ever planted are shown in green, and the cumulative number of mature recruits in purple. These are used to obtain Measure 2, the 'replacement ratio'.

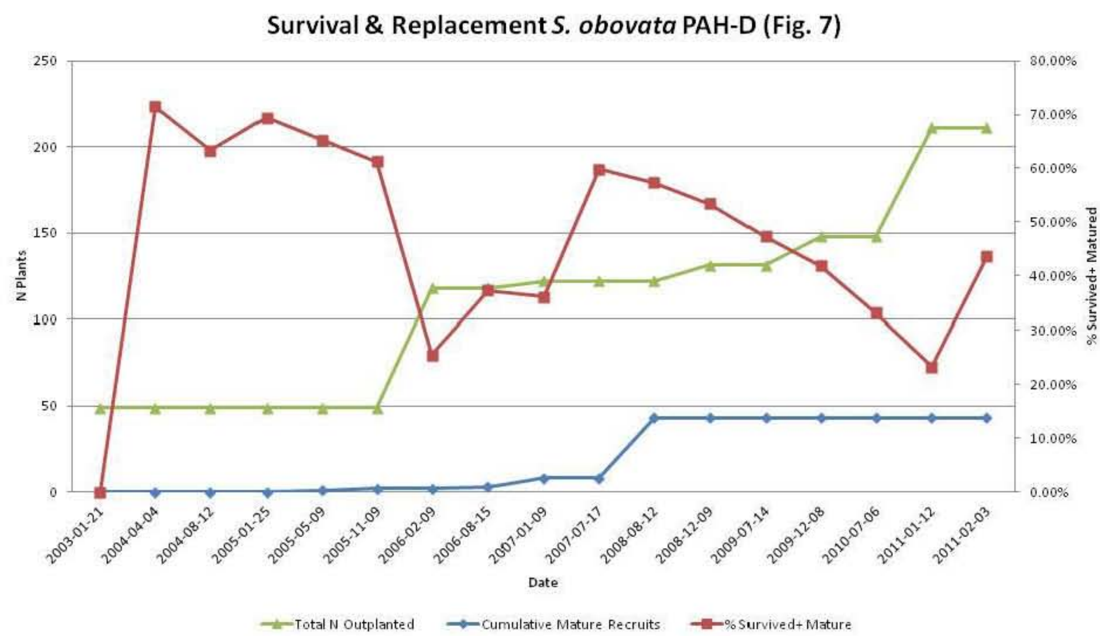
Population Structure: PAH-D (Fig. 5)



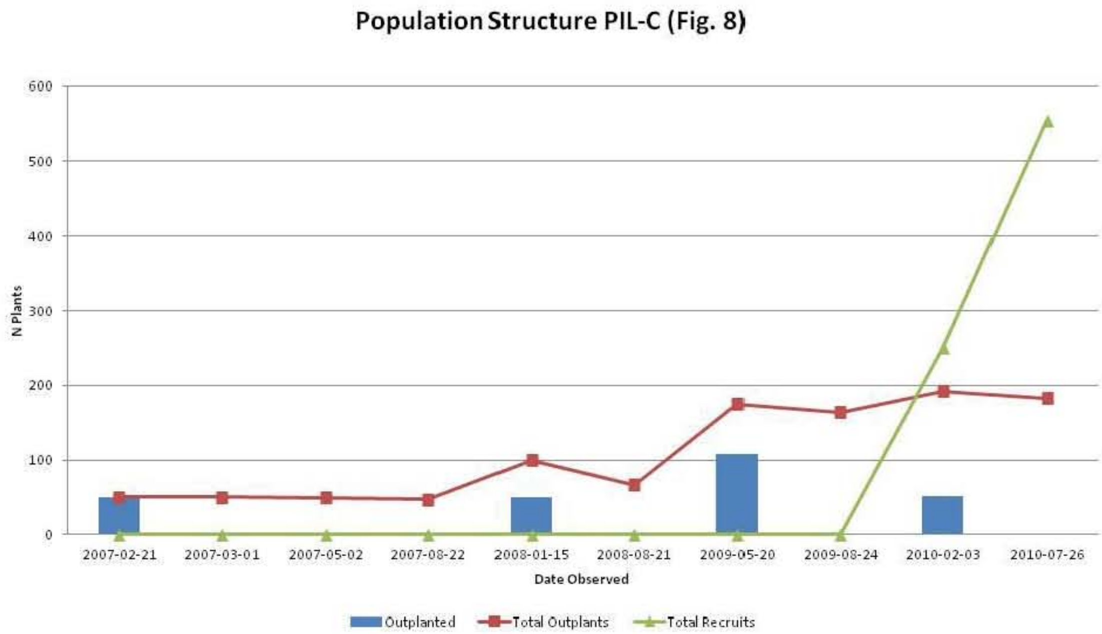
This graph depicts the population structure recorded at this reintroduction each observation date. Purple bars represent the total number of plants outplanted on a given day. The red line shows the total number of live outplants over time and the green line depicts recruitment with the total number of live recruits (seedling, immature and mature). Both F1 and F2s have been observed at this site.



This graph depicts population structure at this reintroduction. Blue bars represent the total number of plants outplanted on a given day. The lines correspond to different size classes of both outplants and recruits. Planting at this site was completed in 2011.



This graph displays the population structure data that are used to guide how many outplants are needed to create a stable population with ≥100 reproducing plants. These measures are discussed in the 'Population Structure and Planning for Outplanting' and 'Reintroduction Plan' sections. The orange line shows the percentage of outplants that matured and are alive. This is Measure 1, the 'survival ratio' and is currently ~45%. The cumulative number of plants ever planted are shown in green, and the cumulative number of mature recruits in blue. These are used to obtain Measure 2, the 'replacement ratio'.



This graph depicts population structure at this reintroduction. Blue bars represent the total number of plants outplanted on a given day. The orange line shows the total number of live outplants over time; while the green line depicts recruitment with the total number of live recruits. Planting was completed at this site in 2010.

Monitoring Plan

- All extant *in situ* sites (LEH-A, LEH-B, PIL-B) will be monitored annually using the HRPRG Rare Plant Monitoring Form (RPMF) to record population structure, age class, reproductive status and vigor of all known plants. The site will be searched for new seedlings and all new juvenile plants will be tagged as long as the health and safety of the plants and the site are not jeopardized. This monitoring data will help guide *in situ* threat management and genetic storage needs.
- The managed reintroduction sites in all PUs will be monitored annually in the winter (January-March) using the RPMF to record population structure, age class, reproductive status and vigor. All outplants will be accounted for, and a total population census will be conducted. This data will be used to obtain the survival and replacements ratios that will guide future outplanting.
- New juvenile F1 plants at PAH-D, PAH-E and MMR-G will be tagged until a total of 50 have been tagged at each of these three sites. The annual survival (RPMF-Vigor) of these tagged plants will be recorded annually along with the rest of the plants using the RPMF. This data may be used to document life-history data and measure vital rates. These rates may be later used in conjunction with population census data to obtain a population growth rate, compare the importance of each vital rate (i.e. seedling-immature vs. immature-mature) and explore results of differing management such as slug control. The results of this analyses are the third measure used to adjust the number of outplants planned for future nearby reintroductions and to augment or replace underperforming sites if a decline is anticipated.
- Sluggo® applications have recently commenced at the West Makaleha (LEH-C) & Kahanahaiki (MMR-G) reintroductions. Recruitment will be monitored and compared to previous years to determine if the application of Sluggo® affects the amount of recruitment at these two reintroductions.

Genetic Storage Plan

What propagule type is used for meeting genetic storage goal?	What is the source for the propagules?	What is the Genetic Storage Method used to meet the goal?	What is the proposed re-collection interval for seed storage?	Is seed storage testing ongoing?	Plan for maintaining genetic storage.*
Seeds	Reintroductions	Seed Storage: -18C / 20% RH	≥15 years†	Yes	Single-source and Mixed Reintroductions*

†Seeds in storage of this species have not shown a decline in viability. The next viability tests are scheduled in 2015. Re-collection intervals will continually be extended until a decline in viability is detected. In 2015 there is one plant that will need to be re-collected. OANRP can collect from the reintroduction site in West Makaleha to accomplish this goal. Additional re-collections from other reintroductions will be necessary starting in 2021.

*Plants in the nursery will be pollinated with a mixed pollen load from all sources. Pollinated flowers will be tagged. These fruit will serve as a propagule source for mixed reintroductions in the Makaha PU.

*Seeds will be collected from reintroductions.

Reintroduction Plan

Manage for Stability Population Units	Reintroduction Site(s)	Number of Plants to be planted	Propagule Type	Propagule Population(s) Source	Number of Founders in Source Population	Plant Size	Pot Size
Kahanahaiki to Pahole	MMR-G §	250 (210)	Immature plants	MMR-A	1	>10cm	4"-1gallon
Kahanahaiki to Pahole	PAH-D¤	200	Immature plants	PAH-C	3	>10cm	4"-1gallon
Kahanahaiki to Pahole	PAH-E §	180 (166)	Immature plants	PAH-A	1	>10cm	4"-1gallon
Keawapilau to West Makaleha	PIL-C¤	310	Immature plants	PIL-A, B	4	>10cm	4"-1gallon
Keawapilau to West Makaleha	LEH-C¤	133	Immature plants	LEH-A	6	>10cm	4"-1gallon
Makaha	MAK-A*	400 (0)	Immature plants	Mixed source from hand-pollinating all plants	N/A	>10cm	4"

The total number to be planted at each site is given followed by the number already planted in ().
*= outplanting not started yet
¤= planting complete
§ =will be completed by February 2012.

Reintroduction Plan Comments

Since recruitment has begun at the MMR-G site, **the survival ratio**, (**Measure 1**) is no longer used to guide the number to plant. Instead, the number to be planted at each site is currently determined by factoring in the number of mature recruits produced by the surviving mature outplants at the MMR-G site in the Kahanahaiki to Pahole PU (Measure 2 Replacement Ratio). This site was selected because it is the longest established outplanting and has had F1 and F2 recruits observed for many years. The **replacement ratio, (Measure 2)** is the cumulative sum of mature recruits at MMR-G to the total outplanted and this gives a value of one mature recruit for every 3.46 outplants (1:3.46). Incorporating this value, the target number to plant in each PU has been increased to 400 outplants for a goal of establishing 100 mature recruits within 5 years. The data from survival and replacement will continue to be updated and used to guide the number of outplants used to supplement those sites and in planning future efforts in the Makaha PU. Planting at the MAK-A site will be phased in over a few years to ensure that the initial survival rates are comparable to Kahanahaiki (MMR-G).

Reintroduction Plan Comments

A recent study was undertaken to determine the fitness of outplants grown from seed produced by outcrossing and self-fertilization of the available stocks of *S. obovata* (Weisenberger 2012). Results and management recommendations from this study are being used to guide the founder mix at each outplanting and are summarized below:

A common garden study in Kahanahaiki was carried out to compare relative fitness of progeny from the outcrossing and self-fertilizing treatments. Relative fitness of plants increases when parents are from different populations. When the maternal parent was from the furthest populations from Kahanahaiki (and consequently cooler and wetter), relative fitness was reduced, regardless of the paternal parent.

-Mixed source reintroductions will be implemented at the Makaha PU. The completed single-source founder reintroductions at the Kahanahaiki to Pahole and Keawapilau to West Makaleha PUs will be maintained as is for now.

-Due to a lower elevation, higher annual maximum temperature, and lower annual rainfall at Kahanahaiki gulch, only Kahanahaiki stock should be planted into this gulch (see Habitat Characteristics Table). Some caution should be exercised when outplanting Kahanahaiki stock into substantially wetter habitats, as these plants may be adapted to drier conditions. If initial outplanting attempts fail, effort to balance representation of this stock should cease.

-Stock from Makaleha (particularly LEH-A) should not be planted into habitat much drier and warmer than current conditions. The site where the LEH-A stock is planted (LEH-C) has similar temperature and rainfall patterns as the wild site.

-In Makaha, an introduction into wetter and cooler conditions is being planned. If stock from the drier end of environmental extremes (MMR-A) fails at this site, efforts to balance representation should cease. The stock to be used for controlled breeding for these outplantings will come from seeds collected from the single-source reintroductions at MMR-G, PAH-D, PAH-E, PIL-C and *in situ*-collected seed from LEH-B and PIL-B. These plants will be maintained *ex situ* in the nursery and hand-pollinated to mixed-source pollen loads. The resulting outcrossed plants will be used for the Makaha introductions.

2010-2011 Stabilization Goals Update

MFS Population Units	PU Stability Target		MU Threat Control						Genetic Storage
	Has the Stability Target for mature plants been met?	Does the PU have observed structure to support the stability target in the long-term?	Ungulates	Weeds	Rodents	Fire	Slug	Black Twig Borer	Are there enough propagules in Genetic Storage?
Kahanahaiki to Pahole	YES	TBD	YES	YES	PARTIAL	NO	PARTIAL	N/A	YES
Keawapilau to West Makaleha	YES	TBD	YES	YES	NO	NO	PARTIAL	N/A	YES
Makaha*	NO	NO	NO	NO	NO	NO	NO	N/A	N/A

For each PU, the status of compliance with all stability goals is displayed in this table. All required MFS PUs are listed for each taxon. 'YES, NO or PARTIAL' are used to represent compliance with each stability goal. For population targets, whether or not each PU has enough mature plants is displayed, followed by an estimate on whether a stable population structure is present. The major threats are listed separately for each PU. The boxes are shaded to display whether each threat is present at each PU. A dark shade identifies PUs where the threat is present and the lighter boxes where the threat is not applicable. The corresponding status of threat control is listed as 'YES, NO or PARTIAL' for each PU. A summary of the status of genetic storage collections is displayed in the last column.

*Not Planted yet

5 Year Action Plan

	Proposed Actions for the following years:				
Population Unit	MIP YEAR 8 October 1 2011 – September 31 2012	MIP YEAR 9 October 1 2012 – September 31 2013	MIP YEAR 10 October 1 2013 – September 31 2014	MIP YEAR 11 October 1 2014 – September 31 2015	MIP YEAR 12 October 1 2015 – September 31 2016
Kahanahaiki to Pahole	•Monitor Annually in Qtr.1 (MMR-G, PAH-D, PAH-E) •Complete reintroductions •Collect seed for storage and propagation •Slug control at MMR-G	•Monitor Annually in Qtr.1 (MMR-G, PAH-D, PAH-E) •Slug control at MMR-G	•Monitor Annually in Qtr.1 (MMR-G, PAH-D, PAH-E) •Review and adapt management •Slug control at MMR-G	•Monitor Annually in Qtr.1 (MMR-G, PAH-D, PAH-E) •Slug control at MMR-G	•Monitor Annually in Qtr.1 (MMR-G, PAH-D, PAH-E) •Slug control at MMR-G
Keawapilau to West Makaleha	•Monitor Annually in Qtr.1 (LEH-A-C, PIL-B-C) •Collect seed for storage and propagation •Slug control at LEH-C	•Monitor Annually in Qtr.1 (LEH-A-C, PIL-B-C) •Slug control at LEH-C	•Monitor Annually in Qtr.1 (LEH-A-C, PIL-B-C) •Review and adapt management •Slug control at LEH-C	•Monitor Annually in Qtr.1 (LEH-A-C, PIL-B-C) •Slug control at LEH-C	•Monitor Annually in Qtr.1 (LEH-A-C, PIL-B-C) •Slug control at LEH-C
Makaha	•Prepare planting sites at MAK-A •Complete Makaha II fence	•Begin introduction at MAK-A	•Monitor Annually •Determine the need for slug control	•Monitor Annually •Complete introduction at MAK-A	•Monitor Annually •Review and adapt management

Review and adapt management: The status of each PU in relation to the IP stabilization goals, population structure trends from monitoring data, and threats to each site will be assessed. If PUs are not meeting stability goals, management may be adapted to control threats to plants in affected age classes, the number of outplants may be increased and the founder sources may be changed.

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