

APPENDIX 5-1

MANAGEMENT ACTIONS TO PREVENT THE CONTINUED DECLINE OF ESU-C *ACHATINELLA MUSTELINA* IN HALEAUAU GULCH IN SCHOFIELD BARRACKS WEST RANGE

BACKGROUND

Achatinella mustelina were first documented at Haleauau SBW-A in Schofield Barracks West Range in 1997 when John Obata and Daniel Chung accompanied Oahu Army Natural Resources Program (OANRP) staff into the valley (Figure 1). On February 3, 2003 a total of ten snails were collected for captive rearing at the Snail Lab at the University of Hawaii at Manoa (UH). On June 29, 2013 a total of 13 *A. mustelina*, descendants of the original ten, were translocated to SBW-B.

Map removed to protect rare resources

Figure 1. Locations of *Achatinella mustelina* ESU-C population reference sites, and the proposed location for a snail enclosure at Kaala. The vast majority of remaining ESU-C snails are located in the manage for stability sites. The no management sites have few to no snails remaining.

On June 29, 2013 staff counted a total of 80 *A. mustelina* at SBW-A in Haleauau (Figure 2 and Table 1). OANRP translocated ten of them to the UH Snail Lab for pulsing with the intent of returning them in six months to a year. However, due to their decline and the threat of disease while in captivity, those snails remained in the lab. When staff returned to SBW-A on December 16, 2015 only 42 snails

were counted (Table 2). Many of the host trees had died and the snails appeared to be in decline. Staff camped there on January 24, 2017 to complete a current night survey and better document population trends. A total of 30 *A. mustelina* were counted (Table 3). Timed-count monitoring methods (time spent searching, geographic area surveyed, time of day, etc.) were the same for the 2013, 2015, and 2017 counts.

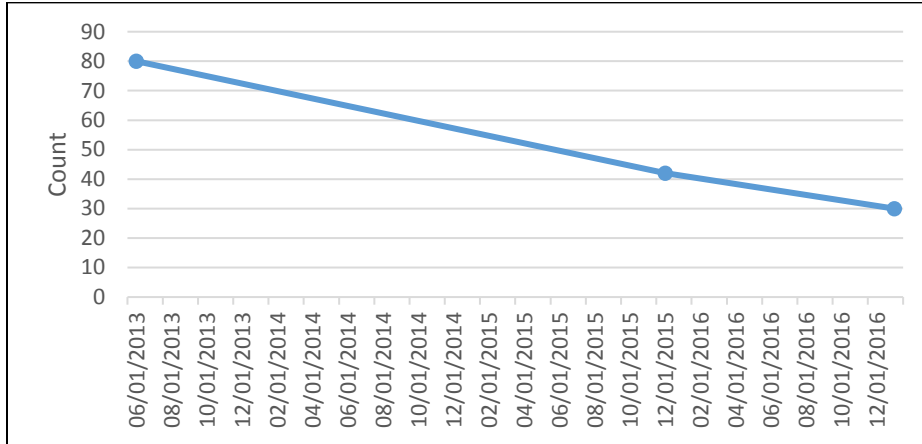


Figure 2. Timed-counts of *Achatinella mustelina* at SBW-A, North Haleauau Hame Ridge. On June 29, 2013, 10 snails were removed to the University of Hawaii Tree Snail Conservation Laboratory.

Table 1. Haleauau SBW-A population and host taxa count on June 29, 2013. Native host taxa are in boldface.

Taxon	Snails	Host
<i>Alyxia stellata</i>	1	1
<i>Antidesma platyphyllum</i>	35	20
<i>Coprosma foliosa</i>	3	2
<i>Freycinetia arborea</i>	1	1
<i>Ilex anomala</i>	1	1
<i>Melicope spp</i>	1	1
<i>Nestegis sandwicensis</i>	6	1
<i>Planchonella sandwicensis</i>	5	1
<i>Psidium cattleianum</i>	24	14
<i>Schinus terebinthifolius</i>	2	1
<i>Toona ciliata</i>	1	1
Total snails counted: 80 (5 small, 39 medium, 36 large)		

Table 2. Haleauau SBW-A population and host taxa count on December 16, 2015. Native host taxa are in boldface.

Taxon	Snails	Host
<i>Alyxia stellata</i>	2	2
<i>Antidesma platyphyllum</i>	14	11
<i>Nestegis sandwicensis</i>	2	1
<i>Plachonella sandwicensis</i>	2	1
<i>Psidium cattleianum</i>	22	15
Total snails counted: 42 (0 small, 18 medium, 24 large)		

Table 3. Haleauau SBW-A population and host taxa count on January 24, 2017. Native host taxa are in boldface.

Taxon	Snails	Host
<i>Antidesma platyphyllum</i>	11	8
<i>Psidium cattleianum</i>	17	9
<i>Psycotria spp</i>	1	1
<i>Planchonella sandwicensis</i>	1	1
Total snails counted: 30 (0 small, 14 medium, 16 large)		

The number of host trees at SBW-A continue to decline. The number of *Antidesma platyphyllum* with snails have dropped from 20 to 8 trees and *Psidium cattleianum* from 14 to 9 trees. Some of the flagged trees previously known to have snails are now dead. Most host trees had only one snail counted, so most remaining snails are unlikely to encounter each other and reproduce. In addition, trees adjacent to the flagged host trees were surveyed. The lack of *A. mustelina* in adjacent trees reinforces the observation that numbers are due to a true decline and not because of migration to other neighboring host trees.

Conversely, there is a sizeable and apparently stable *A. mustelina* population at Skeet Pass SBW-W. The population is on very steep terrain, and ropes are necessary to access some areas. Developing repeatable methods for monitoring snails has been challenging. Though the surveys to date have not incorporated comparable methods, it is apparent from the most recent timed-count of 231 snails on September 20, 2016 that many snails are present at the site (Table 4). Anecdotal reflections of observers indicate that numbers have remained stable.

Table 4. Skeet Pass SBW-W population and host taxa count on September 20, 2016. Native host taxa are in boldface.

Taxon	Snails	Host
<i>Bidens torta</i>	6	3
<i>Broussaisia arguta</i>	9	2
<i>Cibotium chamissoi</i>	1	1
<i>Coprosma longifolia</i>	29	21
<i>Dianella sandwicensis</i>	3	3
<i>Dicranopteris linearis</i>	3	3
<i>Dubautia laxa</i>	8	2
<i>Ilex anomala</i>	3	3
<i>Melicope spp</i>	1	1
<i>Metrosideros polymorpha</i>	119	48
<i>Metrosideros rugosa</i>	1	1
<i>Perrottetia sandwicensis</i>	45	21
<i>Rubus argutus</i>	1	1
<i>Scaevola gaudichaudiana</i>	1	1
<i>Verbena litoralis</i>	1	1
Total snails counted: 231 (20 small, 76 medium, 135 large)		

The reasons for the population decline at Haleauau are not entirely clear. *Euglandina rosea* are present, but not ubiquitous. One adult male Jackson's Chameleon was found very close to the snail population several years ago, but no other chameleons have been found since. Rat control has been fairly consistent for the SBW-A population (Victor snap traps are maintained twice quarterly from July to November, and monthly from December to June), but given the low numbers of *A. mustelina*, the likely loss of a few snails due to rat predation every so often is detrimental over time. Poor habitat, population

fragmentation, and low fecundity are likely other contributing factors to the overall decline. The primary host tree in Haleauau is currently *P. cattleianum*, whereas the host plants at Skeet Pass are 98% native.

As agreed upon by the Implementation Team (IT) at the snail IT meeting on December 13, 2016, an enclosure will be constructed at Mt. Kaala for the protection of ESU-C snails in 2018, to include snails from the two manage for stability population reference sites, SBW-A Haleauau and SBW-W Skeet Pass, as well as the few remaining snails from the 12 “no management” sites. The Army has no plans to ever build an enclosure in the back of the SBW where the access is unreliable. Access is only available to Haleauau one week per month. This is not adequate time for construction. For the existing snail enclosures, months of time were needed to prepare, construct and remove predators. Similarly, this limited time allowance is not adequate for snail enclosure threat control management with regards to regularly scheduled and emergency maintenance requirements for the barriers and predators. Also the amount of earthwork required to install a snail enclosure is beyond what would be possible in an area studded with unexploded ordnance. The only site near ESU-C for *A. mustelina* with a suitable slope and access is atop Mt. Kaala. And with global warming, Mt. Kaala offers a wetter environment at higher elevation.

DISCUSSION AND RECOMMENDATIONS

At the snail IT meeting on December 13, 2016, OANRP recommended moving Haleauau SBW-A snails to a site with *A. mustelina* at Skeet Pass SBW-W, on the ridgeline from Kaala to Puu Kamaohanui, where a sizeable population of snails persists, given the population decline observed from 2013 to 2015 at Haleauau. **Given the further decline documented in January of 2017 at Haleauau SBW-A, OANRP propose moving SBW-A snails as soon as possible to Skeet Pass SBW-W.** Otherwise, by the time the Kaala enclosure is completed, the numbers will likely be greatly reduced. Dr. Melissa Price presented at the IT meeting and proposed translocation falls into the following categories:

- **Predation.** *Euglandina rosea*, rats and Jackson’s chameleons are present at Haleauau. Standardized monitoring has documented a dramatic decrease in snails at the site, suggesting predation pressures may be adversely impacting the population, despite on-going rat control. Though rats and *E. rosea* are also present at Skeet Pass, the population appears to be resilient to predation pressures. Rats appear to be effectively controlled, and *E. rosea* are presumed to be in low numbers, given the stable population of *A. mustelina* at SBW-W.
- **Assisted evolution.** Representing Haleauau snails in the future predator enclosure is important for preserving genetic diversity that increases the likelihood of adaptation to climate change.
- **Assisted colonization.** Haleauau is the lowest elevation with extant snails in ESU-C, therefore snails from this site are more likely to survive warming temperatures and drying conditions which could potentially be important for survival of the species.

The SBW-A snails are at 2400 ft and the Skeet Pass SBW-W snails are at 3200 ft in elevation. The distance between them is approximately 2,500 ft. (or approximately 750 m). Translocating snails from SBW-A to 3800 ft at Mt. Kaala would likely be a greater shock to the snails than moving them to Skeet Pass SBW-W. Moving them to SBW-W a year or so in advance of enclosure completion may allow them to acclimatize gradually to increases in elevation. Instead of being moved a total of 1400 ft in elevation at once, they would first be moved 800 ft and then another 600 ft a year or two later. They will possibly have a better chance of surviving at Kaala with an acclimation period at SBW-W than if they were to be moved 1400 ft in elevation all at once. They would also be moving from a drier, weedier, habitat to a wetter, more native one.

ACTION PLAN

Goals:

- Protect *A. mustelina* at Haleauau area from immediate threat of predation
- Assisted evolution
- Assisted colonization

Objectives:

- Find remaining *A. mustelina* individuals at Haleauau SBW-A and translocate them to the Skeet Pass SBW-W population
- Release the snails into native forest in Skeet Pass where they can more readily intermix and increase genetic diversity
- Gradually acclimatize snails to a wetter/higher location prior to translocation to the Kaala snail enclosure, while preserving genes adapted to drier conditions

Snail translocation protocol:

Extraction: Snails will be collected during the day and night at Haleauau and placed into plastic terraria with good ventilation and preferred vegetation. The collection trip will require two days and one night in the field.

Transportation: Staff plan to camp in Haleauau for one night, hike out in the morning, drive to Dragon X (the landing zone (LZ) on Schofield Barracks) and fly by helicopter to Puu Kamaohanui, 500 meters to the east of Skeet Pass. Snail terraria will be carefully carried in a backpack into the helicopter for the five minute ride across Schofield Barracks West Range. The hike from the LZ to SBW-W takes about 30 minutes. All measures will be taken to ensure snails are not exposed to high temperature and direct sunlight during transportation.

Monitoring: OANRP will photograph all snails moved from Haleauau to Skeet Pass for use with HotSpotter photo identification software, and when snails are moved to Kaala, survivorship of the Haleauau group will be estimated. Staff will monitor snails at Skeet Pass after the translocation to access mortality and with timed-counts annually with methods comparable to prior surveys. Photo identification methods will not be incorporated into the timed-counts, as the steep nature of the terrain precludes sufficient proximity to snails for appropriate photographic resolution. Skeet Pass is too steep for ground shell monitoring. Any snails seen opportunistically will be evaluated with HotSpotter to determine if they are from SBW-A.

Threat control: The Skeet Pass snail population is protected by a rat grid that is maintained every six weeks, as well as an ungulate fence. The rat grid consists of two types of devices, Kamate snap traps, and Goodnature A-24 repeater traps. Threat control will continue until all snails are translocated to the Kaala enclosure.