Chapter 5: *ACHATINELLA MUSTELINA* MANAGEMENT

5.1 BACKGROUND

In this chapter, OANRP *Achatinella mustelina* management is outlined for the next three years: July 2017-June 2018, July 2018-June 2019 and July 2019-June 2020. Highlights of the past two years and progress toward the goals set for the Evolutionary Significant Units (ESUs) are also summarized. There are a total of eight managed populations within the six ESUs (Figure 1). ESU-B and ESU-D have two managed populations each because of their large geographic spread. The Makua Implementation Plan (MIP) set a goal of 300 snails in each of the eight managed populations. The snail populations within the ESUs are divided into Population Reference Sites (PRS). Each PRS is a discrete grouping of snails. There are many PRS in each ESU given the fragmented status of the populations.

In addition, *A. mustelina* predators must be managed at select PRSs. These include black rats (*Rattus rattus*), rosy wolf snails (*Euglandina rosea*), and Jackson's chameleons (*Trioceros jacksonii xantholophus*).

OANRP has made significant progress toward these goals over the years. At five of the eight managed populations in the ESUs, the goal of 300 snails is met (Table 1). At three ESUs (ESU-A, D, and F) enclosures are used to protect PRS from all threats. Populations within all enclosures are stable or increasing. In many ESUs rat control is ongoing. See ESU tables in each section for the threat control status at individual PRS.

Construction is underway for a new enclosure at Palikea North for ESU-E. OANRP plan to complete construction in the summer of 2017. Plans are being developed for two additional enclosures. OANRP plan to construct enclosures at Kaala (ESU-C) and West Makaleha (ESU-B) by the summer of 2018. With the completion of these additional enclosures and successful translocation efforts, all six ESUs will be protected from predators.

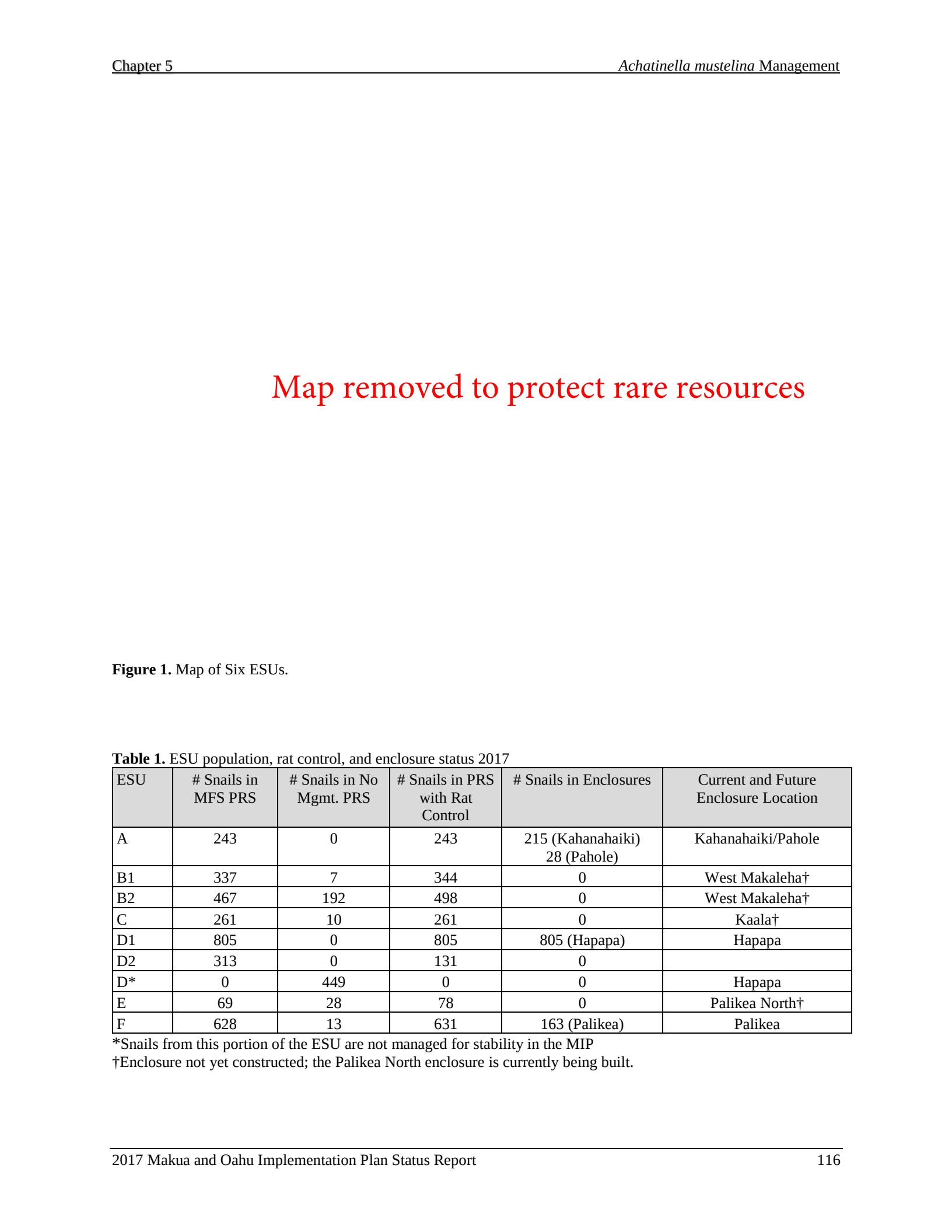

Figure 1. Map of Six ESUs.

Table 1. ESU population, rat control, and enclosure status 2017

ESU	# Snails in MFS PRS	# Snails in No Mgmt. PRS	# Snails in PRS with Rat Control	# Snails in Enclosures	Current and Future Enclosure Location
A	243	0	243	215 (Kahanahaiki) 28 (Pahole)	Kahanahaiki/Pahole
B1	337	7	344	0	West Makaleha†
B2	467	192	498	0	West Makaleha†
C	261	10	261	0	Kaala†
D1	805	0	805	805 (Hapapa)	Hapapa
D2	313	0	131	0	
D*	0	449	0	0	Hapapa
E	69	28	78	0	Palikea North†
F	628	13	631	163 (Palikea)	Palikea

*Snails from this portion of the ESU are not managed for stability in the MIP
†Enclosure not yet constructed; the Palikea North enclosure is currently being built.

5.2 ESU-A

ESU-A *Achatinella mustelina*

Map removed to protect rare resources

Figure 2. Map of ESU-A

5.2.1 Management History and Population Trends

Spanning parts of Kahanahaiki Gulch and Pahole Natural Area Reserve, there are 14 PRS at ESU-A (Figure 2). The two enclosure sites are designated Manage for Stability (MFS) and the remaining are No

Management (NM)(Table 2). The MFS PRS have 243 counted snails while the NM PRS snails have all been moved into one of the two snail enclosures. OANRP manages the enclosure at Kahanahaiki (MMR-A) and successful habitat restoration efforts are ongoing with gradually increasing native habitat and cover throughout the enclosure and snails utilizing reintroduced plants for food and cover. SEPP manages the Pahole enclosure (PAH-B) and native cover is also increasing at that enclosure following restoration efforts. Clearing has begun around the Pahole enclosure to rebuild it in the near future to increase its size and improve the level of predator protection. *Euglandina rosea* are assumed to be ubiquitous across the habitat. *Trioceros jacksonii xantholophus* have not been seen in this area.

Table 2. ESU-A population structure and threat control summary

Number of Snails Counted

Population Reference Site	Management Designation	Total Snails	Date of Survey	Size Classes				Threat Control				
				Large	Medium	Small	Unk	Ungulate	Weed	Rat	Euglandina rosea	Jackson's Chameleon
Achatinella mustelina												
ESU: A	**Pahole to Kahanahaiki**											
KAP-A	No Management	0	2015-10-14	0	0	0	0	Yes	No	No	No	No
Just below Makua rim on trail above hunter's cabin.												
KAP-B	No Management	0	2013-10-08	0	0	0	0	Yes	No	No	No	No
Chaher weeding site												
KAP-C	No Management	0	2015-10-28	0	0	0	0	Yes	No	No	No	No
One Acre Site												
LEH-F	No Management	0	2016-03-30	0	0	0	0	Yes	No	No	No	No
West Makaleha off of Keawapilau ridge												
MMR-A	Manage for stability	215	2017-05-02	86	107	22	0	Yes	Partial	Yes	Yes	No
Kahanahaiki Exclosure												
MMR-C	No Management	0 *	2016-08-24	0	0	0	0	Yes	Partial	Yes	No	No
Maile Flats												
MMR-D	No Management	0	2015-03-11	0	0	0	0	Yes	Partial	Yes	No	No
Kahanahaiki Gulch												
MMR-M	No Management	0 *	2017-01-17	0	0	0	0	Partial	No	No	No	No
East Rim 2A ridge												
MMR-N	No Management	0	2015-03-11	0	0	0	0	Yes	Partial	Yes	No	No
Kahanahaiki gulch at Steph Joe's slug boxes												
MMR-O	No Management	0	2015-12-07	0	0	0	0	Yes	Partial	Yes	No	No
Giant Olopua												
PAH-A	No Management	0	2011-07-15	0	0	0	0	Yes	No	No	No	No
Cyasup Pahole gulch reintro lower site												
PAH-B	Manage for stability	28	2016-06-20	8	13	7	0	Yes	Partial	Yes	Yes	No
Pahole Exclosure												
PAH-C	No Management	0 *	2015-11-04	0	0	0	0	Yes	Partial	Yes	No	No
below Pahole snail exclosure												
PAH-D	No Management	0 *	2016-06-20	0	0	0	0	Yes	No	No	No	No
Along Makua Rim west of Kapuna fence												
	ESU Total:	243		94	120	29	0					

Size Class Definitions

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

*=Total Snails were Trans Located or Reintroduced

= Threat to Taxon at Population Reference Site

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

Yes=Threat is being controlled at PopRefSite

No=Threat is not being controlled at PopRefSite

Partial=Threat is being partially controlled at PopRefSite

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

(When there is an asterisk under the "Total Snails" column, it means that some snails from that population have been translocated or reintroduced. If there is a 0*, that means that snails have been translocated from

that site and when surveyed again later, 0 snails were found. If there is a 5*, that means that 5 snails have been translocated from that site and it has not been resurveyed since that time.)

5.2.1.1 MMR-A Kahanahaiki Enclosure PRS

The 76m² enclosure at Kahanahaiki is the focus of OANRP's management within ESU-A as all of the observed snails in Kahanahaiki have been translocated to the enclosure. Monitoring of the *A. mustelina* population within the enclosure has continued quarterly, including timed count monitoring (TCM) and ground shell plot (GSP) monitoring. There has been no evidence of predator incursion. Following the overhaul of the enclosure which was completed in early 2014, until the end of 2016, the overall trends observed during monitoring were increasing TCM numbers over time (even after translocations into the enclosure dropped to very low numbers), and low GSP counts (Figure 3).

However, in early 2017 staff began noticing numerous ground shells in the enclosure. Initial thoughts were that possibly *E. rosea* had somehow crossed our barriers and gotten into the enclosure, but with further searching an *A. mustelina* shell was found with rotting tissue mass. This seemed unusual for *E. rosea* since they are known to devour their prey entirely and do not leave food behind.

Staff became particularly alarmed when 50 ground shells were found on February 8, 2017, considering that in all of 2016 only 32 ground shells were found in the enclosure. It was speculated that the mortality could be due to high wind events that occurred around that time. Staff began monitoring the site every 1-3 weeks, and shells continued to be found in higher than expected numbers through the end of April. Snails on the ground were still alive at times but seemed sickly or lethargic. All size classes of snails were represented among the shells (Figure 4). The ongoing high mortality seemed to suggest that high winds from earlier in the year were not to blame. No *E. rosea* were ever found, and staff were unable to determine the cause of mortality.

OANRP arranged with SEPP to collect a fresh sample and preserve it in formalin for analysis. However, the high mortality event ceased before a sample could be collected. In May 2017, mortality rates returned to low numbers, and have remained low through the preparation of this document. Whether the mortality observed between January and April of 2017 resulted from disease or weather remains unknown.

During this extended period of unusually high mortality, a total of 130 ground shells were collected. While the number of snails observed during the first quarter TCM (February 15) remained high (273 snails counted), there were indications of a population decline by the second quarter (May 2), with only 215 snails counted. Though there were some lower than expected timed-counts in prior years, those were instances of data with low confidence due to either inexperienced staff or weather conditions. The most recent timed-count in May represents high confidence data, as monitoring conditions were favorable, and the most highly skilled observers were used. It is anticipated that if mortality remains low, the population will return to its previous trend of increasing numbers over time.

The unprecedented occurrence of a sudden and extended period of mortality within a snail enclosure gives OANRP further confidence in our quarterly monitoring protocol, as opposed to annual or biannual monitoring as has been suggested in the past. This allows us to track population trends and mortality more closely, with the potential to respond to possible crisis situations in a timelier manner. Though we were unable to obtain a sample for analysis during this episode, we now have the tools at hand to quickly obtain a proper sample for analysis if warranted in the future, and a resource established for conducting pathology analysis.

In the past year, 7 snails were added to the existing population from MMR-C and MMR-M. The number of potential snails remaining outside of the enclosure is likely very small.

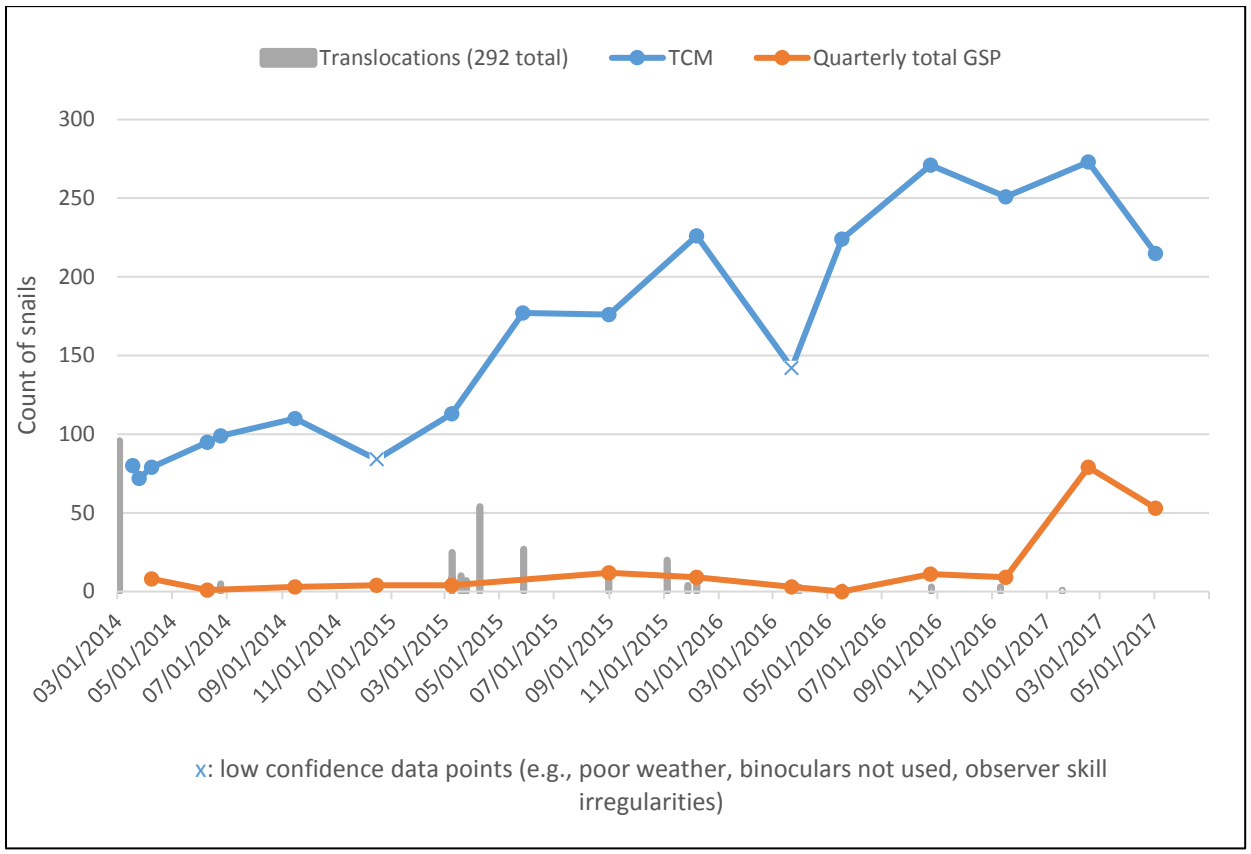

Figure 3. Quarterly timed-count monitoring (TCM) and ground shell counts (GSP) for *A. mustelina* in the Kahanahaiki snail enclosure from the first quarter of 2014 to the second quarter of 2017, with numbers of snails translocated into the enclosure over time. Note: TCM data represents a subsample of the population, as not all snails are detectable at any one time.

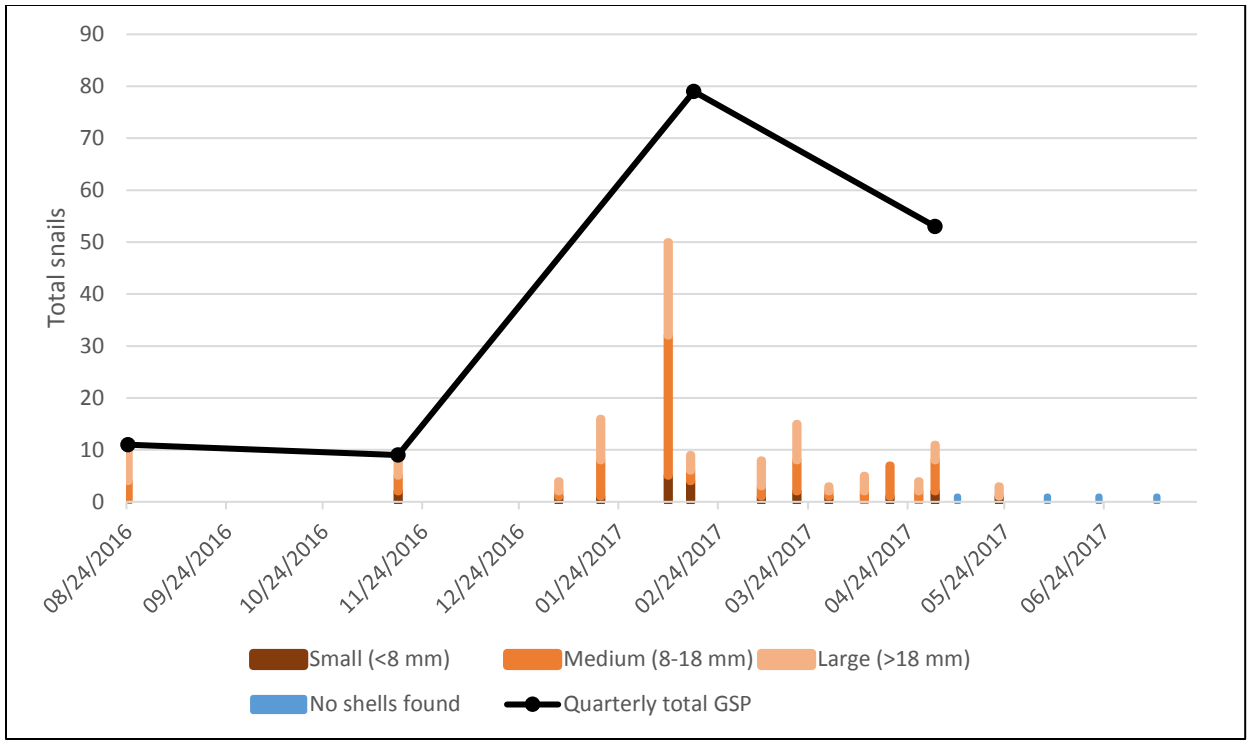

Figure 4: Ground shells found over the last reporting year (July 2016 to June 2017) by size class, showing the trend line for quarterly total ground shell counts. The Kahanahaiki snail enclosure ground shell plot covers the entire enclosure, given its small size. Ground shell plot (GSP) monitoring normally occurs on a quarterly basis coinciding with quarterly timed-count monitoring, but due to higher than expected mortality in 2017, more frequent GSP monitoring was initiated. Quarterly GSP numbers in 2017 were obtained from cumulative numbers from GSP between timed-count monitoring intervals.

5.2.1.2 PAH-B PRS

The enclosure at Pahole is the focus of SEPP's management in this area. Currently SEPP has secured funds to reconstruct the wall and increase the enclosure size. OANRP will assist in these efforts. TCM by SEPP in sampled areas in the enclosure suggest the population is relatively stable, though counts have dropped slightly over the past two years (Figure 5). There were once many more snails inside the enclosure but the habitat declined and snails disappeared. However, through DOFAW and SEPP's weed control and outplanting efforts, the habitat is improving, and with construction funded the future is optimistic. It is noteworthy that the high mortality that occurred only 300 m away at the MMR-A Kahanahaiki Enclosure PRS in 2017 did not occur here.

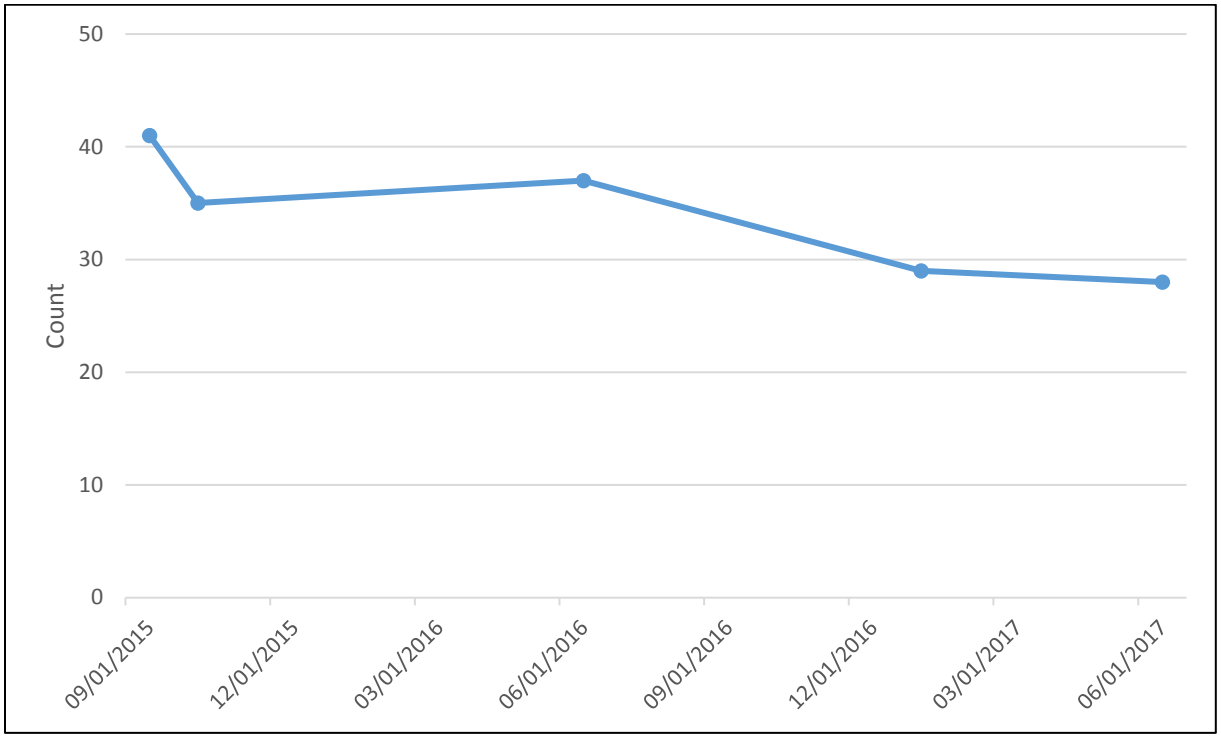

Figure 5: Timed-counts of *Achatinella mustelina* in sampled areas of PAH-B, Pahole Enclosure, monitored by SEPP.

5.2.1.3 No Management PRS

All snails found at NM-PRS within ESU-A have been translocated to the Kahanahaiki snail enclosure. OANRP visit each site at least three times to ensure any remaining snails are translocated. As time allows staff return for additional searches. Table 3 below summarizes the translocation efforts completed this year. A total of 7 snails were translocated.

Table 3. Translocations into MMR-A Kahanahaiki enclosure 2016-2017

Translocation Date	Population Reference Site	Small	Medium	Large	Total
2016-08-24	MMR-C Maile Flats	0	2	1	3
2016-11-10	MMR-M East Rim	0	2	1	3
2017-01-18	MMR-M East Rim	0	0	1	1

5.2.2 Future Management

OANRP will continue to work according to the monitoring plan (Table 4), and additional translocation efforts will be completed as outlined in the Three-Year Action Plan below (Table 5). Threat control will continue around the existing enclosures, including tracking tunnels for *R. rattus*, and searches for *E. rosea*, and *T. jacksonii xantholophus*. Weed control and habitat improvements will continue cautiously to ensure there are no impacts on the snails. Installation of the remote monitoring system which will alert staff if there should ever be a treefall at the Kahanahaiki snail enclosure has been delayed due to needed upgrades of the system by our vendor technicians. A new remote monitoring system will be installed in the near future. OANRP continues to investigate a debris alarm system. Once a suitable system is

developed it will be deployed at Kahanahaiki and Pahole. OANRP will consider doing additional planting of snail host trees within the Kahanahaiki enclosure to enhance habitat.

Table 4. ESU-A Monitoring Plan for MFS PRS

PRS	Monitoring Type	Monitoring Interval	Survey Years	Comments
MMR-A Kahanahaiki Enclosure	TCM	quarterly	all	Conduct night TCM with 2 personnel 2 hours each, for 4 person-hours total; quarterly
	GSP	quarterly	all	GSP MMR-A.
PAH-B Pahole Enclosure	TCM/GSP	quarterly	all	Assist OSEPP as needed

Table 5. Three Year Action Plan for ESU-A

PRS	MIP YEAR 14 July 2017 – June 2018	MIP YEAR 15 July 2018 – June 2019	MIP YEAR 16 July 2019 – June 2020
MMR-A Kahanahaiki Enclosure	• Implement monitoring plan • Rat control • Install Remote Monitoring system • Install debris alarm • Maintain enclosure and monitor for predators • Improve habitat via weed control and restoration planting	• Implement monitoring plan • Rat control • Maintain enclosure and monitor for predators • Conduct additional outplanting if needed • Improve habitat via weed control and restoration planting	• Implement monitoring plan • Rat control • Maintain enclosure and monitor for predators • Improve habitat via weed control and restoration planting
PAH-B Pahole Enclosure	• Assist SEPP with installation of remote monitoring system	• Assist SEPP with installation of remote monitoring system	

5.3 ESU-B

ESU-B covers a large geographic area and is therefore divided into two units: ESU-B1 along the north-facing slopes of the southern Makua rim and ESU-B2 along the north-facing rim of the Mokuleia Forest

Reserve. The subdivision of ESU-B has some genetic basis, see Makua Implementation Plan 2001. Management of ESU-B1 is focused at Ohikilolo (Figure 6). ESU-B2 includes the gulches in Makaleha (Figure 7).

Figure 6. Map of ESU-B1

5.3.1 ESU-B1 Management History and Population Trends

There are two MFS PRS within ESU-B1, MMR-E (Ohikilolo Mauka) and MMR-F (Ohikilolo Makai) (Table 6). A combined total of 330 snails were observed during the most recent TCM at these PRS. There are seven NM-PRS (not all are depicted in (Table 6). These sites had low numbers when last monitored more than ten years ago, and have not been monitored since.

The Ohikilolo MU (Management Unit) remains unique in that *E. rosea* have never been recorded in the area. *T. jacksonii xantholophus* have also never been seen. Rats are controlled across the known snail habitat with an A24 and Victor snap trap grid. Occasionally, goats breach the fenceline into the upper portions of the MU, therefore the ungulate control is designated as partial control.

Table 6. ESU-B1 population structure and threat control summary

Number of Snails Counted

Population Reference Site	Management Designation	Total Snails	Date of Survey	Size Classes				Threat Control				
				Large	Medium	Small	Unk	Ungulate	Weed	Rat	Euglandina rosea	Jackson's Chameleon
Achatinella mustelina												
ESU: B1 Ohikilolo												
MMR-E	Manage for stability	78	2016-07-21	53	19	6	0	Yes	Partial	Yes	No	No
Ohikilolo Mauka												
MMR-F	Manage for stability	252	2016-07-20	160	68	24	0	Yes	Partial	Yes	No	No
Ohikilolo Makai												
MMR-G	No Management	0	2016-04-20	0	0	0	0	Yes	No	No	No	No
Ohikilolo Alemac Site												
MMR-H	No Management	0 *	2016-07-19	0	0	0	0	Yes	No	Yes	No	No
Ohikilolo Kolahi Prikaa Reintro Site												
MMR-I	No Management	2	2002-06-03	2	0	0	0	Yes	No	No	No	No
Hedpar MMR-B												
MMR-J	No Management	5	2000-11-27	0	0	0	5	Partial	No	No	No	No
One ridge east of Lower Makua Camp												
MMR-K	No Management	0	2016-08-30	0	0	0	0	Partial	No	No	No	No
Ctesqu ridge												
MMR-L	No Management	0	2016-08-30	0	0	0	0	Partial	No	No	No	No
Myrsine along Ohikilolo fence from 3 pts												
	ESU Total:	337		215	87	30	5					

Size Class Definitions

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

*=Total Snails were Trans Located or Reintroduced

= Threat to Taxon at Population Reference Site

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

Yes= Threat is being controlled at PopRefSite

No=Threat is not being controlled at PopRefSite

Partial=Threat is being partially controlled at PopRefSite

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

5.3.1.1 MMR-E Ohikilolo Mauka PRS

OANRP did not conduct monitoring at the PRS in the last year. Monitoring is scheduled to occur in 2018, every other year. Anecdotal observations indicate the PRS is doing well.

5.3.1.2 MMR-F Ohikilolo Makai PRS

OANRP did not conduct monitoring at the PRS in the last year. Monitoring is scheduled to occur in 2018, every other year. Anecdotal observations indicate the PRS is doing well.

For the future, OANRP is proposing to only monitor the entire PRS every four years and monitor a smaller subset area with qualified staff every two years. This is proposed given the amount of staffing effort required to monitor the entire PRS, to lessen trampling impacts to habitat, and the apparently stable numbers. Monitoring a subset every two years should still allow us to be able to detect population trends owing to increased or decreased predation or other factors. For rat control, OANRP will investigate the possibility of expanding the rat control grid to include snail areas that are currently outside the grid.

5.3.1.3 No Management PRS

MMR-H was discontinued as a MRS in 2015-2016 due to declines in numbers. OANRP planned to make three translocation trips to move all snails found up to MMR-F. The third trip was made to MMR- H in the last year (Table 7). As six snails were still found OANRP will make one additional trip in the following year to search for any remaining snails as time allows. All other NM-PRS are not a management priority as numbers are low and monitoring dates are old.

Table 7: Translocation of *A. mustelina* into MMR-F Ohikilolo Makai 2016-2017

Translocation Date	Population Reference Site	Small	Medium	Large	Total
2017-03-21	MMR-H Koiahi	0	1	2	3

5.3.2 ESU-B1 Future Management

OANRP will continue monitoring as indicated below (Table 8). Rat control and the use of tracking tunnels will continue across the MU (Table 9). Searches for *E. rosea*, and *T. jacksonii xantholophus* during other work will also continue. A subset of snails from ESU-B1 will be moved into the future planned enclosure at 3 Points/West Makaleha along with the ESU-B2 following enclosure completion.

Table 8. ESU-B1 monitoring plan for MFS PRS

PRS	Monitoring Type	Monitoring Interval	Survey Years	Comments
MMR-E Ohikilolo Mauka	TCM	Every 2 years	2018, 2020	Eight person-hours day survey with binoculars
	GSP	Annual	All	GSP MMR-E-1
MMR-F Ohikilolo Makai	TCM	Every 2 years	2018, 2022	TCM with binoculars. Effort to be determined based on chosen areas.
	TCM	Every 4 years	2020	46 person-hours day TCM with binoculars
	GSP	Annual	All	GSP MMR-F-4

Table 9. Three Year Action Plan for ESU-B1

PRS	MIP YEAR 14 July 2017 – June 2018	MIP YEAR 15 July 2018 – June 2019	MIP YEAR 16 July 2019 – June 2020
MMR-E Ohikilolo Mauka	• Implement monitoring plan • Rat control	• Implement monitoring plan • Rat control	• Implement monitoring plan • Rat control • Consider moving a sample of snails to 3 Points enclosure
MMR-F Ohikilolo Makai	• Implement monitoring plan • Rat control	• Implement monitoring plan • Rat control	• Implement monitoring plan • Rat control • Consider moving a sample of snails to 3 Points enclosure
MMR-H Ohikilolo Koiahi	• Translocate at least one more time to MMR-F		

Map removed to protect rare resources

Figure 7: Map of ESU-B2

5.3.3 ESU-B2 Management History and Population Trends

There are two MFS PRSs within ESU-B2, both located below the Kaala Road: LEH-C (Culvert 69) and LEH-D (Culvert 73) (Table 10). Together these PRS have 467 observed snails. There are nine NM-PRS, many of which have not been surveyed for many years. Numbers have likely declined at these sites. OANRP are working to construct an enclosure at West Makaleha by the summer of 2018 to manage the snails in this portion of ESU-B. NM PRS will be visited to translocate snails once the enclosure is

complete. Currently rats are controlled with A24s at LEH-C along the ridge crest and also at LEH-D. While *E. rosea* are assumed present throughout ESU-B2, *T. jacksonii xantholophus* have not been observed. The goat population and habitat damage has increased over the last several years. With the recent completion of the Kaala Road fence, and additional strategic fencing planned for the upper Makaleha area, aggressive goat and pig control is needed to eliminate populations as their impacts will now be in a more concentrated area.

Table 10. ESU-B2 population structure and threat control summary

Number of Snails Counted

Population Reference Site	Management Designation	Total Snails	Date of Survey	Size Classes				Threat Control				
				Large	Medium	Small	Unk	Ungulate	Weed	Rat	Euglandina rosea	Jackson's Chameleon
Achatinella mustelina												
ESU: B2	**East and Central Makaleha**											
AAVI-A Kaawa Gulch	No Management	20	2016-04-06	11	5	4	0	No	No	No	No	No
LEH-A Central Makaleha (culvert 39)	No Management	49 *	2011-05-18	29	15	5	0	No	No	No	No	No
LEH-B East Makaleha (culvert 45)	No Management	33	2011-04-19	11	12	10	0	No	No	No	No	No
LEH-C East Branch of East Makaleha (culvert 69)	Manage for stability	378	2016-12-31	267	99	12	0	No	Partial	Yes	No	No
LEH-D East Branch of East Makaleha (culvert 73)	Manage for stability	89	2017-05-04	56	28	5	0	No	No	Yes	No	No
LEH-E East Makaleha (culvert 56-57)	No Management	31	2011-04-20	16	7	8	0	No	No	Yes	No	No
LEH-G East Makaleha (culvert 59)	No Management	3	2006-04-17	3	0	0	0	No	Partial	No	No	No
LEH-H East Makaleha (culvert 54)	No Management	34	2000-03-23	0	0	0	34	No	No	No	No	No
LEH-I East Makaleha (culvert 67)	No Management	16	2000-03-23	16	0	0	0	No	No	No	No	No
LEH-J East Makaleha (culvert 69 - lower down	No Management	2	2006-11-16	2	0	0	0	No	No	No	No	No
LEH-K Culvert 43 Ridge	No Management	0	2016-11-09	0	0	0	0	No	No	No	No	No
LEH-L 3 Points	No Management	4	2014-04-07	3	0	1	0	Yes	Partial	No	No	No
	ESU Total:	659		414	166	45	34					

Size Class Definitions

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

*=Snails were Trans Located or Reintroduced

= Threat to Taxon at Population Reference Site

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

Yes= Threat is being controlled at PopRefSite

No=Threat is not being controlled at PopRefSite

Partial=Threat is being partially controlled at PopRefSite

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

5.3.3.1 LEH-C East Branch of East Makaleha Culvert 69 PRS

OANRP conducted a TCM in 2016 and 378 snails were observed. OANRP will conduct the next TCM in Quarter 4 of 2018. There is not a suitable site here for a GSP because most of the snails are found while on rappel and the area in general is very steep.

5.3.3.2 LEH-D East Branch of East Makaleha Culvert 73 PRS

This area is also very steep with a predominant uluhe understory and is determined to be inappropriate for GSP monitoring. In place of a GSP, TCM will be performed annually (Figure 8). OANRP will establish TCM here in Quarter 1 of 2018.

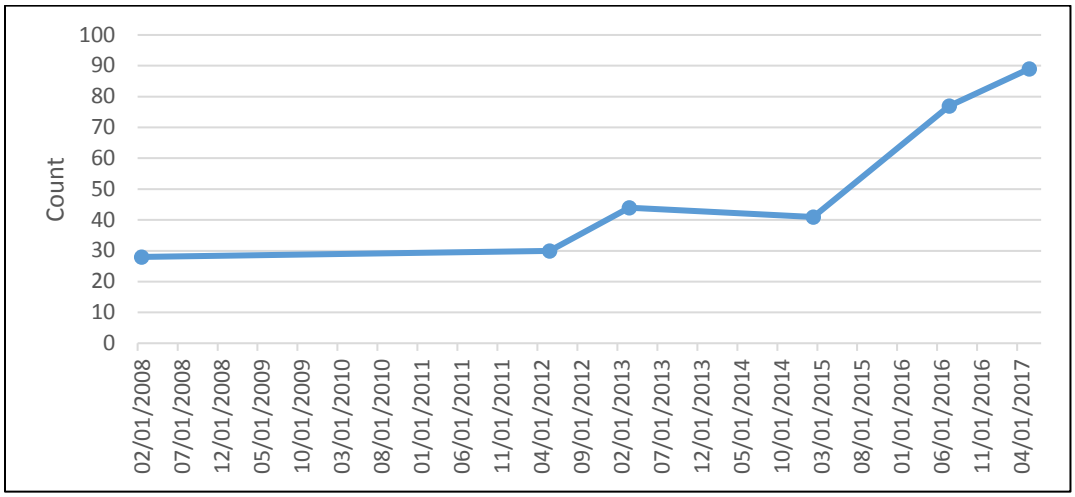

Figure 8. Counts of *Achatinella mustelina* at LEH-D East Branch of East Makaleha (Culvert 73). Search areas were expanded in 2016 and 2017, such that numbers do not reflect population trends, but rather more snails found in new areas.

5.3.3.3 No Management PRS

The nine NM PRS are not a priority for OANRP. These sites will be visited opportunistically. Once the West Makaleha enclosure is completed, OANRP will translocate snails into it from at least the larger sites and opportunistically visit the smaller sites.

5.3.4 ESU-B2 Future Management

OANRP will conduct monitoring as outlined below (Table 11). Rat control will continue at LEH-C (Culvert 69) and LEH-D (Culvert 73) (Table 12). OANRP will pursue building a snail enclosure at West Makaleha/3-Points for ESU-B snails in Makaleha. Once the enclosure construction is underway, OANRP will finalize translocation plans with the IT. OANRP will also likely be assisting State of Hawaii NARS staff with material transport of fencing materials for the strategic fences along sections of the Makaleha area and with future goat and pig control efforts.

Table 11. ESU-B2 Monitoring Plan for MFS PRS

PRS	Monitoring Type	Monitoring Interval	Survey Years	Comments
LEH-C East Culvert 69	TCM	every 2 years	2016, 2018	Conduct night TCM for 5 person-hours, and day TCM for 18 person-hours in steep areas of site (see prior notes to replicate search areas).
LEH-D East Culvert 73	TCM	annual	all	Conduct day TCM for 4 person-hours.

Table 12. Three Year Action Plan for ESU-B2

PRS	MIP YEAR 14 July 2017 – June 2018	MIP YEAR 15 July 2018 – June 2019	MIP YEAR 16 July 2019 – June 2020
LEH-C East Culvert 69	• Implement monitoring plan • Rat control • Construction of enclosure at 3 Points	• Implement monitoring plan • Rat control • Construction of enclosure at 3 Points	• Implement monitoring plan • Rat control • Translocate snails to 3 Points enclosure
LEH-D East Culvert 73	• Implement monitoring plan • Rat control • Pursue construction of enclosure at 3 Points	• Implement monitoring plan • Rat control • Pursue construction of enclosure at 3 Points	• Implement monitoring plan • Rat control • Translocate snails to 3 Points enclosure
NM PRS			• Translocate snails to 3 Points enclosure

5.4 ESU-C

Map removed to protect rare resources

Figure 9. Map of ESU-C

5.4.1 ESU-C Management History and Population Trends

There are two MFS PRS with 261 observed snails at ESU-C: SBW-A (North Haleauau Hame Ridge) and SBW-W (Skeet Pass) (Table 13). There are several NM PRS that have very few total observed snails and have not been monitored recently. OANRP conducts rat control at both MFS PRS. *Euglandina rosea* are present across the ESU. *Trioceros jacksonii xantholophus* was seen once in the lower elevation area of Lihue MU and do not seem to be common across the area, but distribution is not well known. OANRP plan to construct an enclosure on the slopes of Kaala by the summer of 2018 (Figure 9). This enclosure will be geographically closer to the ESU-D *A. mustelina* than the ESU-C snails. A translocation plan will be developed with the IT once enclosure construction is underway. Ungulate control for pigs and goats is ongoing. Goats are occasionally observed along the ridgeline between Manuwai and Lihue MU near the historic snail populations. Low numbers of pigs are still present in the Lihue fence.

Table 13. ESU-C population structure and threat control summary

Number of Snails Counted

Population Reference Site	Management Designation	Total Snails	Date of Survey	Size Classes				Threat Control				
				Large	Medium	Small	Unk	Ungulate	Weed	Rat	Euglandina rosea	Jackson's Chameleon
Achatinella mustelina												
ESU: C	**Schofield Barracks West Range, Alaiheihe and Palikea Gulches**											
ALI-A	No Management	0	2009-06-02	0	0	0	0	No	No	No	No	No
Palikea gulch												
ALI-B	No Management	0	2009-06-02	0	0	0	0	No	Partial	No	No	No
Palikea gulch west Just east of Alaiheihe/Palikea dividing ridge.												
ANU-A	No Management	1	2004-06-02	0	1	0	0	Yes	No	No	No	No
Manuwai gulch												
IHE-A	No Management	0	2005-03-22	0	0	0	0	No	No	No	No	No
Alaiheihe Gulch Western Most Site												
IHE-B	No Management	3	2009-06-02	1	2	0	0	No	No	No	No	No
Alaiheihe middle site "Ptemac Site"												
IHE-C	No Management	0	2005-03-22	0	0	0	0	No	No	No	No	No
Alaiheihe below Nalu's LZ, TT's spot												
SBW-A	Manage for stability	30 *	2017-01-25	16	14	0	0	Yes	Partial	Yes	No	No
North Haleauau Hame Ridge												
SBW-B	No Management	0	2017-01-25	0	0	0	0	Yes	Partial	Yes	No	No
North Haleauau one ridge north of Hame												
SBW-C	No Management	0	2009-09-06	0	0	0	0	Yes	No	No	No	No
North Haleauau just above Pouteria pair territory												
SBW-P	No Management	0	2015-09-21	0	0	0	0	Yes	No	No	No	No
South Water gulch by Stenogyne kanehoana												
SBW-W	Manage for stability	303	2014-08-27	190	89	24	0	Partial	Partial	Yes	No	No
Skeet Pass												
SBW-X	No Management	1	2009-11-23	0	1	0	0	Yes	No	Partial	No	No
elepalo #4												
SBW-Y	No Management	3	2009-11-23	0	3	0	0	Yes	No	Partial	No	No
Elepalo #8												
SBW-Z	No Management	2	2017-04-19	1	1	0	0	Yes	No	No	No	No
Clair's Ridge												
	ESU Total:	343		208	111	24	0					

Size Class Definitions

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

*=Snails were Trans Located or Reintroduced

= Threat to Taxon at Population Reference Site

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

Yes= Threat is being controlled at PopRefSite

No=Threat is not being controlled at PopRefSite

Partial=Threat is being partially controlled at PopRefSite

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

5.4.1.1 SBW-A North Haleauau-Hame Ridge PRS

SBW-A is located in the UXO area. OANRP has been documenting steady declines in recent years and has submitted a proposal to begin to translocate the remaining snails to SBW-W where there is no enclosure. OANRP would like the IT to act on this topic such that management can be carried out in the next year. See Appendix 5-1 for details.

5.4.1.2 SBW-W Skeet Pass PRS

On September 20, 2017, a total of 231 snails were counted while surveying. Because a slightly different monitoring style was used compared with the 2014 survey, not as many snails were counted. It is very steep habitat and ropes have been used to access some of the areas. The site will be monitored again in Quarter 3 of 2018.

5.4.1.3 No Management PRS

There is a total of 12 sites in this category and many of them have not been surveyed recently. Although most of them only had a few snails, as time allows OANRP will conduct surveys to ascertain whether there are any snails surviving.

5.4.2 ESU-C Future Management

OANRP will conduct monitoring of the MFS PRS (Table 14) and construction of the enclosure at Kaala will be pursued (Table 15) as outlined below. OANRP will work with the IT to develop a translocation plan for snails once construction of the enclosure is underway. OANRP looks forward to determining a plan of action for the SBW-A snails with the IT. Searches for *E. rosea*, and *T. jacksonii xantholophus* in the course of other work will also continue. Ungulate control will also be ongoing.

Table 14. ESU-C Monitoring Plan for MFS PRS

PRS	Monitoring Type	Monitoring Interval	Survey Years	Comments
SBW-A North Haleauau	TCM	annual	all	Conduct night TCM for 6 person-hours.
SBW-W Skeet Pass PRS	TCM	every 2 years	2016, 2018	Conduct night TCM for 9.25 person-hours

Table 15. Three Year Action Plan for ESU-C

PRS	MIP YEAR 14 July 2017 – June 2018	MIP YEAR 15 July 2018 – June 2019	MIP YEAR 16 July 2019 – June 2020
SBW-A North Haleauau	• Implement monitoring plan • Rat control • Begin construction of enclosure at Kaala	• Implement monitoring plan • Rat control • Complete construction of enclosure at Kaala	• Implement monitoring plan • Rat control • Translocate snails to Kaala enclosure
SBW-W Skeet Pass PRS	• Implement monitoring plan • Rat control • Begin construction of enclosure at Kaala	• Implement monitoring plan • Rat control • Complete construction of enclosure at Kaala	• Implement monitoring plan • Rat control • Translocate snails to Kaala enclosure
NM PRS			• Translocate snails to Kaala enclosure

5.5 ESU-D

ESU-D covers a large geographic area and is therefore divided into three units: ESU-D1 in the Kaluaa area (including Hapapa) (Figure 10), ESU-D2 in Makaha Valley (Figure 13) and ESU-D (Figure 12) in the Lihue area. ESU D1 and D2 have MFS PRS, however ESU-D does not. The geographic extremes were picked for management by the IT so that the greatest genetic diversity could be represented. These three groups will be discussed below from South to North in the following order D1, D, and D2.

Map removed to protect rare resources

Figure 10: Map of ESU-D1

5.5.1 ESU-D1 Management History and Population Trends

There is one MFS PRS at KAL-G (Puu Hapapa Snail Enclosure) (Table 16). During TCM, 805 snails were observed and the population appears to be stable or increasing. There are 10 NM PRS with few to no snails as they have been translocated into the enclosure. Habitat restoration efforts in the Puu Hapapa Enclosure are largely complete with a nearly continuous sub-canopy of native host plants now established to facilitate genetic communication of snails across the enclosure. Improvements to the barrier alarm and electric deterrence and alarm system for *E. rosea* are ongoing. Staff will continue to opportunistically survey and translocate snails if found at the 10 NM PRS. Threats are abundant outside of the enclosure with *E. rosea* and *T. jacksonii xantholophus* commonly seen. Pigs occasionally disturb snail habitat in the unfenced area of PRS SBS-B.

Table 16. ESU-D1 Population Structure and Threat Control Summary

Number of Snails Counted

Population Reference Site	Management Designation	Total Snails	Date of Survey	Size Classes				Threat Control				
				Large	Medium	Small	Unk	Ungulate	Weed	Rat	Euglandina rosea	Jackson's Chameleon
Achatinella mustelina												
ESU: D1	**North Kaluaa, Waieli, Puu Hapapa, and Schofield Barracks South Range**											
ELI-A	No Management	5 *	2016-11-07	4	1	0	0	Yes	No	No	No	No
South Waieli Gulch North Branch												
ELI-B	No Management	2 *	2016-06-15	1	1	0	0	Yes	No	No	No	No
South Waieli Gulch, North Side of Ridge												
KAL-A	No Management	0 *	2014-03-06	0	0	0	0	Yes	Partial	Yes	Partial	Partial
Land of 10,000 snails												
KAL-B	No Management	0 *	2015-02-12	0	0	0	0	Yes	Partial	No	No	No
Gulch 1 Kaluaa												
KAL-C	No Management	0 *	2015-01-27	0	0	0	0	Partial	Partial	No	No	No
North Kaluaa												
KAL-D	No Management	0 *	2015-01-14	0	0	0	0	Yes	Partial	No	No	No
Gulch 3												
KAL-E	No Management	1 *	2016-08-29	0	1	0	0	Yes	No	No	No	No
Gulch 2												
KAL-F	No Management	0 *	2016-06-06	0	0	0	0	Yes	No	No	No	No
Central Kaluaa South Branch												
KAL-G	Manage for stability	805	2017-06-07	544	189	72	0	Yes	Yes	Yes	Yes	Yes
Puu Hapapa snail enclosure												
MIK-A	No Management	0	2012-10-04	0	0	0	0	No	No	No	No	No
Mikilua Gulch												
SBS-A	No Management	0	2012-12-19	0	0	0	0	Yes	No	No	No	No
Moho Gulch Lamsan and Amamic exclosure												
SBS-B	No Management	0 *	2013-12-11	0	0	0	0	No	No	No	No	No
Puu Hapapa												
SBS-D	No Management	2 *	2016-12-08	2	0	0	0	No	No	No	No	No
Two gulches west of Moho gulch enclosure												
	ESU Total:	815		551	192	72	0					

Size Class Definitions

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

*=Total Snails were Trans Located or Reintroduced

= Threat to Taxon at Population Reference Site

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

Yes=Threat is being controlled at PopRefSite

No=Threat is not being controlled at PopRefSite

Partial=Threat is being partially controlled at PopRefSite

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

5.5.1.1 KAL-G Puu Hapapa Snail Enclosure PRS

A total of 805 snails were observed during TCM on June 7, 2017 (This figure may possibly be 50-75% of what is actually present) (Figure 11). Though TCM counts oscillate, the population appears to be stable if not increasing. This is most strongly supported by data since July 2014, as numbers rose over time while new translocations dropped to very low numbers after that time. Staff continue to conduct TCM here on a quarterly basis. The habitat continues to improve and the snails have been observed spreading out into new vegetation as outplanted trees grow larger. In the past year, no *T. jacksonii xantholophus* or *E. rosea* have been found inside the enclosure. Staff have been diligent in trimming the trees along the fence walls to prevent ingress of any *T. jacksonii xantholophus*. SEPP monitors other rare snail taxa which they have translocated into the enclosure, including *Amastra spirizona* from Makaha, *Laminella sanguinea* from the Waieli side of Puu Hapapa, *Amastra intermedia* from Mikilua and Daniel Chung's captive propagation project, *Cookeconcha* sp. from Puu Hapapa, and *Leptachatina* sp. from Mikilua.

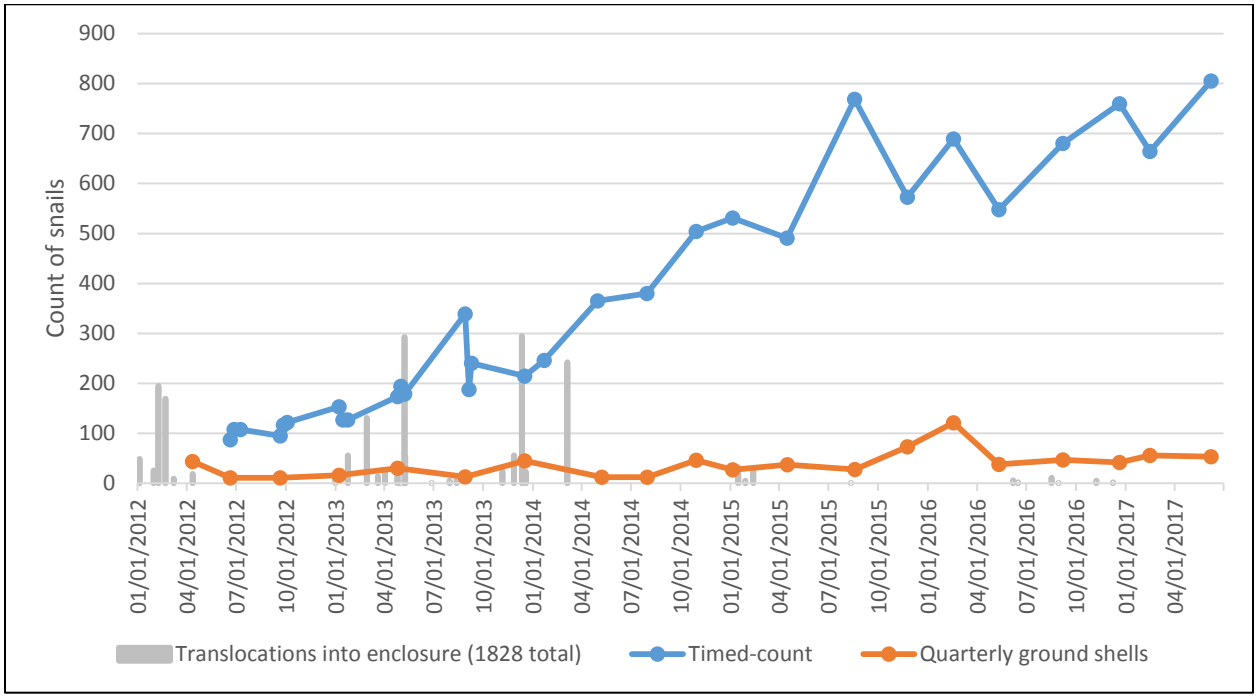

Figure 11. Timed-counts and ground shell counts for *A. mustelina* in Hapapa snail enclosure from June 2012 to June 2017, with numbers of snails translocated into the enclosure over time. Note: TCM data represents a subsample of the population, as not all snails are detectable at any one time.

5.5.1.2 No Management PRS

The ten NM PRS are not monitored regularly. With a high abundance of threats, these sites will likely continue to decline. OANRP staff opportunistically translocate the few snails remaining into the enclosure. Table 17 shows the number of snails from which populations were translocated into the snail enclosure in the past year.

Table 17. Translocations of A. mustelina into KAL-G Hapapa Enclosure 2016-2017

Translocation Date	Population Reference Site	Small	Medium	Large	Total
2016-08-16	SBS-D Puu Hapapa	0	3	8	11
2016-08-29	KAL-E Kaluaa Gulch 2	0	1	0	1
2016-11-07	ELI-A South Waieli Gulch North Branch	0	1	4	5
2016-12-08	SBS-D Puu Hapapa	0	0	2	2

5.5.2 ESU-D1 Future Management

OANRP staff will continue monitoring KAL-G (Puu Hapapa Snail Enclosure) (Table 18) and management will continue as described in Table 19. Threat control will continue around the existing enclosure, including tracking tunnels for *R. rattus*, and searches for *E. rosea*, and *T. jacksonii xantholophus*. Weed control and habitat improvements will continue. Improvements to the barrier alarm system and electric deterrence system for *E. rosea* will also be installed in the coming year. Habitat improvements will continue in the area surrounding the enclosure. Pig control at the SBS-B population will be done as needed as well as any further translocations from this PRS.

Table 18. ESU-D1 Monitoring Plan for MFS PRS

PRS	Monitoring Type	Monitoring Interval	Survey Years	Comments
KAL-G Puu Hapapa Snail Enclosure	TCM	quarterly	all	Conduct night TCM with 4 personnel for 7 person-hours total. Consider limiting TCM to twice a year.
	GSP	quarterly	all	GSP KAL-G-1

Table 19. Three Year Action Plan for ESU-D1

PRS	MIP YEAR 13 July 2016 – June 2017	MIP YEAR 14 July 2017 – June 2018	MIP YEAR 15 July 2018 – June 2019
KAL-G Puu Hapapa Snail Enclosure	• Implement monitoring plan • Rat control • Maintain enclosure and monitor for predators • Improve habitat via weed control and restoration planting	• Implement monitoring plan • Rat control • Maintain enclosure and monitor for predators	• Implement monitoring plan • Rat control • Maintain enclosure and monitor for predators

5.5.3 ESU-D No management PRS

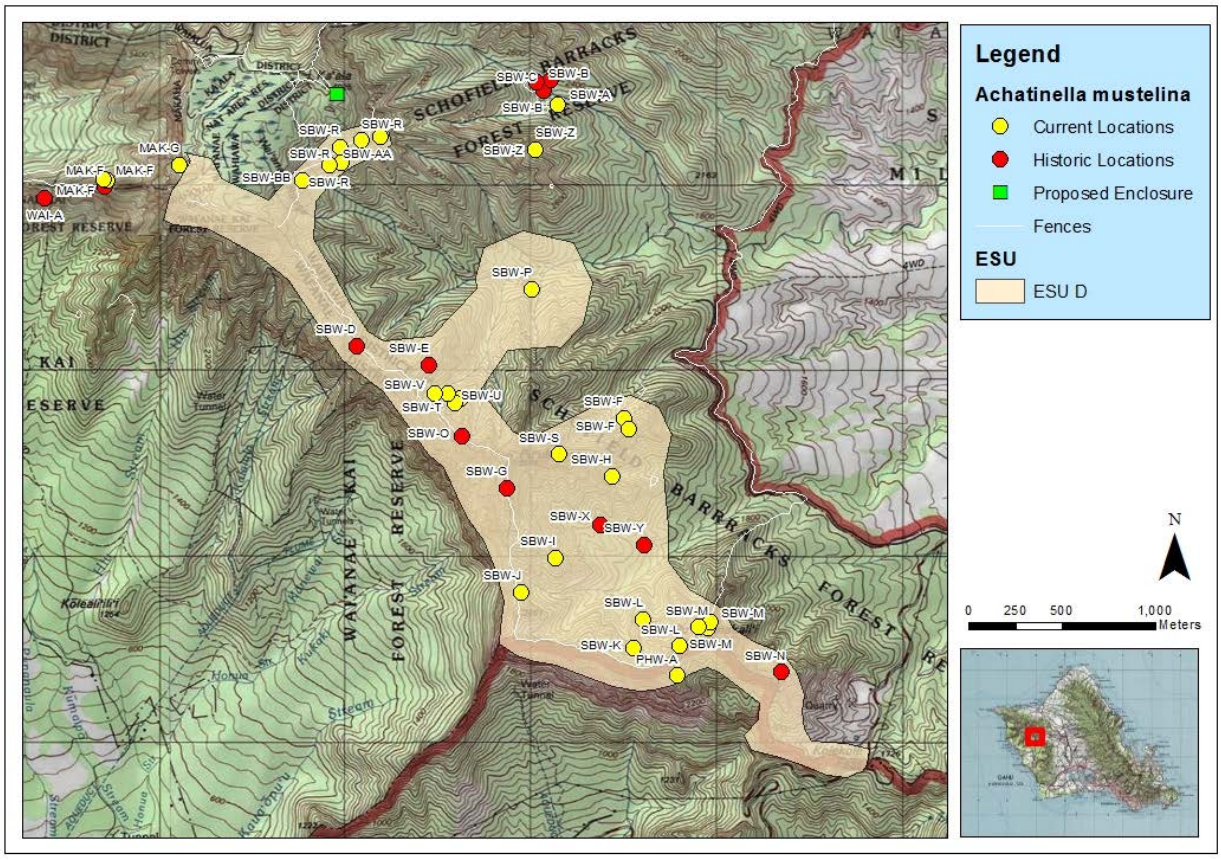

Figure 12. Map of ESU-D

None of these populations are being managed and many have not been surveyed recently (Table 20). OANRP plan to survey this sites in the coming year to obtain current data and recommend moving some of these snails into the Puu Hapapa snail enclosure given the high level of predation (Appendix 5-2).

Table 20. ESU-D Population Structure and Threat Control Summary

Number of Snails Counted

Population Reference Site	Management Designation	Total Snails	Date of Survey	Size Classes				Threat Control				
				Large	Medium	Small	Unk	Ungulate	Weed	Rat	Euglandina rosea	Jackson's Chameleon
Achatinella mustelina												
ESU: D	**No Management ESU Sites of Waianae Kai, Kaluaa, Puhawai, SBS, and SBW**											
PHW-A	No Management	1	2017-02-22	0	1	0	0	No	No	No	No	No
Lualualei, Puhawai below Tetfil finger												
SBS-C	No Management	0 *	2012-12-19	0	0	0	0	No	No	No	No	No
Lower Moho Gulch - Jennifer Crummer's spot												
SBW-AA	No Management	12	2012-10-25	7	5	0	0	Yes	No	No	No	No
Mt Kaala below blue trail fence												
SBW-BB	No Management	15	2013-10-10	6	5	4	0	Yes	No	No	No	No
Below transect 790												
SBW-D	No Management	1	2000-02-18	0	0	0	1	Yes	Partial	No	No	No
Kaala-Kalena ridge on "M" in Military												
SBW-E	No Management	1	2000-02-18	1	0	0	0	Yes	No	No	No	No
Kaala-Kalena ridge between Military and Reservation												
SBW-F	No Management	4	2006-06-22	3	0	1	0	Yes	No	No	No	No
North Mohiakea Banana Gulch												
SBW-G	No Management	0	2003-10-14	0	0	0	0	Yes	Partial	No	No	No
South of Puu Kalena												
SBW-H	No Management	9	2015-06-23	5	2	2	0	Yes	No	No	No	No
North Branch of South Mohiakea												
SBW-I	No Management	8	2016-06-21	6	1	1	0	Yes	No	No	No	No
South Mohiakea Sicyos site												
SBW-J	No Management	10	2000-05-17	10	0	0	0	Yes	Partial	No	No	No
Zandip site along Kalena-Kumakalii Ridge												
SBW-K	No Management	47	2009-11-05	30	9	8	0	Yes	No	No	No	No
Kumakalii-Kalena ridge-"TR" gulch on the map by "Wahiawa District"												
SBW-L	No Management	36	2017-02-23	24	10	2	0	Yes	No	No	No	No
Kalena-Kumakalii Ridge-Dike rock gulch												
SBW-M	No Management	8	2017-02-23	5	1	2	0	Yes	No	No	No	No
Puu Kumakalii												

SBW-N	No Management	0	2009-06-24	0	0	0	0	No	No	No	No	No
1st Peak North of Kolekole Pass												
SBW-O	No Management	0	2014-11-16	0	0	0	0	Yes	Partial	No	No	No
North of Puu Kalena Alstri Notch												
SBW-Q	No Management	81	2007-08-21	47	32	2	0	Yes	No	No	No	No
North of Puu Kalena below Schtri Notch												
SBW-R	No Management	121	2014-09-11	92	25	4	0	Yes	Partial	No	No	No
Mt. Kaala southern end of Haleauau fencline												
SBW-S	No Management	4	2007-08-29	3	1	0	0	Yes	No	No	No	No
Upper Banana Gulch												
SBW-T	No Management	33	2009-06-10	25	1	7	0	Yes	No	No	No	No
Albizzia Gulch												
SBW-U	No Management	17	2007-08-22	13	3	1	0	Yes	No	No	No	No
Gulch #1/Tri Gulch Camp												
SBW-V	No Management	31	2007-08-22	21	9	1	0	Yes	No	No	No	No
Gulch #4/Tri Gulch Camp												
WAI-A	No Management	10	2000-06-26	0	0	0	10	No	No	No	No	No
Waianae Kai - Hesarb site												
	ESU Total:	449		298	105	35	11					

Size Class Definitions

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

*=Total Snails were Trans Located or Reintroduced

= Threat to Taxon at Population Reference Site

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

Yes=Threat is being controlled at PopRefSite

No=Threat is not being controlled at PopRefSite

Partial=Threat is being partially controlled at PopRefSite

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

5.5.4 ESU-D2

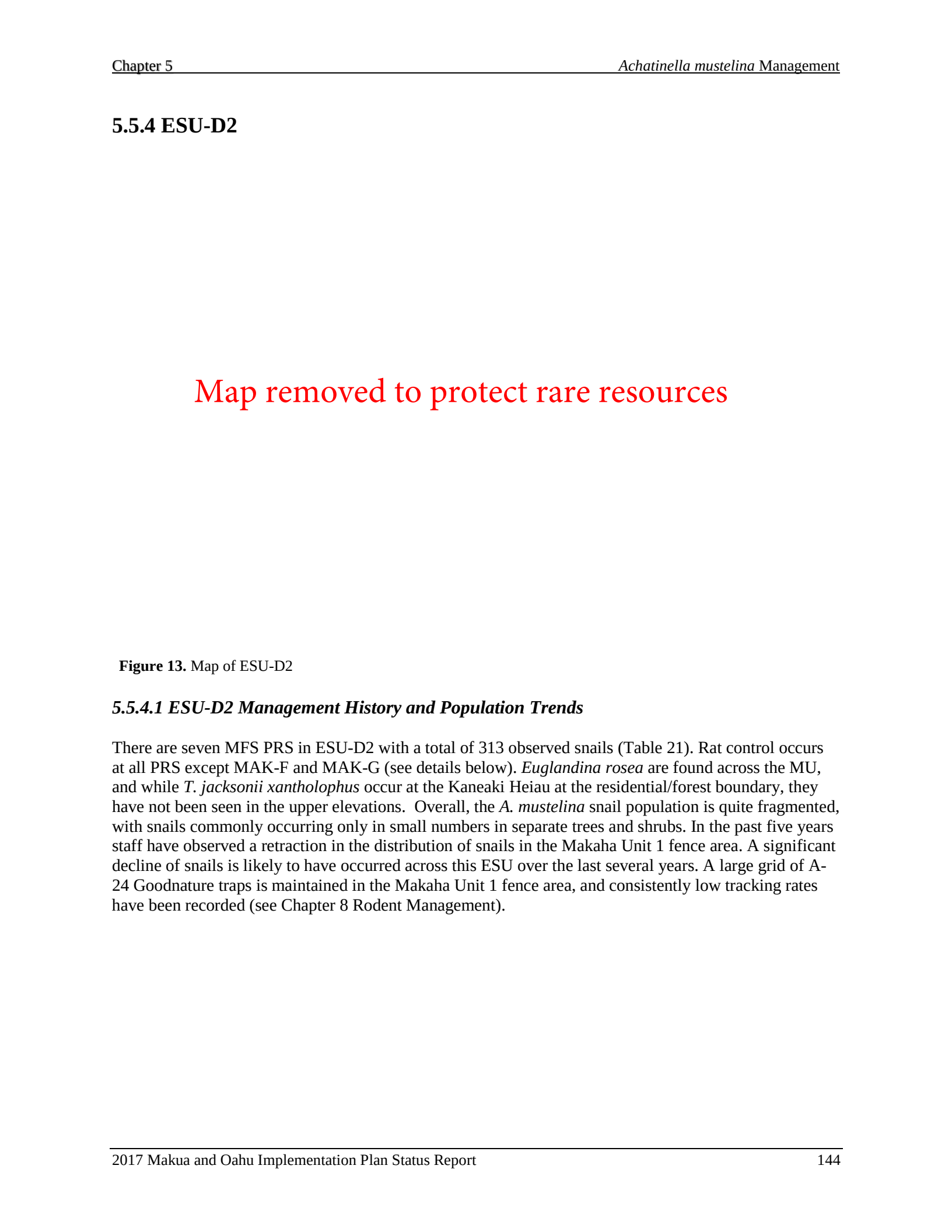

Figure 13. Map of ESU-D2

5.5.4.1 ESU-D2 Management History and Population Trends

There are seven MFS PRS in ESU-D2 with a total of 313 observed snails (Table 21). Rat control occurs at all PRS except MAK-F and MAK-G (see details below). *Euglandina rosea* are found across the MU, and while *T. jacksonii xantholophus* occur at the Kaneaki Heiau at the residential/forest boundary, they have not been seen in the upper elevations. Overall, the *A. mustelina* snail population is quite fragmented, with snails commonly occurring only in small numbers in separate trees and shrubs. In the past five years staff have observed a retraction in the distribution of snails in the Makaha Unit 1 fence area. A significant decline of snails is likely to have occurred across this ESU over the last several years. A large grid of A-24 Goodnature traps is maintained in the Makaha Unit 1 fence area, and consistently low tracking rates have been recorded (see Chapter 8 Rodent Management).

Table 21. ESU-D2 Population Structure and Threat Control Summary

Number of Snails Counted

Population Reference Site	Management Designation	Total Snails	Date of Survey	Size Classes				Threat Control				
				Large	Medium	Small	Unk	Ungulate	Weed	Rat	Euglandina rosea	Jackson's Chameleon
Achatinella mustelina												
ESU: D2 Makaha												
MAK-A	Manage for stability	9 *	2016-09-19	4	4	1	0	Yes	Partial	Yes	No	No
Isolau ridge												
MAK-B	Manage for stability	14	2017-02-01	11	1	2	0	Yes	Partial	Yes	No	No
Kumaipo ridge crest												
MAK-C	Manage for stability	14	2015-06-16	11	3	0	0	Yes	Partial	Yes	No	No
Near pinnacle rocks. Includes Hesarb ridge.												
MAK-D	Manage for stability	34	2016-09-19	15	18	1	0	Yes	Partial	Yes	No	No
On ledge below ridge crest above MAK-A site.												
MAK-E	Manage for stability	60	2015-06-18	47	10	3	0	Yes	Partial	Yes	No	No
Ridge east of Cyasup exclosure												
MAK-F	Manage for stability	145	2016-09-19	101	37	7	0	No	Partial	No	No	No
Waianae Kai trail to Kaala												
MAK-G	Manage for stability	37	2016-04-05	28	5	4	0	No	No	No	No	No
Upper Makaha 3850 ft.												
	ESU Total:	313		217	78	18	0					

Size Class Definitions

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

*=Total Snails were Trans Located or Reintroduced

= Threat to Taxon at Population Reference Site

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

Yes= Threat is being controlled at PopRefSite

No=Threat is not being controlled at PopRefSite

Partial=Threat is being partially controlled at PopRefSite

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

5.5.4.1.1 MAK-A Kumaipo Isolau Ridge PRS

This PRS was last surveyed on September 19, 2016 when 9 snails were counted. Incidental observations indicate that there have been declines since the last TCM.

5.5.4.1.2 MAK-B Kumaipo Ridge Crest PRS

Many of the trees at this site that used to harbor snails have died and snail numbers have since declined. On the February 1, 2017 survey a total of 14 snails were observed and all of these were off of the main ridge trail. During the survey on January 19, 2010 a total of 21 snails were counted and most of these were on the main ridge trail. OANRP will survey this site as time allows, and if numbers are low it will be re-designated as NM. This PRS is not a priority due to the low number of snails.

5.5.4.1.3 MAK-C Near Pinnacle Rocks PRS

Fourteen snails were seen in June of 2015. OANRP will survey this site in 2017 to update numbers.

5.5.4.1.4 MAK-D On Ledge Below Ridge Crest Above MAK-A Site PRS

This PRS was last surveyed on September 19, 2016 and will be surveyed again next year to monitor trends. The most recent TCM indicates that there have been declines since the last TCM in 2014.

5.5.4.1.5 MAK-E Ridge East of Cyasup Exclosure PRS

This PRS has the second highest number of snails in the ESU. OANRP will monitor the site in 2017 to track trends.

5.5.4.1.6 MAK-F Waianae Kai Trail PRS

This site was last surveyed on September 19, 2016. A total of 145 snails were found here with the aid of ropes and three rappellers. There is still more area that needs to be explored to understand the full extent of the PRS. It is a difficult and steep area with thick vegetation. OANRP staff will continue to explore the area in the next year to determine the extent of the PRS.

5.5.4.1.7 MAK-G Upper Makaha PRS

This is a new site discovered by state staff while searching for rare plants in November 2015. OANRP staff surveyed on April 5, 2016 and found a total of 37 snails (4 small, 5 medium and 28 large). OANRP staff will return to the PRS this year to further explore the area and determine the extent of the PRS. This PRS is located just 150 ft. lower than the summit bog at 3850 ft., and is the highest elevation site for *A. mustelina* in the entire universe.

5.5.4.2 ESU-D2 Future Management

With recent finds at higher elevations OANRP is optimistic that there may be more snails to discover (Table 22). However threat control will be challenging in these steep inaccessible areas. OANRP will continue to explore higher elevation areas in the next year to determine numbers and consider possible threat control options (Table 23). Since the snails in Makaha show genetic similarities with the snails on Ohikilolo and because the weather conditions are also similar, OANRP proposed translocating snails

from Makaha to Ohikilolo. There are presently data loggers in both areas and they will be collected and analyzed in the near future to determine climate similarity

Table 22. ESU-D2 Monitoring Plan for MFS PRS

PRS	Monitoring Type	Monitoring Interval	Survey Years	Comments
MAK-A Isolau Ridge	TCM	every 2 years	2016, 2018, 2020	Conduct night TCM with 3 personnel 2 hours each, for 6 total person-hours.
MAK-C Near Pinnacle Rocks	TCM	every 2 years	2017, 2019, 2021	Conduct night TCM for 6 person-hours.
MAK-D On Ledge	TCM	every 2 years	2016, 2018, 2020	Conduct night TCM for 10 person-hours. Five hours in the lower area and 5 in the upper.
MAK-E Ridge East of Cyasup	TCM	every 2 years	2017, 2019, 2021	Conduct night TCM for 4 person-hours.
MAK-F Waianae Kai	TCM	every 2 years	2016, 2018, 2020	Conduct night TCM for 4 total person-hours. Conduct day TCM on rope for 4 person-hours.
MAK-G Upper Makaha	TCM	every 2 years	2017, 2019, 2021	Conduct night TCM for 4 total person-hours. Conduct day TCM on rope for 4 person-hours.

Table 23. Three Year Action Plan for ESU-D2

PRS	MIP YEAR 14 July 2017 – June 2018	MIP YEAR 15 July 2018 – June 2019	MIP YEAR 16 July 2019 – June 2020
MAK-A Isolau Ridge	• Resurvey • Implement monitoring plan	• Rat control	• Implement monitoring plan • Rat control
MAK-C Near Pinnacle Rocks	• Implement monitoring plan • Rat control	• Rat control	• Implement monitoring plan • Rat control
MAK-D On Ledge	• Implement monitoring plan • Rat control	• Rat control	• Implement monitoring plan • Rat control
MAK-E Ridge East of Cyasup	• Rat control	• Implement monitoring plan • Rat control	• Rat control
MAK-F Waianae Kai	• Determine PRS extent • Investigate rat control	• Implement monitoring plan • Rat control	• Rat control
MAK-G Upper Makaha	• Determine PRS extent • Investigate rat control	• Implement monitoring plan • Rat control	• Rat control

5.6 ESU-E

Map removed to protect rare resources

Figure 14. Map of ESU-E

5.6.1 ESU- E Management History and Population Trends

There are seven MFS PRS (Figure 14) that include 69 observed snails and seven NM PRS with twenty-eight observed snails at ESU-E (Table 24). The larger PRS were surveyed during the past year. Overall OANRP suspects that the declines observed in 2014 have continued. Most of the PRSs are included in the larger rat control grid in the Ekahanui MU. *Trioceros jacksonii xantholophus* have been seen once in Ekahanui but do not seem prevalent. *Euglandina rosea* are common and thought to be the major cause of decline. ESU-E is an area of considerable management focus given steep declines in snail numbers. Plans were made with the IT in 2015 to translocate snails to a permanent enclosure at Palikea. In order to temporarily maintain all remaining ESU-E snails in a highly protected location pending completion of a larger permanent enclosure at Palikea, OANRP has begun to collect snails and deposit them at the SEPP lab.

Table 24. ESU-E Population Structure and Threat Control Summary

Number of Snails Counted

Population Reference Site	Management Designation	Total Snails	Date of Survey	Size Classes				Threat Control				
				Large	Medium	Small	Unk	Ungulate	Weed	Rat	Euglandina rosea	Jackson's Chameleon
Achatinella mustelina												
ESU: E	**Puu Kaua / Ekahanui**											
EKA-A	Manage for stability	34 *	2017-04-12	20	13	1	0	Yes	No	Yes	No	No
Mamane Ridge and Near Piapripri EKA-A												
EKA-B	Manage for stability	7 *	2017-04-12	6	1	0	0	Yes	Partial	Yes	No	No
Below north population of Tetlep. Between Piapri EKA-A, EKA-B and EKA-C												
EKA-C	Manage for stability	28 *	2017-04-12	24	2	2	0	Yes	Partial	Yes	No	No
At Piapripri EKA-C site												
EKA-D	Manage for stability	0	2017-05-31	0	0	0	0	Yes	No	No	No	No
Puu Kaua												
EKA-E	No Management	8	2014-05-28	6	1	1	0	Yes	No	Yes	No	No
Amastra site												
EKA-F	No Management	1	2015-08-12	1	0	0	0	Yes	No	Yes	No	No
from Piapri-C head along blue trail under cliffs mauka												
EKA-G	No Management	0	2013-02-17	0	0	0	0	Yes	Partial	Yes	No	No
Cenagr												
EKA-M	Manage for stability	0	2016-12-19	0	0	0	0	Yes	No	Yes	Yes	Yes
Mamane Ridge snail enclosure												
EKA-S	Manage for stability	0	2016-12-07	0	0	0	0	Yes	No	Yes	Yes	Yes
Spirizona snail enclosure												
HUL-A	No Management	3	2016-05-25	2	1	0	0	No	No	No	No	No
North Huliwai South Branch												
HUL-B	No Management	1	2007-06-18	1	0	0	0	No	No	No	No	No
South Huliwai Gulch												
HUL-C	No Management	7	2016-05-25	5	2	0	0	No	No	No	No	No
Off Ridge Crest South of Puu Kanehoa												
HUL-D	No Management	8	2016-06-01	6	1	1	0	No	No	No	No	No
Puu Kanehoa												
	ESU Total:	97		71	21	5	0					

Size Class Definitions

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

*=Total Snails were Trans Located or Reintroduced

= Threat to Taxon at Population Reference Site

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

Yes= Threat is being controlled at PopRefSite

No=Threat is not being controlled at PopRefSite

Partial=Threat is being partially controlled at PopRefSite

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

5.6.1.1 EKA-A Mamane Ridge PRS

This site was surveyed on April 11, 2017 and a total of 45 snails were counted. Among those 11 were collected and given to SEPP for captive propagation. Staff have collected *E. rosea* here and it appears that this predator is having a detrimental effect on the snails. During the survey of September 28, 2016 a total of 31 snails were counted here.

5.6.1.2 EKA-B Below Tetlep PRS

This site also appears to be showing a decline, likely due to *E. rosea.* On April 12, 2017, a total of 7 (1 medium, and 6 large) *A. mustelina* were found, all of which were collected and given to SEPP for captive rearing.

5.6.1.3 EKA-C Plapri PRS

This is one of the two primary sites in the entire ESU. Staff have found and controlled *E. rosea* while surveying here. On April 11, 2017 a total of 41 *A. mustelina* were found, from which 13 (3 medium, and 10 large) were collected and given to SEPP for captive propagation.

5.6.1.4 EKA-D Puu Kaua PRS

Snails at this site have been in serious decline since a dieback affected most of the *M. lessertiana* trees in the area. *E. rosea* have also been a serious problem here. On May 31, 2017 a total of 5 *A. mustelina* were collected here and given to SEPP. Staff plan to return to this site and search again for any remaining snails.

5.6.1.5 EKA-H South Ekahanui North Branch PRS

This site was last surveyed on June 29, 2017 when a total of 10 snails were collected and given to SEPP. On this trip staff did not have ropes to search the steep habitat that had been searched in 2013. OANRP plan to return with ropes in the near future to survey and collect any remaining snails from the area.

5.6.1.6 EKA-M Mamane Ridge PRS and EKA-S Spirizona PRS Temporary Snail Enclosures

The most recent timed-counts at these sites in December 2016 found no live snails remaining (Figure 15). As discussed in detail in last year's report, the cause of the failure of the temporary enclosures remains unknown. OANRP does not intend to utilize such temporary enclosures in the future.

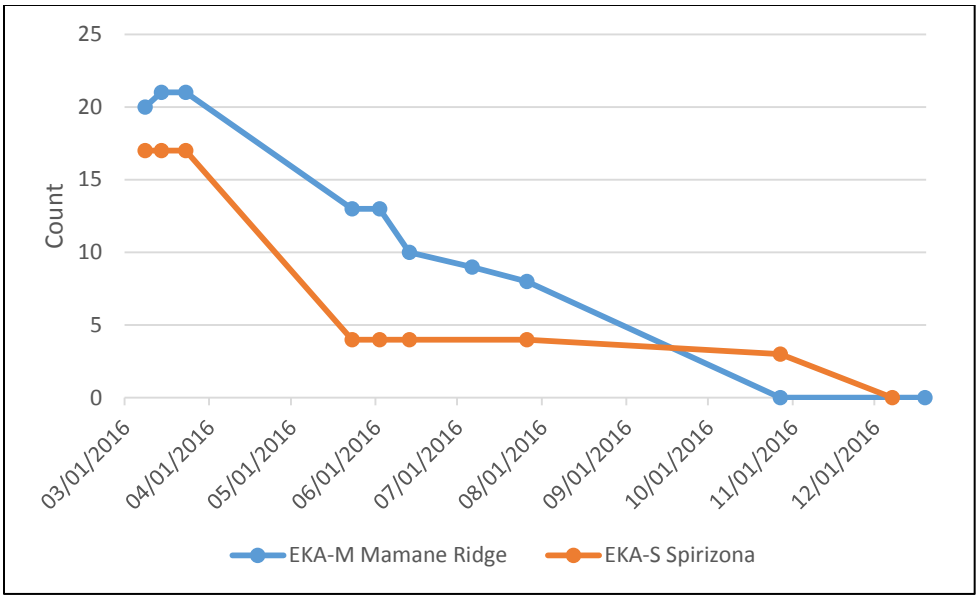

Figure 15. Timed-counts of *Achatinella mustelina* at EKA-M Mamane Ridge and EKA-S Spirizona temporary snail enclosures following the translocation of 20 snails into each enclosure.

5.6.1.7 HUL-D Puu Kanehoa PRS

A small population consisting of 8 snails was found here on June 1, 2016. This site is close to the study site used by Dr. Michael Hadfield in 1976. During his study he estimated the population to be approximately 200+ snails, but at the completion of his research in 1979, all of the snails had disappeared due to *E. rosea*. It always gives a feeling of hope to find snails in an area where they were thought to have been extirpated 40 years ago. This area will be included in translocation efforts.

5.6.1.8 No Management PRS

Most of these sites have few snails surviving but when SEPP has enough room to accommodate all of the snails in Ekahanui, an effort will be made to survey all potential sites.

5.6.1.9 OANRP Euglandina removal efforts

In an effort to maximize survival of remaining snails in Ekahanui OANRP focused on predator removal around known snail hot spots at EKA-A and B. OANRP made trips bimonthly for a total of 13 trips between December of 2016 and June of 2017. Over these trips a total of 80 hours were spent on the effort. Figure 16 records the results of these efforts. It is disappointing to see that despite consistent removal there is no apparent impact on *E. rosea* numbers. This figure illustrates that hand removal alone is not an effective technique to reduce *E. rosea* numbers. However, it was worth the effort in this case as the snails are becoming so rare all efforts are warranted.

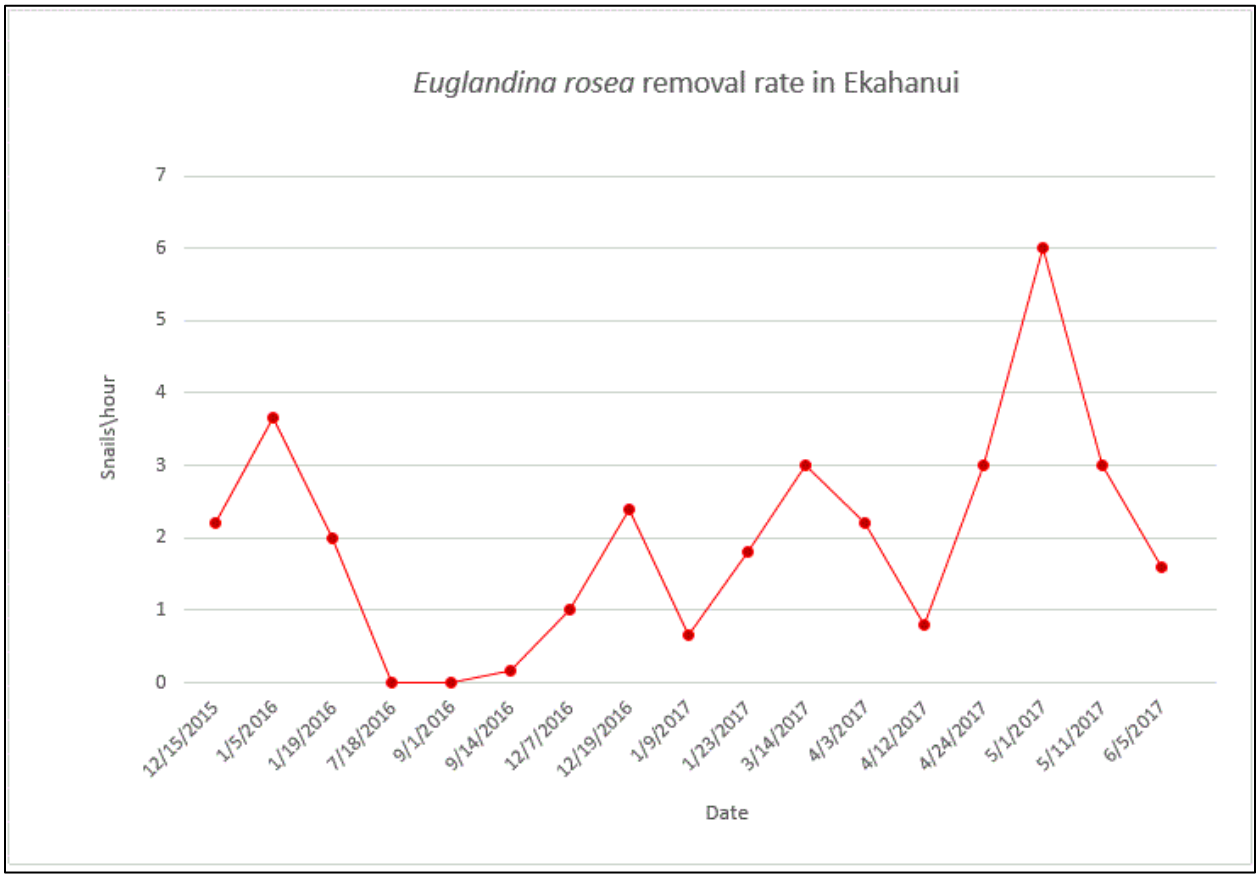

Figure 16. A total of 32 small (<25mm) and 141 large (>25mm) *Euglandina rosea* were removed from Ekahanui over 108 search hours between December 2015 and May 2017.

5.6.1.10 OANRP collections for captive propagation

As approved by the IT in December 2016 OANRP has been working with the SEPP lab to collect Ekahanui snails for safe keeping until the North Palikea snail enclosure is ready for translocation. Efforts began in April 2017 with a total of 6 trips (Table 25). Thus far the lab has been highly successful, with very few deaths and multiple births. A total of 71 snails have been collected (Table 26). With many births in the lab, there are currently 100 snails (Table 27).

Table 25. Collections of *A. mustelina* from ESU-E given to SEPP for Captive Propagation and Remaining Snails in Wild

Population	Date	Small in Lab	Medium in Lab	Large in Lab	Small in Wild	Medium in Wild	Large in Wild
EKA-A	4/11/2017	2	4	5	1	13	20
EKA-B	4/12/2017	0	1	6	0	0	0
EKA-C	4/11/2017	0	3	10	2	2	24
EKA-D	5/31/2017	0	2	3	0	0	1
EKA-H	6/29/2017	0	4	6	0	0	0

Table 26. Ekahanui snails deposited at SEPP Lab

Date	Population	Number
4/13/2017	EKA-A, B, C	31
6/1/2017	EKA-D	5
6/30/2017	EKA-E	10
7/13/2017	EKA-F	18
7/13/2017	EKA-G	7
TOTAL		71

Table 27. SEPP Lab Populations of Ekahanui *A. mustelina*, July 2017

PRS	Juvenile	Sub-adult	Adult	Total
EKA- A, B	17	6	10	33
EKA-C	10	6	5	21
EKA-D	2	4	1	7
EKA-E	2	4	5	11
EKA-F	4	11	6	21
EKA-G	0	5	2	7
TOTAL	35	36	29	100

5.6.1.11 Palikea North construction update

The Palikea North Snail Enclosure is currently under construction and will be completed by September 2017. Clearing the vegetation from the area for the enclosure began in June of last year. Due to the discovery of *A. mustelina* within the site, the project was halted from July through December 2016. After the Conjunction with Intensive Weed Management Protocol for Oahu Army Natural Resources Program (Appendix 5-3) were adjusted and finalized, the project resumed January 2017. Clearing was complete in early February. During the clearing process, snail surveys were conducted before and after clearing a sector (Appendix 5-4). About 152 person hours were spent surveying at night for *A. mustelina* for the duration of tree clearing; no snails were found within the area zoned for clearing since June 2016. The person hours spent cutting, dragging and chipping totaled 909.5 hours.

After clearing the area of non-native vegetation, several native species including *M. polymorpha*, *F. arborea*, *C. foliosa*, and *Broussaisia arguta* remained standing. The removal of vegetation around the *F. arborea* created an unsuitable habitat (too hot and dry) causing them to wilt. To create shade and increase ground moisture, shade cloth was installed over the *F. arborea* patches, tarp was laid down uphill of two of the larger patches to divert rain surface runoff to the patches, an additional water catchment was built and a sprinkler system was installed

In April 2017, the contract was finalized and construction of the snail enclosure began. Following the PCSU technical report, Development of tree snail protection enclosures: from design to implementation (#194, 2016), the enclosure was built with a few modifications. The wall structure consists of 4”x4” reinforced plastic posts in concrete footings with a 2”x12” baseboard installed 5” below ground level and a 2”x6” top board measuring at a height of 60” for the frame (Figure 17). A high-density polyethylene (HDPE) geomembrane sheet creates the wall barrier. The rat hood is attached at the top edge of the HDPE geomembrane and has a minimum 6” diameter. To prevent incursion from the bottom of the fence and erosion control, the HDPE geomembrane extends from the wall by a foot, lies on the ground and is held down by the Geoweb® geocells filled with gravel. The *E. rosea* barriers consist of the angle, cut mesh and electrical. The angle barrier is attached to the wall with a minimum of 8” above the ground from the

bottom edge to allow ease of checking under the angle. The cut mesh attaches just above the angle and the electrical barrier is added to the flat-face of the cut mesh barrier perpendicular to the ground (Figure 18).

Figure 17. Palikea North snail enclosure wall frame, inside of enclosure

Figure 18. Palikea North snail enclosure wall with *E. rosea* barriers, rat hood and erosion control

During the construction of the enclosure, the interior still contained many small branches/sticks/rocks and the numerous cut-stumps posed a safety hazard. To ensure the enclosure to be free of *E. rosea*, ground cover was raked down to the topsoil to remove hiding places for *E. rosea*. Clearing the ground cover involved about 257 person hours of raking, weed whacking the stumps, using a leaf blower to clear out any crevices and holes, and dumping the ground cover outside the walls.

A 10m x 10m grid was laid out dividing the entire area within the enclosure to aid in weeding, *E. rosea* searches and in the future for planting. Photopoint poles were initially installed with PVC and later replaced permanently with metal pipes.

Euglandina rosea sweeps will begin in September 2017 and pending results of sweeps restoration planting is scheduled for October-November. Once restoration is underway OANRP will begin planning for reintroduction of ESU E SEPP lab snails. Reintroduction will hopefully be possible in early 2019, if vegetation has grown in sufficiently to provide adequate host plants and shade. For more details on restoration plans see Palikea North Enclosure Restoration Plan (Appendix 5-5).

5.6.2 ESU-E Future Management Plans

Future management focuses on maximizing collections from Ekahanui (Table 28). OANRP will continue to closely work with SEPP to plan collections. In addition OANRP will continue to work in the field to minimize impacts by collecting *E.* rosea from PRS with remaining snails. No monitoring or ground shell plots are planned (Table 29).

Table 28. ESU-E Monitoring Plan for MFS PRS

PRS	Monitoring Type	Monitoring Interval	Survey Years	Comments
EKA-A Mamane Ridge	Translocate to SEPP	quarterly	2017, 2018	Coordinate with SEPP
	Euglandina search	quarterly	2017, 2018	Focus on wet season
EKA-B Below Tetlep	Translocate to SEPP	quarterly	2017, 2018	Coordinate with SEPP
EKA-C Plapri	Translocate to SEPP	quarterly	2017, 2018	Coordinate with SEPP
	Euglandina search	quarterly	2017, 2018	Focus on wet season
EKA-D Puu Kaua	Translocate to SEPP	annually	2017, 2018	Coordinate with SEPP
EKA-H South Ekahanui	Translocate to SEPP	annually	2017, 2018	Coordinate with SEPP

Table 29. Three Year Action Plan for ESU-E

PRS	MIP YEAR 14 July 2017 – June 2018	MIP YEAR 15 July 2018 – June 2019	MIP YEAR 16 July 2019 – June 2020
EKA-A Mamane Ridge	• Rat Control • *E. rosea* searches • Collect for SEPP	• Rat Control • *E. rosea* searches • Collect for SEPP	
EKA-B Below Tetlep	• Rat Control • Collect for SEPP	• Rat Control • Collect for SEPP	
EKA-C Plapri	• Rat Control • *E. rosea* searches • Collect for SEPP	• Rat Control • *E. rosea* searches • Collect for SEPP	
EKA-D Puu Kaua	• Rat Control • Collect for SEPP	• Rat Control • Collect for SEPP	
EKA-H South Ekahanui	• Rat Control • Collect for SEPP	• Rat Control • Collect for SEPP	
HUL-A	• Collect for SEPP	• Collect for SEPP	
HUL-C	• Collect for SEPP	• Collect for SEPP	
HUL-D	• Collect for SEPP	• Collect for SEPP	

5.7 ESU-F

Map removed to protect rare resources

Figure 19. Map of ESU-F.

5.7.1 Management History and Population Trends

A total of 572 snails have been detected by TCM in the three MFS PRS in ESU-F (Table 30). Most of the snails from the NM PRS in Palikea are listed as zero as snails from these PRS were moved into the enclosure (Figure 19), and no monitoring has been conducted at them since. There are 8 snails in the NM PRS from Palawai which will likely be translocated to the existing enclosure in the near future. Small snail populations are still occasionally found in the Palikea Fence and those populations will be assessed for translocation based on their population sizes and risk of predation (e.g. if *E. rosea* are found nearby they will likely be moved). All PRS in the Palikea Fence are within the large rat control grid. SEPP maintains a rat grid around the NM PRS at PAL-B (Delsub Lama Fence). The other NM PRSs in Palawai have no rat control. *E. rosea* is present in PRSs outside of the enclosure and are routinely collected from under the angle barrier. There has only been one *T. jacksonii xantholophus* collected in this ESU. It was found in close proximity to the enclosure on June 24, 2014. Another chameleon was seen on March 14, 2017 but it managed to escape. However, there have not been any additional sightings in many hours of night surveying in the ESU and it is assumed they are in very low densities.

Table 30. ESU-F Population Structure and Threat Control Summary

Number of Snails Counted

Population Reference Site	Management Designation	Total Snails	Date of Survey	Size Classes				Threat Control				
				Large	Medium	Small	Unk	Ungulate	Weed	Rat	Euglandina rosea	Jackson's Chameleon
Achatinella mustelina												
ESU: F Puu Palikea												
KAA-A Mauna Kapu (Palehua)	No Management	0 *	2016-01-25	0	0	0	0	No	No	No	No	No
PAK-A Puu Palikea-Ohia spot	Manage for stability	0 *	2015-09-28	0	0	0	0	Yes	Partial	Yes	No	No
PAK-B Iele Patch	Manage for stability	6 *	2017-04-25	2	3	1	0	Yes	Partial	Yes	No	No
PAK-C Steps spot	Manage for stability	0 *	2017-05-23	0	0	0	0	Yes	Partial	Yes	No	No
PAK-D Joel Lau's site	Manage for stability	0 *	2016-05-05	0	0	0	0	No	Partial	Yes	No	No
PAK-E Exogau site	Manage for stability	0	2015-10-07	0	0	0	0	Yes	Partial	Yes	No	No
PAK-F Dodonaea site	Manage for stability	0 *	2016-10-25	0	0	0	0	Yes	Partial	Yes	No	No
PAK-G Hame and Alani site just above Cyagri fence	Manage for stability	0 *	2016-10-25	0	0	0	0	Yes	Partial	Yes	No	No
PAK-H Mike Hadfield's study site at Puu Palikea	Manage for stability	0 *	2017-04-05	0	0	0	0	Yes	Partial	Yes	No	No
PAK-I One ridge truck side of E and F	Manage for stability	3 *	2017-04-25	3	0	0	0	No	Partial	Yes	No	No
PAK-K Pilo site	Manage for stability	92	2015-10-08	56	33	3	0	Yes	Partial	Yes	No	No
PAK-L Olapa site north of Puu Palikea	Manage for stability	48 *	2017-04-05	34	11	3	0	Yes	Partial	Yes	No	No
PAK-M Middle Site	Manage for stability	316	2016-06-07	205	82	29	0	Yes	Partial	Yes	No	No
PAK-N Campside of Lobelia Ridge	No Management	0 *	2015-10-07	0	0	0	0	No	Partial	No	No	No
PAK-O Below camp fence	No Management	1	2009-09-23	1	0	0	0	No	Partial	Yes	No	No

Size Class Definitions

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

*=Total Snails were Trans Located or Reintroduced

= Threat to Taxon at Population Reference Site

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

Yes= Threat is being controlled at PopRefSite

No=Threat is not being controlled at PopRefSite

Partial=Threat is being partially controlled at PopRefSite

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

Number of Snails Counted

Population Reference Site	Management Designation	Total Snails	Date of Survey	Size Classes				Threat Control				
				Large	Medium	Small	Unk	Ungulate	Weed	Rat	Euglandina rosea	Jackson's Chameleon
PAK-P Palikea snail exclosure	Manage for stability	163	2017-06-20	107	45	11	0	Yes	Partial	Yes	Yes	Yes
PAK-Q outside snail enclosure	Manage for stability	0 *	2016-10-25	0	0	0	0	Yes	Partial	Yes	No	No
PAK-R 4 Trail Junction	Manage for stability	0 *	2016-10-25	0	0	0	0	Yes	Partial	Yes	No	No
PAK-S Palikea North	No Management	0 *	2016-06-30	0	0	0	0	Yes	Partial	Yes	No	No
PAL-A Palawai next to Pri sp.	No Management	8	2014-05-14	6	1	1	0	No	No	No	No	No
PAL-B Delsub Lama Fence	No Management	0	2014-12-22	0	0	0	0	No	No	Yes	No	No
PAL-C Palawai Hesarb trail	No Management	0	2013-05-13	0	0	0	0	No	No	No	No	No
	ESU Total:	637		414	175	48	0					

Size Class Definitions

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

*=Total Snails were Trans Located or Reintroduced

= Threat to Taxon at Population Reference Site

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

Yes= Threat is being controlled at PopRefSite

No=Threat is not being controlled at PopRefSite

Partial=Threat is being partially controlled at PopRefSite

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

5.7.1.1 PAK-H Hadfield's PRS

This PRS was surveyed on April 5, 2017 and no snails where found. Some restoration work had been performed here and after some trees were trimmed and ground cover removed, the area dried out considerably and the snails disappeared.

5.7.1.2 PAK-K Pilo PRS

OANRP staff conducted TCM on October 8, 2015 and a total of 92 snails were counted. This appears to be a healthy population and will not be translocated into the enclosure. It is due to be resurveyed in Q3 of 2017.

5.7.1.3 PAK-L Olapa PRS

This site had 76 snails when OANRP staff conducted TCM on October 7, 2015. The habitat is comprised of many native trees but when staff surveyed here in March of 2017, freshly dead shells were found still stuck on leaves in the trees. They appeared very fresh since rain hadn't washed them onto the ground yet. Staff returned the following week and found one live *E. rosea* in the uluhe ferns under the snail trees and decided to move the surviving snails into the snail enclosure. On April 5, 2017 a total of 48 *A. mustelina* were translocated into the enclosure.

5.7.1.4 PAK-M Middle Site PRS

This is the largest population in the ESU and on June 7, 2016 a total of 316 snails were counted during the TCM. This population appears stable and will not be translocated into the enclosure unless the level of predation increases and significant declines are detected. The area has many native trees and shrubs. Some habitat improvements may be made to control encroaching weed trees in the lower reaches of the area.

5.7.1.5 PAK-P Enclosure PRS

OANRP staff have translocated snails into the Palikea snail enclosure and have begun TCM on a quarterly basis (Figure 20). Snails outside the enclosure in small populations will continue to be brought inside for protection from predators. On May 22, 2017 TCM was performed during the day with 2-person hours spent in each of two separate plots within the enclosure for a total of 65 snails counted. Once a year, a night TCM is performed for 4-person hours covering the entire enclosure. Future translocations from some of the other PRS (e.g. PAK-M) may occur if sharp declines are observed in population sizes. On June 20, 2017 a total of 163 *A. mustelina* (11 small, 45 medium, and 107 large) were counted. The previous high TCM was 114 on April 13, 2016.

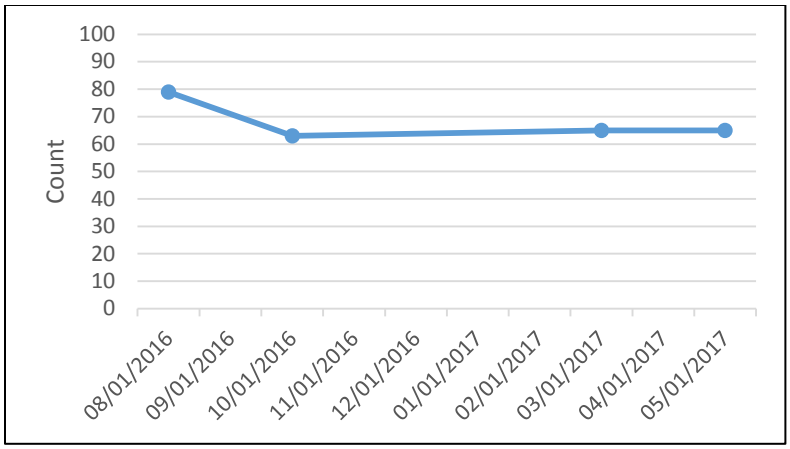

Figure 20. PAK-P Quarterly TCM

On May 8th, 2017, during a night survey around the Palikea snail enclosure, an *E. rosea* was spotted on vegetation inside. After further searches that night, another *E.rosea* was found climbing on the wall. Since then, intensive searches and ground cover removal to facilitate these searches have been performed (Table 31).

Table 31. Euglandina rosea search effort in Palikea enclosure

Week	Dates	Person Hours	# *E. rosea* Found
1	May 16-19, 2017	52.15	2 Large, 1 egg cache
2	May 23-24, 2017	34	5 Large, 2 egg caches
3	May31, 2017	12	None (SEPP)
4	June 5-8, 2017	27.5	None
5	June 15, 2017	21	2 Large
6	June 19-20, 2016	8	None
7	June 26-28, 2017	13	None
8	July 5-6, 2017	25	None
9	July 10-12, 2017	41	None
10	July 19, 2017	2	None
11	July 26, 2017	17.25	None
12	August 1, 2017	17	None
13	August 8, 2017	6	None
Total		275.9	9

In the Palikea Enclosure, a careful reduction of some ieie (*Freycenetia arborea*) is currently being conducted for snail monitoring purposes as the ieie is becoming considerably dense in some areas of the enclosure. The barriers on the enclosure continue to function and prevent predator ingress. OANRP will make 1-2 trips in the next year to complete erosion control work around the enclosure wall. The debris alarm system will be installed once the system under development is finalized.

5.7.1.6 PAK-S Palikea North Enclosure Site PRS

Since June 2016, there has been no *A. mustelina* found within the enclosure site. OANRP followed protocol developed with the US Fish and Wildlife Service (FWS).

5.7.1.7 No Management PRS

These sites have historically had very few snails and declining numbers. Translocations completed in 2016-2017 are outlined below (Table 32).

Table 32. Translocations of *A. mustelina* into PAK-P Palikea Snail Enclosure in 2016-2017

Translocation Date	PRS Translocation Source	Small	Medium	Large	Total
2016-08-01	KAA-A	0	1	1	2
2016-10-25	PAK-F	0	2	4	6
2016-10-25	PAK-G	0	0	4	4
2016-10-25	PAK-I	0	1	10	11
2016-10-25	PAK-Q	0	0	1	1
2016-10-25	PAK-R	0	0	3	3
2017-01-10	PAK-S	0	0	1	1
2017-04-05	PAK-I	0	0	1	1
2017-04-05	PAK-L	3	11	34	48
2017-04-05	PAK-R	0	2	6	8
2017-04-25	PAK-B	1	3	2	6
2017-04-25	PAK-I	0	0	3	3
Total		4	20	70	94

5.7.2 ESU-F Future Management

OANRP will continue monitoring and managing as described in Tables 33 and 34. The majority of the translocations are complete from NM PRS. OANRP will continue to translocate snails from small declining NM PRS. Each of these sites will be visited a minimum of three times. The six PRS listed below (Table 33) require additional visits. Unlisted NM PRS have been visited three times.

As mentioned earlier, small snail populations are still occasionally found in the Palikea MU. They will be translocated based on numbers and risk of imminent predation. Threat control will continue in the MU, including quarterly tracking tunnels for *R. rattus*, and searches for *E. rosea*, and *T. jacksonii xantholophus*. Weed control and habitat improvements will continue cautiously in known snail habitat to ensure there are no impacts to the snails. Habitat improvements across the MU will include gradual removal of non-native trees in snail areas and outplanting of natives to fill in light gaps and provide more host species.

Table 33. ESU-F Monitoring Plan for MFS PRS

PRS	Monitoring Type	Monitoring Interval	Survey Years	Comments
PAK-B Ie ie Patch	Translocate to enclosure	quarterly	2017, 2018	
PAK-K Pilo	TCM	every 2 years	2017, 2019, 2021	Conduct day TCM for 4 person-hours.
PAK-L Olapa	Translocate to enclosure	quarterly	2017, 2018	
PAK-M Middle	TCM	every 2 years	2016, 2018	Conduct baseline night survey, recording hours to use as standard.
PAK-P Palikea Enclosure	TCM	Quarterly	2016, 2017, 2018	Conduct day TCM for 4 person-hours.
PAK-P Palikea Enclosure	Survey	annual	2016, 2017, 2018	Conduct night survey to determine dispersal and perform *T. jacksonii xantholophus* search for a total of 4 person-hours.

Table 34. Three Year Action Plan for ESU-F

PRS	MIP YEAR 14 July 2017 – June 2018	MIP YEAR 15 July 2018 – June 2019	MIP YEAR 16 July 2019 – June 2020
KAA-A Mauna Kapu	• Translocate to enclosure	• Translocate to enclosure	
PAK-G Hame	• Translocate to enclosure	• Translocate to enclosure	
PAK-K Pilo	• Implement monitoring plan • Rat Control	• Implement monitoring plan • Rat Control	• Implement monitoring plan • Rat Control
PAK-L Olapa	• Translocate to enclosure • Rat Control	• Translocate to enclosure • Rat Control	• Rat Control
PAK-M Middle	• Implement monitoring plan • Rat Control	• Implement monitoring plan • Rat Control	• Implement monitoring plan • Rat Control
PAK-P Palikea Enclosure	• Implement monitoring plan • Rat control • Maintain enclosure and monitor for predators • Improve habitat via weed control and restoration planting	• Implement monitoring plan • Rat control • Maintain enclosure and monitor for predators • Conduct additional outplanting if needed	• Implement monitoring plan • Rat control • Maintain enclosure and monitor for predators
PAK-I One Ridge Truck side of E and F	• Translocate to enclosure		
PAK-F Dodonea Site	• Translocate to enclosure		
PAK-S Palikea North	• Complete surveys • Translocate to enclosure		