Management Plan for *Achatinella mustelina* ESU-E Initial Release of Excess Laboratory Snails at the Ekahanui Temporary Enclosure and the Palikea North Enclosure

2018

Army Natural Resource Program – Oahu (OANRP)

Contents

I. Background and Purpose

Following documentation of population decline of *Achatinella mustelina* evolutionarily significant unit (ESU) 'E' (OANRP 2014), the U.S. Fish and Wildlife Service approved the Army Natural Resource Program - Oahu (OANRP) plans in 2015 to construct a permanent predator-proof enclosure at Palikea North to protect these snails in accordance with the U.S. Army's responsibility for rare snail stabilization. Construction of the Palikea North enclosure was completed and habitat restoration efforts began in 2017. Suitable levels of habitat restoration for a full release of all laboratory snails and translocation of any remaining wild ESU-E snails is not expected for a few more years.

In order to temporarily maintain all remaining ESU-E snails in a highly protected location pending completion of a larger permanent enclosure with restored habitat at Palikea, two small temporary enclosures were designed and built in 2016 to house these snails in Ekahanui. Unfortunately those enclosures were not successful given high mortality rates within less than one year of initial translocations (OANRP 2016). By nine months, there was 65% and 82% confirmed mortality of the original 42 snails at the sites, and no live snails were found. The cause of mortality remains unknown, but it is conjectured that it was possibly due to the lack of weathering of the construction materials, having insufficiently dense vegetation, and/or snails dying while crawling on the screen walls which do not allow snails to form an airtight seal during dry weather estivation.

Plans were subsequently made to maintain ESU-E *A. mustelina* at the new Snail Extinction Prevention Program (SEPP) laboratory after environmental chambers became available for these snails. As of September 2018, 185 snails were moved to the SEPP laboratory, where they have been reproducing at a rate projected to surpass the holding capacity of the incubators by the end of November 2018. At that time, approximately 100 snails must be released to accommodate the continually expanding laboratory population.

OANRP plans to release half of these excess snails at one of the Ekahanui temporary enclosures (the second temporary enclosure was removed), and the other half at the Palikea North enclosure (FIG. 1). The Ekahanui temporary enclosure is now considered a feasible release site as it has weathered for over two years, the vegetation has become denser (FIG. 2), and modifications are planned to create a network of solid substrate to provide more pathways for snail movement on which snails may estivate. Though vegetation cover is currently low throughout the Palikea North enclosure, there are clusters of dense vegetation containing the snail host plant *Freycinetia arborea* deemed feasible for release (FIG. 3). Shade cloth and sprinkler systems are planned for use at both sites to enhance shade and moisture levels.

Releasing snails in two separate locations will allow for a comparison of success from which subsequent decisions regarding the release of future excess snails can be made. While neither of the release sites are optimal, they were determined to be the best among alternate options discussed during the 2018 Implementation Team meeting and in consultation with SEPP. Returning snails to their original wild sites was considered inappropriate, as they cannot be adequately protected from predators. Building a new temporary enclosure in appropriate habitat outside the enclosure at Palikea was deemed too risky, as it could potentially repeat the same problems initially encountered with the temporary enclosures at Ekahanui. Transferring snails to a laboratory at the Honolulu Zoo was not considered, as appropriate facilities to maintain snails will not be available for another year. Remaining ESU-E *A. mustelina* at the wild sites will not be moved into the enclosures at this time.

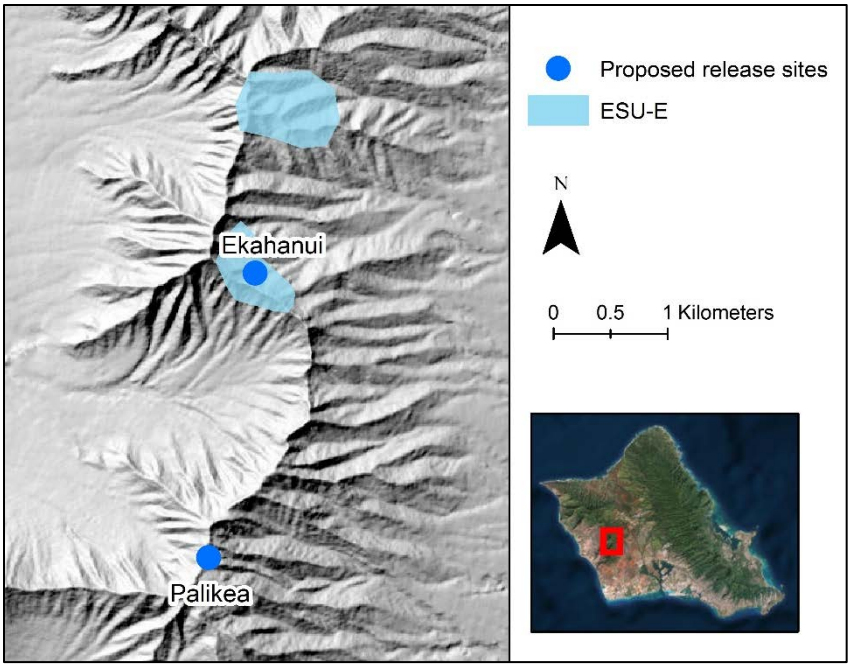

Figure 1. Location of the Ekahanui temporary enclosure and the Palikea North enclosure in relation to the ESU-E population areas.

Figure 2. Vegetation inside the Ekahanui temporary enclosure, July 2018

Figure 3. View of one of the more dense clusters of vegetation, proposed for the initial release of snails at the Palikea North enclosure, September 2018.

The purpose of this management plan is:

1) To outline and guide the management and maintenance of the release sites.

2) To guide the release and monitoring of *A. mustelina* at the enclosures.

3) To guide the evaluation of success and planning for next steps.

The management actions proposed in this plan were generated from the standpoint of providing the overflow laboratory snails with the best possible opportunities for success among non-ideal options. Data derived from monitoring used in association with the planned evaluation process will guide the decision-making process for the release of future excess laboratory snails. It will also provide a second opportunity to assess the utility of temporary enclosures, and may help guide the evaluation of small-scale habitat readiness within the Palikea North enclosure.

II. Enclosure Structures

A. Design

1. Ekahanui Temporary Enclosure

The enclosure encompasses ca. 24 m^2 and is ~5 m by 5 m and 3m tall, framed with untreated lumber, fully screened on all sides and the top with polyester-coated galvanized steel mesh, and has a wood-framed mesh door on the downslope wall (FIG. 4). The mesh excludes predators *Euglandina rosea*, rodents, and *Trioceros jacksonii xantholophus* (Jackson's chameleon). The enclosure will be examined to ensure that the integrity of the bottom is intact. Structural connectivity between vegetation will be mounted via a network of cut *Psidium cattleianum* branches to promote movement on substrate other than the wall mesh.

Figure 4. Photograph of the temporary enclosure structure at Ekahanui, July 2018

2. Palikea North Enclosure

The Palikea North enclosure measures ca. 2500 m^2 and was designed similar to that of the Hapapa enclosure (Rohrer et al. 2016), but 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 (FIG. 5). 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. Similar to the Hapapa enclosure, the *E. rosea* barriers consist of an angle barrier, cut mesh and electrical wires. 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 a 2" x 1.5" board just below the hood.

Figure 5. Palikea North enclosure design: wall frame inside of enclosure (left), and outside wall with *E. rosea* barrier, rat hood, and erosion control (right).

The release site within the enclosure measures ca. 32 m^2 will be additionally surrounded by a plywood wall approximately 18" tall and buried 6" below ground level, with an electric barrier along the inside of the wall to prevent *A. mustelina* from leaving the area. The electronic barrier will be of a similar design as the main enclosure wall. The electronics will deter snails from crossing the barrier, but will not harm them. The purpose of the supplemental wall is to prevent snails from traversing into areas of sparse vegetation where they may encounter environmental stress, and to facilitate monitoring of survival and mortality within a confined area. Materials are already on site and weathering; the wall will be constructed in the month prior to the release.

B. Enclosure Structure Monitoring and Maintenance

Both release sites will be visually monitored at least on a monthly basis to ensure the integrity of the barriers remain intact. The A game camera will be installed outside the Ekahanui temporary enclosure programmed to email photographs of the structure three times per day to facilitate a timely maintenance response in the event that a tree fall or rock fall damages the enclosure. Intelesense Technologies provides a comprehensive integrated monitoring service for the Palikea North enclosure, wherein staff will receive email alerts in the event of conductivity failure of the electronic barrier.

C. Habitat

1. Ekahanui Temporary Enclosure

An area containing native vegetation including snail host species was chosen for the site of the Ekahanui temporary enclosure. Plant species present are predominately *Pisonia umbellifera*, *Planchonella sandwicensis*, and *Pipturus albidus*. Outplanted *Chrysodracon forbesii* are also present. While vegetation was fairly sparse following the initial construction, it has since filled in more and started to grow through the mesh ceiling. Any vegetation growth that threatens to compromise the integrity of the enclosure will be trimmed to prevent damage to the structure. Supplementation with native outplants is not planned as the enclosure is sufficiently vegetated. The enclosure receives partial shade from the surrounding trees and has a steep northeast aspect.

2. Palikea North Enclosure

The enclosure currently contains diverse, sparse native vegetation, including trees, shrubs and ferns present prior to clearing and construction, as well as over two thousand outplants, transplants, and progeny from seed sowing and natural recruitment that are somewhat evenly distributed throughout the enclosure. However, because the snails will be released into a dense cluster of vegetation enclosed by an electronic barrier, discussion of the habitat will be specific to that area. The release site measures approximately 8m by 5m, and is dominated by native vegetation, primarily *F. arborea*, *Coprosma longifolia*, *Kadua affinis*, *Metrosideros polymorpha*, *Cibotium chamissoi*, *Nephrolepis exaltata* subsp. *hawaiiensis*, *P. albidus*, and *Bidens torta.* Vegetation height is approximately 1-2 m above ground level in most areas, with small trees as tall as 4 m. Following the clearing of non-native vegetation and the initiation of vegetation restoration efforts, native vegetation has increased and is expected to continue to expand in the release site (as well as throughout the enclosure) (FIG. 6). As restoration efforts are ongoing for the enclosure, additional outplants may be incorporated to enhance vegetative cover and connectivity within the release site. Species planned for outplanting in the fall of 2018 include *Scaevola gaudichaudiana*, *C. longifolia*, *Clermontia oblongifolia*, *Ilex anomala*, *P. albidus*, and *Labordia kaalae*, any of which may be used at the release site as needed. Seed sows are also planned for *P. albidus* and *B. torta.*

Figure 6. Photographs of the proposed release area in September 2017 (left) and in July 2018 (right), showing the expansion of native vegetation over 10 months from natural regeneration and outplantings. The circled area shows the approximate location of the planned barrier wall.

Shade will be provided by a shade cloth, and an automatic sprinkler system will be installed to provide supplemental moisture. Weed maintenance will occur as needed to control primarily for invasion of the fast-growing colonizer *Phytolacca octandra* that has been recruiting throughout the enclosure as well as the invasive grasses *Paspalum conjugatum* and *Ehrharta stipoides*. These weeds are easily hand-pulled when small, and will not require the use of herbicide.

The enclosure is free of rodents, following the installation of six Victor® rat snap traps, one Victor® mouse snap trap, and five Goodnature® A24 self-resetting rat traps which eliminated the small resident

population within the enclosure once construction of the walls and barriers was completed. Four tracking tunnels have been used to confirm the absence of rodent activity. The enclosure is also devoid of non-native snails and slugs, as the area has been repeatedly and systematically searched for *E. rosea* in accordance with the protocol set forth in the OANRP restoration plan (OANRP 2017), and as the area has been treated with molluscicide (Ferroxx®). No *E. rosea* have been found in over a year. Molluscide applications ceased in October 2017, and any residual material should no longer be harmful to *A. mustelina* by the time of their release, as it is ineffective after six weeks.

D. Predator Control and Monitoring

1. Rodents

In addition to the existing grid of A24 rat traps located throughout Ekahanui MU, two additional A24s will be installed outside the enclosure, and two Victor® rat snap traps will be maintained along the base of the wall inside the Ekahanui enclosure. A rodent tracking tunnel will also be placed within the enclosure to detect rat presence. The snap traps and tracking tunnel will remain unbaited to avoid attracting rodents from the outside.

The Palikea North enclosure lies within a large scale rat grid of A24 traps that span the Palikea management unit that suppresses rodent populations. The enclosure wall and hood prevent ingress by rats. A vegetation-free buffer of 2 m along the inside and outside wall of the enclosure will help keep vegetation growing on the inside from hanging out, and vegetation on the outside from allowing a rat to jump and reach a branch to get inside. As a precaution in the event of ingress, e.g., as a result of a tree fall that compromises the wall barrier, the A24 traps and tracking tunnels noted above will continue to be utilized and maintained quarterly to ensure the safety of *A. mustelina*. The A24 traps will be baited with a Goodnature® long-life chocolate rat lure and fitted with an automatic lure pump that steadily delivers fresh bait and prevents the growth of mold within the bait canisters.

2. *Euglandina rosea*

Though numerous searches for *E. rosea* were conducted at the Ekahanui enclosure in association with the previous attempt to maintain *A. mustelina* at this site, no searches have been conducted since 2016. For this reason, the enclosure will be systematically surveyed three times by a team of two personnel for one hour during the day prior to the snail release. Three levels of *E. rosea* control will be utilized to maintain/achieve eradication within the enclosure. High removal effort (if *E. rosea* are found): 2 staff search for 1 hour 1 day a week for 4 weeks. Medium removal effort (following completion of high removal effort and no additional *E. rosea* are found): 2 staff search for 1 hour 1 day every 2 weeks for 4 weeks. Low removal effort (following completion of medium removal effort and no additional *E. rosea* are found): 2 staff search for 1 hour 1 day every month.

As no *E. rosea* have been found in over one year at the Palikea North enclosure, staff will continue to follow the protocol set forth in the restoration plan (OANRP 2017), with three staff dedicating a minimum of 14 staff hours one day quarterly, thoroughly covering the entire enclosure and searching all vegetation, including the release area. Staff also monitor the angle barrier at least quarterly and remove any *E. rosea* found within it (FIG. 7).

Figure 7. Monitoring of the angle barrier at Hapapa snail enclosure. The angle barrier at Palikea North enclosure is similarly monitored with the use of a mirror to view *E. rosea* trapped within it.

3. Jackson's Chameleon

One Jackson's Chameleon had been found in the Ekahanui area previously, and the level of threat is unknown. As the enclosure is completely enclosed by mesh along the walls and top, breaches are not anticipated, though during searches for *E. rosea*, staff will also search for chameleons.

Jackson's Chameleons are also known to be present in the area surrounding the Palikea North enclosure, as two have been seen within close proximity to the enclosure in recent years. The level of threat at this location is also unknown. During the clearing of non-native vegetation prior to the enclosure construction, no chameleons were found. Similarly, during *E. rosea* searches following construction completion, staff were also searching for Jackson's, and none were found. Staff will continue to monitor for the presence of Jackson's Chameleons during the quarterly *E. rosea* searches, including the release area. If any chameleons are found in the enclosure, OANRP will develop a removal protocol.

E. Environmental Monitoring

Environmental conditions at the release sites should not include extended periods of extreme heat (> 90°F) or low relative humidity (< 60%). Data loggers (HOBO® Pro v2 U23-001) with solar radiation shields (HOBO® RS1) will be installed at each release site to record hourly temperature and relative humidity. Data will be offloaded monthly to monitor environmental conditions at each site.

III. *Achatinella mustelina* Reintroduction and Monitoring Plan

A. Phase 1: Pre-release

Because mortality was not confirmed for 35% of the *A. mustelina* previously released in the Ekahanui temporary enclosure, thorough searches of the enclosure will be conducted prior to release of laboratory snails. The enclosure will be systematically surveyed by a team of two personnel for one hour on two separate dates at least two weeks apart and with at least one intervening episode of rainy weather between surveys. At least one of these surveys will take place at night, when snails area more easily detected. The purpose of conducting a second search following rainy weather is to increase the likelihood of finding any snails that may be out of view during the first survey, and which may remain in estivation in the same out-of-view location if the weather remains dry between monitoring dates. If live snails are found, they will be photographed for identification purposes, and may remain within the enclosure. Ground shell searches of the entirety of the enclosure will also be conducted on the same dates as the live snail searches, and any shells found will be similarly photographed for identification. All shells found will be removed from the enclosure. This may be done simultaneously with *E. rosea* searches.

The Palikea North enclosure was repeatedly searched for the presence of ESU-F *A. mustelina* (OANRP 2017) prior to construction, and all discovered snails were moved into the ESU-F enclosure at Palikea South. Staff continued to search for any possible missed *A. mustelina* during the numerous intensive *E. rosea* searches, and none were found. Additional searches for ESU-F *A. mustelina* are not necessary, however the ground should be cleared of shells prior to release in preparation for documenting mortality of released ESU-E snails.

Only sub-adult snails (> 8 mm) will be selected for release, as they may be more likely than smaller snails to survive the stresses of release from the laboratory into the wild. Smaller snails in wild populations are also documented as having lower rates of survival than larger ones (Hadfield et al. 1993). Snails released from the laboratory will include a combination of some born in the lab as well as some captive snails originally collected from wild populations. Adult snails (>18 mm), all of which derive from wild populations, will be maintained in the laboratory to better ensure survival of reproductive individuals, and to safeguard genetic diversity in the lab and for future populations. Snail survivorship (for all size classes) in the laboratory is generally considerably higher than that in the wild. All snails selected for release will be photographed (including both side views) and assigned a unique identification, to be maintained in a HotSpotter© photo-identification database. This will allow staff to track individual snails over time using the HotSpotter© algorithm for matching unique individuals based on shell patterns (Stewart et al. 2013) (FIG. 8), and to estimate population totals following their release. Staff will also collect vegetation from the release sites for use in the incubators in the weeks leading up to their release, to acclimate snails to the enclosure microfauna.

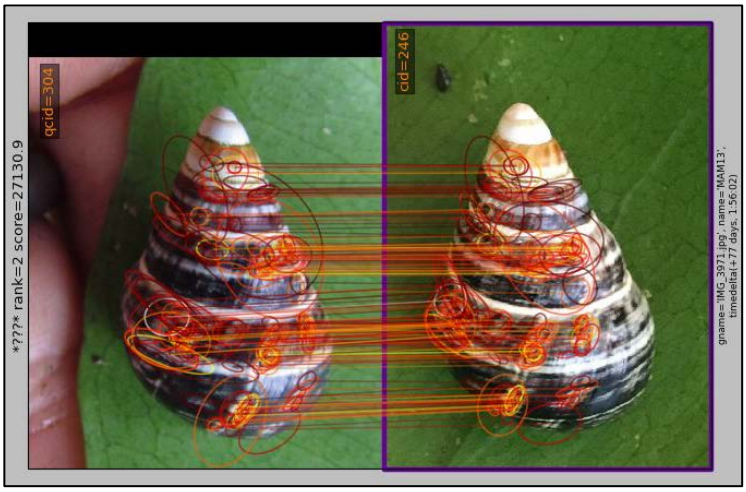

Figure 8. Example of an *A. mustelina* individual identified from an image in a HotSpotter© database based on matching "hotspots" on the shell surface.

B. Phase 2: Release

The snail release will occur upon laboratory populations reaching maximum capacity, projected to occur by the end of November 2018 at the start of the rainy season. In early December 2018, 50 sub-adult snails will be randomly selected for each of the release sites. Snails will be transported in adequately ventilated portable terraria containing live vegetation from their incubators. At Ekahanui, snails will be placed in small screened baskets containing vegetation from the terraria and hung in host trees (FIG. 9). The baskets will be open at the top to allow the snails to gradually exit into the vegetation. In order to facilitate the movement of snails from these containers into host plants, small branches will be placed in the baskets to create a bridge between the basket and host plant, and squirt bottles will be used to wet the container and vegetation as needed. The snails will be subsequently observed to ensure successful movement out of the baskets and onto the host plants. At Palikea, snails will be placed directly within *F. arborea*. The releases will occur during relatively cool, humid conditions to reduce heat stress.

Figure 9. Example of a screen basket used for *A. mustelina* released at the Hapapa snail enclosure. Similar baskets will be used for the initial release of ESU-E snails at the Ekahanui temporary enclosure.

C. Phase 3: Monitoring

To quantify population trends and assess if the released snail populations are self-sustaining over time, a timed-count monitoring (TCM). During TCM, both sites will be systematically surveyed by a team of two personnel for one hour per site during the day, with the total number of observed snails documented. The location of each snail identified will be communicated between the surveyors to minimize double counting. To ensure consistency between survey periods, a minimum of one personnel with previous experience conducting timed-count monitoring will be present.

To estimate population size and track the fate of individual snails, capture-mark-recapture (CMR) monitoring will be jointly conducted during the course of TCM. HotSpotter© photo identification software will be used to track individuals. Photographs will be taken of all snails within reach. Time utilized for this monitoring will not be included within the time allotted for timed-count monitoring. Population size estimates will be obtained using closed system models in the program MARK. Use of this method in a closed system with a known initial population size will help assess the utility of the HotSpotter© technology as well as population size modeling for *A. mustelina*. Each site will have unique issues factoring into the likelihood of detection. It is anticipated that most snails found at the Palikea North enclosure will be reachable for photography due to the predominantly low staure of the vegetation, however many will likely remain undetected due to the dense structure of the vegetation, particularly deep within the *F. arborea*. While relatively more snails may be detected at the Ekahanui enclosure, many will be too high to photograph with appropriate detail for identification. As a result, CMR sampling will consist of a subset of the population at both sites, but it should nonetheless allow for population modelling if snails are actively moving around in the vegetation.

Mortality will be documented by collecting shells from the ground. Ground shell plot (GSP) monitoring will be done at each site by searching for snails on the ground across the entire enclosure/release area. Each shell will be examined to ensure that it does not contain a live snail. All shells will be removed, documented by size class, photographed for use with HotSpotter© photo identification software, and retained in an open container inside the enclosure to mitigate erroneous mortality observations.

Monitoring will occur weekly for two weeks following the release to determine if there are any immediate catastrophic die-offs associated with the release. If mortality rates are not problematic, the monitoring frequency will then proceed to every two weeks for the next six weeks to determine if there are major die-offs as a delayed response to the release or some other cause. Barring unsatisfactory mortality rates by eight weeks, the monitoring interval will then proceed to monthly for the next two months, after which success will be evaluated and next steps will be determined.

IV. Evaluation of Success and Next Steps

Upon completion of the monitoring described above, approximately four months following the initial release, laboratory snail populations are projected to approach maximum capacity again, and decisions must be made regarding plans for the next ca. 100 snails that will need to be released at that time. In order to make decisions regarding the next steps for release of additional excess lab snails, the relative success of each site must be evaluated.

Annual survivorship ranging from 21% to 57% has been documented for wild populations of *A. mustelina* at various sites and times for various size classes and combinations of size classes, with larger snails tending to have greater survivorship rates than smaller ones (Hadfield et al. 1993, Hall et al. 2010). In a study of a growing population of *A. mustelina* at Pahole that was not undergoing apparent predation,

estimated annual survivorship of snails most comparable to the subadult size class intended for the release at the Ekahanui and Palikea enclosures was 31%. As such, if the released snails follow this trend, they may reasonably have a mortality rate of around 6.3 per month, and ≥ 81% survival at four months may be considered to be highly successful.

Because of the exceptionally low mortality rates typically occurring in the laboratory, snails with low fitness may be surviving under laboratory conditions that would otherwise suffer mortality in the wild where they would suffer greater environmental stress. It is anticipated that many snails of low fitness may not survive, resulting in higher mortality rates, particularly in the early weeks post-release.

Snails previously translocated from wild populations to the Ekahanui enclosure had between 20% to 40% survivorship by four months. Survival rates of released lab snails above this rate will be considered moderately successful relative to that of the translocated wild snails. However, survival at or below this rate may present a cause for concern, and will be considered to be low and insufficiently successful.

A die-off of the vast majority of snails, where ≤ 10% of released snails survive by four months will be considered very low success and unsatisfactory. A total loss of all snails by that time would be considered a failure.

In summary, the ranking of survival rates are:

Survival rate (%)	Success rank
81-100	**High**
41-80	**Moderate**
11-40	**Low**
1-10	**Very low**
0	**Failure**

Decisions regarding the next release of excess laboratory snails will take into account the success rankings outlined above in association with survival rates. In the event that both release sites are deemed to have acceptable survival rates, the next set of snails will be added to both sites. Should one site have acceptable survival but the other does not, the snails will only be added to the site with acceptable survival. If both sites have unacceptable survival rates, considerations will be made for whether or not to release additional snails at these sites, or if an alternate release plan will have to be developed. If both sites completely fail by four months, alternate plans may have to be made.

Though presently considered inappropriate or too risky as discussed above, alternate plans in the event of total failure after four months could include 1) returning snails to their original wild sites, 2) building a new temporary enclosure in appropriate habitat outside the enclosure at Palikea, or 3) moving snails to the Honolulu Zoo if appropriate facilities to maintain them become available before conditions in the SEPP laboratory become too crowded.

The next release should be timed such that it happens prior to the start of the hot and dry season, preferably in early April, to avoid undue environmental stress as laboratory snails transition to the outdoors. For this reason, decisions regarding the release must be made in a timely manner. It should also include sufficient numbers of snails such that the laboratory population does not reach maximum capacity prior to the start of the next rainy season.

V. Timeline

The following timeline conveys the planned management events through March 2019. The timeline events beginning in April 2019 are approximated premised on a best case scenario for success at both release sites, to be determined in March 2019, and re-assessed thereafter as deemed necessary.

Table 1. Timeline of planned (though March 2019) and approximated (beginning in April 2019) management events associated with the release of ESU-E *A. mustelina* snails from the laboratory.

Event	Month	Year
Plywood on site to allow for weathering	Aug	2018
3 *E. rosea* searches at Ekahanui (2 day, one night)	Jul-Nov	
Examination of Ekahanui enclosure integrity	Oct	
Outplant and/or seed sow at Palikea	Nov	
Installation of plywood wall with electronics at release site in Palikea	mid-Nov	
Installation of cut *P. cattleianum* branch structural network at Ekahanui	mid-Nov	
Collect vegetation for laboratory snails from enclosures	mid-Nov	
Install shade cloth and sprinkler systems at both sites	mid-Nov	
Photograph snails in lab prior to release	mid-Nov	
1st release: 50 subadult snails at each site	early Dec	
Monitor snails weekly for 2 weeks at each site (TCM, GSP, CMR)	Dec	
Monitor snails every 2 weeks for six weeks at each site (TCM, GSP, CMR)	Dec-Jan	
Monitor snails monthly for 2 months (TCM, GSP, CMR)	Feb-Mar	2019
Evaluate success and determine next steps	late Mar	
2nd release: est. 50 snails at each site	early Apr	
Monitor snails weekly for 2 weeks at each site (TCM, GSP, CMR)	Apr	
Monitor snails every 2 weeks for six weeks at each site (TCM, GSP, CMR)	Apr-May	
Monitor snails monthly for 5 months (TCM, GSP, CMR)	Jun-Oct	
3rd release: est. 50 snails at each site	Nov	
Monitoring begins on a quarterly basis (TCM, GSP, CMR)	Nov	
4th release: est. 50 snails at each site	Mar	2020
5th release: release all remaining captive snails at Palikea	Nov	
Translocate Ekahanui temporary enclosure snails to Palikea	Nov	
Translocate any remaining wild ESU-E snails to Palikea	Nov	
Translocate any remaining wild ESU-E snails to Palikea	Jan	2021
Translocate any remaining wild ESU-E snails to Palikea	Mar	

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