CHAPTER 6: RODENT MANAGEMENT

OANRP has managed MIP and OIP species that are subject to rodent predation with various strategies since 1997. This chapter discusses rodent control methods utilized over the past reporting year and highlights recent changes. Specifically, this chapter has five main sections: Section 6.1 provides an overview of the current rodent control program and discusses recent changes; Section 6.2 discusses recently installed Goodnature® A24 automatic rat trap grids at Kahanahaiki and Ohikilolo; Section 6.3 provides results of an investigation into tracking tunnel data; Section 6.4 discusses on-going trap trials at Palikea and Ekahanui; and Section 6.5 lays out future plans for rat control.

6.1 OANRP RODENT CONTROL PROGRAM SUMMARY

OANRP manages rats threatening some rare species only seasonally (e.g., *Chasiempis ibidis* or 'Oahu Elepaio' during the nesting season), while other species are protected year-round (e.g. *Achatinella* spp.). The methods of rodent control that OANRP currently utilizes for rodent control are limited to using kill-traps (Victor® traps, Ka Mate™ traps, and Goodnature® A24 traps) and predator exclosures.

Rat control in 2014 consisted of deploying small Victor® snap trap and Goodnature® A24 trap grids around resources, maintaining large-scale trapping grids consisting of Victor® or Ka Mate™ traps, and installing and maintaining large-scale trapping grids of Goodnature® A24 traps. More Goodnature® traps will be installed across MUs and around additional population units over the next year. OANRP contracts Pono Pacific to conduct rat control during Elepaio nesting season (December – June) at Ekahanui, Kahanahaiki, Moanalua, Palehua, and Schofield Barracks West Range (SBW). Pono Pacific is also contracted to conduct year round rat control at Ekahanui and Palikea.

Table 1. Current rat control strategies utilized by OANRP as of October 2014.

MU/Area	Primary Spp. Protected	Control Method	Description	Trap Type	# Traps	Deployment	Check Interval
East Makaleha	*A. mustelina*	Trapping Grid	Two small grids	Victor® w/out boxes	30	Year-round	4-6 weeks
				A24 Automatic traps	15		
Ekahanui† *i*	*A. mustelina*	Trapping Grid	Many small grids	Victor® w/out boxes	47	Year-round	4-6 weeks
				A24 Automatic traps	30		
	C. ibidis	Trapping Grid	Large-scale grid	Victor® w/ & w/out boxes[i]	620	Annual: Dec-June	2 weeks
Kahanahaiki †+	*A. mustelina*	Predator Exclosure	Constructed 1998	--	--	Year-round	--
	A. mustelina, C. superba	Trapping Grid	Large-scale grid	A24 Automatic traps	83	Year-round	4 weeks
				Victor® w/ boxes	464		2 weeks

MU/Area	Primary Spp. Protected	Control Method	Description	Trap Type	# Traps	Deployment	Check Interval
Kamaohanui	*A. mustelina*	Trapping Grid	One small grid	Ka Mate A24 Automatic traps	47 10	Year-round	6 weeks
Kapuna	*H. oahuensis* *S. nuttallii*	Trapping Grid	Two small grids	A24 Automatic traps	5 4	Seasonal	6 weeks
Koiahi	*A. mustelina*	Trapping Grid	One small grid	A24 Automatic traps	8	Year-round	6 weeks
Makaha	*A. mustelina*	Trapping Grid	One small grid	Victor® w/out boxes A24 Automatic traps	29 6	Year-round	6 weeks
	H. oahuensis		Two small grids	A24 Automatic traps Victor® w/out boxes	13 24	Seasonal	6 weeks
	C. grimesiana		One small grid	A24 Automatic traps	6	Year-round	6 weeks
Moanalua†	*C. ibidis*	Trapping Grid	Many small grids*	Victor® w/out boxes	288	Annual: Dec-June	2 weeks
Ohikilolo	*A. mustelina, P. kaalae*	Trapping Grid	Many small grids	Victor® w/ boxes A24 Automatic traps	47 53	Year-round	6 weeks
Palehua†	*C. ibidis*	Trapping Grid	Many small grids*	Victor® w/out boxes	168	Annual: Dec-June	2 weeks
Palikea	*A. mustelina*	Predator Exclosure	Constructed 2012	--	--	Year-round	--
Palikea-Mauna Kapu	*A. mustelina*	Trapping Grid	One small grid	Victor® w/ boxes	15	Year-round	6 weeks
Palikea†	*A. mustelina*	Trapping Grid	Large-scale grid	Ka Mate	180	Year-round	2 weeks
SBW Haleauau‡†	*A. mustelina*	Trapping Grid	One small grid	Victor® w/out boxes	28	Year-round	6 weeks
	H. oahuensis	Trapping Grid	One small grid	Victor® w/out boxes A24 Automatic traps	3 3	Seasonal	6 weeks
	C. ibidis	Trapping Grid	Many small grids*	Victor® w/out boxes	364	Annual: Dec-June	2 weeks
W. Makaleha	*C. grimesiana*	Trapping Grid	One small grid	Victor® w/out boxes	28	Year-round	6 weeks
Waianae Kai	*N. angulata*	Trapping Grid	One small grid	Victor® w/out boxes	20	Seasonal	6 weeks

MU/Area	Primary Spp. Protected	Control Method	Description	Trap Type	# Traps	Deployment	Check Interval
Waieli-Hapapa	*A. mustelina*	Trapping Grid	One small grid	Victor® w/out boxes	35	Year-round	6 weeks
		Predator Exclosure	Constructed 2011	--	--	Year-round	--

* *Each managed Elepaio (*C. ibidis*) territory has 12 traps installed ~12 m apart in trees.*
† *Contracted Pono Pacific to maintain rat grids during Elepaio nesting season.*
‡ *N. Haleauau snail sites are included during Elepaio nesting season.*
i *The majority of traps have been removed from the wooden boxes and placed in trees.*
\+ *Victor® snap traps discontinued to run A24s.*

OANRP is continually researching and reassessing rat control methods to determine the most effective strategies for the protection of natural resources.

6.2 A24 GRIDS AT KAHANAHAIKI AND OHIKILOLO

In 2014, OANRP installed two large scale grids of A24s at two management units (MUs) in the Waianae mountain range, Kahanahaiki and Ohikilolo. Both MUs have had extensive rat control conducted in previous years, ranging from small grids of bait stations to large scale Victor® snap trap grids. Due to the difficult accessibility of Ohikilolo (helicopter access only), the A24s were a good option to test here. Kahanahaiki has long been a testing ground for new management techniques and was the first area with ecosystem scale rat control. It was decided to install the A24 grid in Kahanahaiki so that the results could be compared to other rat control strategies used there in the past. Additionally, easy access at this location allows for frequent monitoring and adjustments.

6.2.1 Kahanahaiki Trapping Grid

The Kahanahaiki grid is designed for large-scale lethal trapping for rats (*Rattus* spp.) across the MU. The overall goal is to reduce rat activity within an MU to a level that benefits the endangered plants, *A. mustelina* (Oahu tree snail), native insects, and the native ecosystem as a whole.

On June 9, 2014, OANRP installed a grid of 83 Goodnature® A24 automatic rat traps across the 26 ha Kahanahaiki MU, equating to 3.2 A24s per ha. The A24 grid will be used instead of maintaining the existing snap trap grid of 464 Victor® ® snap traps, equating to 17.8 Victor snaps per ha. The snap traps will be left in place while the success of the A24 grid is assessed. The A24 grid was laid out using 50x100m spacing with some traps placed at 25x100m based on prior snap catch data. From past snap catch data we have observed, the gulch area in general accounts for more rat catches than other areas of the MU, so additional traps were placed here based on this information.

The previous grid setup of snaps were housed in protective wooden boxes on the ground; the perimeter consisted of 234 traps spaced 12.5 meters apart and the interior contained 246 traps on transects and trails at a spacing of 25 meters apart. Snaps were generally checked on a 2-week interval, requiring the use of 4 personnel. A24s were checked monthly, requiring 3 personnel, thus resulting in a sixty percent reduction in labor. The A24s were checked for presence of carcasses, re-baited with Goodnature® preservative peanut butter and the CO_2 canister was tested. Due to a limited number of counters, only 17 of the 83 traps were fitted with counters to monitor hits.

A total of 38 tracking tunnels were monitored inside the grid and 24 tunnels were monitored at a nearby site (Kapuna Gulch, within Pahole Natural Area Reserve) as a control with no active trapping being conducted. Tunnels were monitored one month prior to installation of the A24s and then monthly

thereafter for both sites, Kahanahaiki has been monitored since 2009 and results from 2013 monitoring have been included for comparison (Figure 1). Tunnel data show that percent rat activity at the Kapuna site remains much higher than at Kahanahaiki.

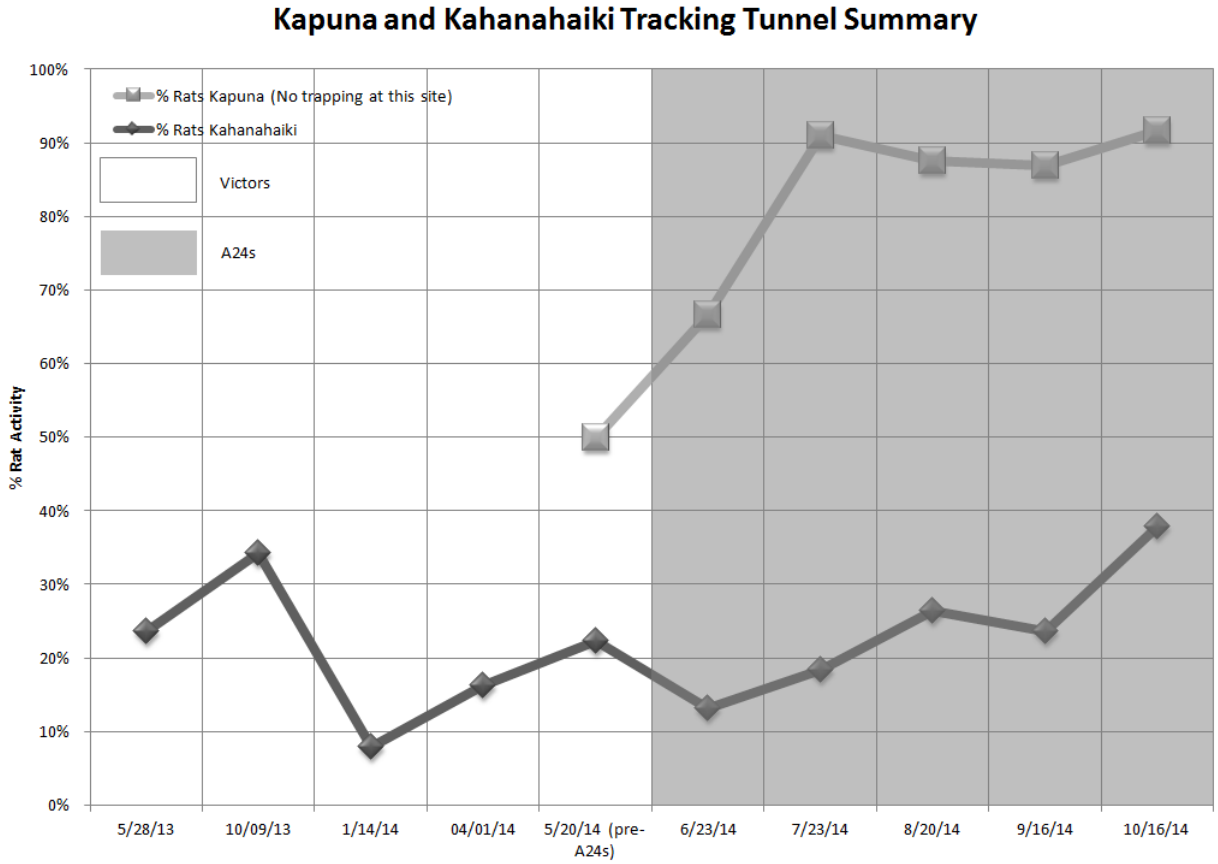

Figure 1. Percent of rat activity each month at Kahanahaiki and Kapuna (No trapping at this site).

Management Considerations for 2015

One of the OANRP goals for the A24s is to eventually reduce trap checking interval from to quarterly. Because this is a multi kill trap and costs more than traditional traps, a balance of staff time and trap cost needs to be achieved to meet program objectives. One of the ways to accomplish this is by increasing the bait longevity and attractiveness in the A24s at Kahanahaiki. A study developed to do this involves constructing custom counters that record the date and time of each hit. This will allow us to determine how effective the bait is over a three month period. From bait trials last year, we have found that the Goodnature Preservative peanut butter and our home made beeswax peanut butter bait seem to be most promising at this point and thus will be used for the trial. Both of these baits seem to be relatively resistant to mold and are not rapidly consumed by slugs.

A second OANRP goal is to reduce rat activity to less than 10%. A trial will be conducted using a 50x50m grid for trap spacing replacing the current trap spacing grid of 100x50m. The checking interval and bait used will be determined by the results of the bait longevity study. Future plans for this MU would depend on results from the bait longevity study. If bait is not palatable for a period of one to two months then other trap options may be considered. We have observed the bait lasting several months at Kahanahaiki with little to no mold and very little scavenging from slugs or ants. Therefore, the checking

interval can be reduced from once a month to every two months. If observations show continued bait retention and attractiveness, the interval can be reduced to quarterly.

OANRP has considered reducing the size and scope of this grid to only protect small populations of rare species within the MU. However, since labor for this site can be potentially only 2 people once every two months or even quarterly we recommend continuing to bait this grid for MU wide protection. The Kahanahaiki MU will be used as the location to develop best practices of grid size, trap density, bait attractiveness, CO_2 canister changing intervals, and check intervals. The development of the trial at Kahanahaiki may be used as a standard for future trials on bait longevity at other MUs to guide check intervals. Once established, best practices will be used across other MUs.

6.2.2 Ohikilolo Trapping Grid

The Ohikilolo grid was established in 2009 to protect two endangered species, *P. kaalae* and *A. mustelina*. The grid has been modified in the past from a combination of Ramik bait stations and Victor® snap traps to just snap traps and now to A24s exclusively. Ohikilolo is only easily accessible via helicopter; therefore, the baiting interval has been every 6 weeks. The use of A24s at this site could potentially decrease the checking interval to quarterly, which would save valuable helicopter time and money.

On March 10, 2014, 53 A24s were installed at Ohikilolo. These traps were spaced approximately 10-25 meters apart on ridge and gulch trails throughout the MU, and re-baited on a 6-week interval. The existing Victor® snap traps were left in place while the success of the A24 grid is assessed. Counters were installed on all traps and bait trials are currently being conducted. Unlike Kahanahaiki, bait at this site has been observed to become very moldy with significant bait loss due to slug consumption. Different combinations of preservatives and wax are being assessed at this site as part of the bait trial.

Tracking tunnels have been used to monitor rat activity within the grid. A total of 27 tracking tunnels are placed throughout the MU and have been monitored on a semi-annually to quarterly interval starting in July 2009 through October 2013, monitoring did not occur between October 2013 through March 2014. Starting in March 2014, tunnels were monitored on a 6-week interval (Figure 2).

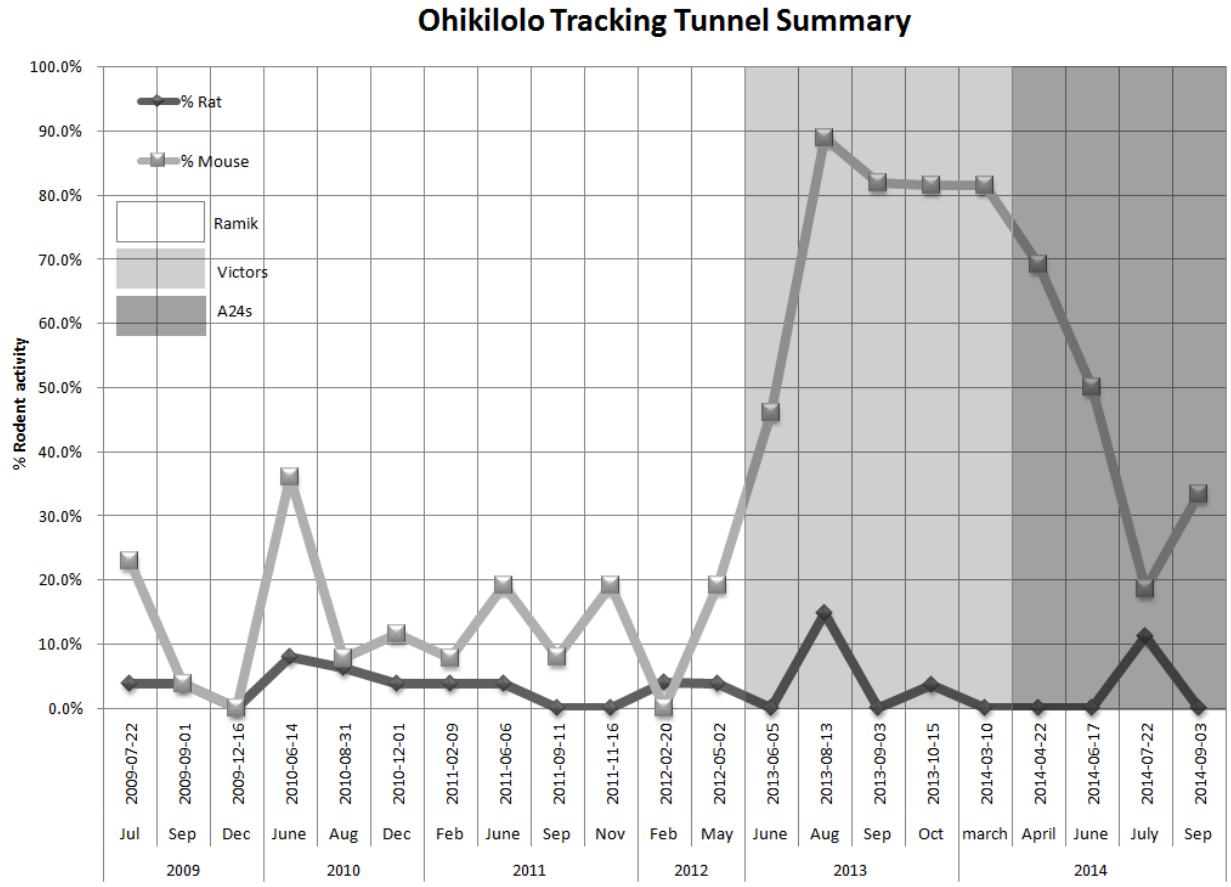

Figure 2. Percent of rodent activity among tracking tunnels by month at Ohikilolo showing when Ramik, Victors and A24s were used. Ramik was last used on May 13th, 2013.

Rodent control at Ohikilolo is designed to specifically target rats because they are the largest rodent threat to the natural resources OANRP protects (Mosher 2010, Shiels 2010). Mice have a significantly smaller home-range size than rats and OANRP believed that the grid was not effective at reducing mouse populations. Data from the tracking tunnels indicate changes in mouse activity levels in association with rodent control methods. Mouse activity levels were relatively low with the use of Ramik and A24s as compared with the use of victors. Victor® snap traps are larger in size than mouse traps and therefore catch very few mice. This suggests that although the grid was designed to target rats, Ramik and A24s also reduced local mouse populations.

6.3 EVALUATION OF TRACKING TUNNELS

In New Zealand, Department of Conservation uses tracking tunnels inside and outside of large trapping areas (> 200 ha) to assess efficacy of rodent control. They have also defined a 'damage threshold' of 5% rat activity in which tracking tunnels must remain below in order to achieve management goals for a species (Hill pers. comm. 2011). To date, OANRP has not been able to determine a damage threshold for rat activity in tracking tunnels that corresponds to management goals because activity levels have been so variable. Initially, OANRP hypothesized that this is because the existing trapping grids are too small or are otherwise unable to maintain a reduced population of rats inside the grid.

A thorough review of our tracking tunnel data has revealed another possible explanation for large fluctuations of percent rat tracking at some of our MUs. Historically, a small amount of peanut butter has

been added to a leaf that is then placed on the tracking card. This setup allows for easy removal of bait by the first species to encounter the tunnel, therefore not attracting any other species. For example, if cats, mice or mongoose are tracked and remove the bait, rat tracks are generally not observed. When percent of cats tracked is high, percent of rats tracked is low. One possible explanation is that rats are showing avoidance to the tunnels because of high cat presence in the area. However, after putting a larger amount of peanut butter directly on the tracking cards at our Kapuna site we observed three cards with both cat and rat tracks with some peanut butter remaining. We have also documented this in other sites over the years. This leads us to believe that rats are not avoiding tunnels near cats; rather, they are not being tracked due to absence of bait in the tunnels. Both Ekahanui and Kahanahaiki tracking tunnel data have been analyzed to explore this possible relationship (Fig. 3).

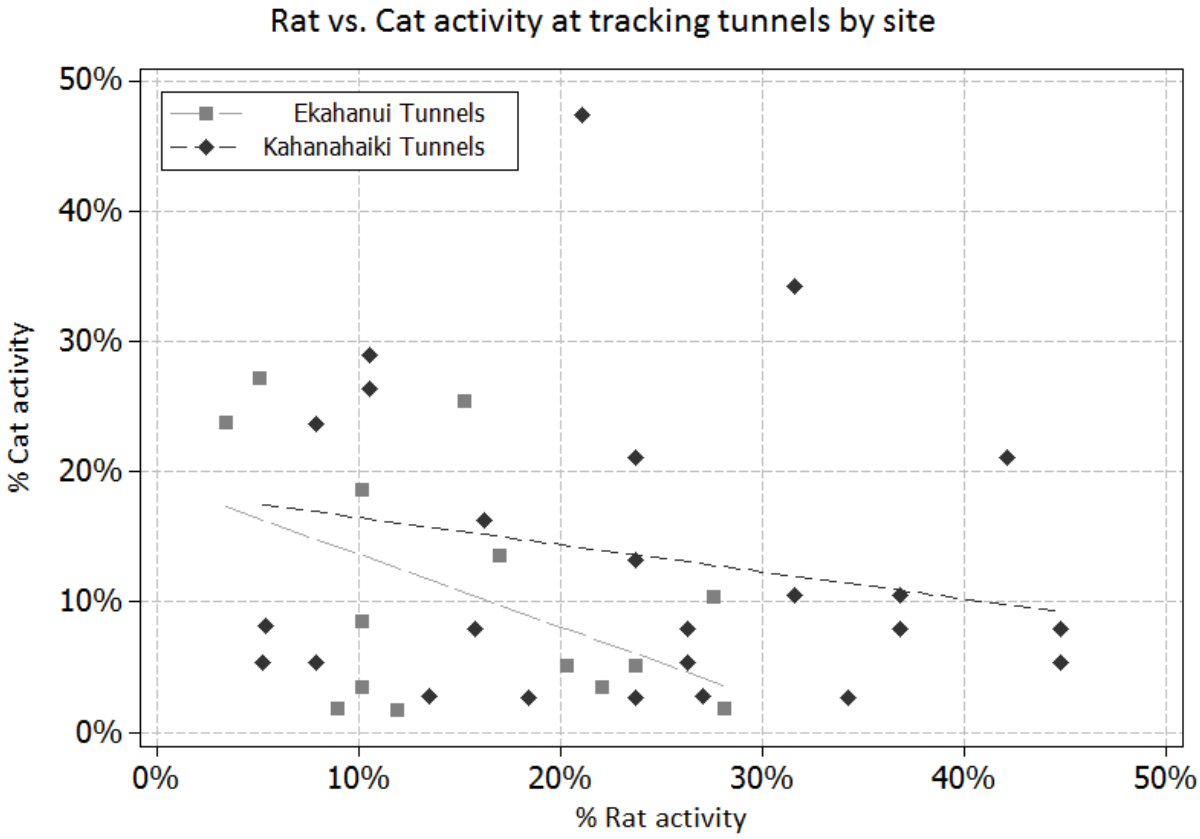

Figure 3. Percent of rat vs. cat activity at tracking tunnels by site.

After looking at the percent tracking data we do see a negative relationship for both sites. It appears that there is a pattern there, but a Pearson Correlation is not significant when looking at both sites combined ($p = 0.182$). However, when looking at each site individually, Ekahanui is approaching significance ($p = 0.08$). Kahanahaiki was not significant ($p = 0.269$), but, with the removal of three outliers in 2010 that had both high percentages of cats and rats, becomes significant ($p = 0.010$).

We also analyzed the relationship between mice and rat percent activity at both sites combined (Fig. 4). We found a significantly positive correlation with mice and rat activity ($p = 0.024$). It is possible that both mice and rats could be responding to a resource together (where rat abundance is high so is mice abundance). This would suggest that rats are not defending territories against mice, thus, removal of rats would not cause an explosion of mice. It is impossible to distinguish rat versus mice kills using counter data on the A24s.

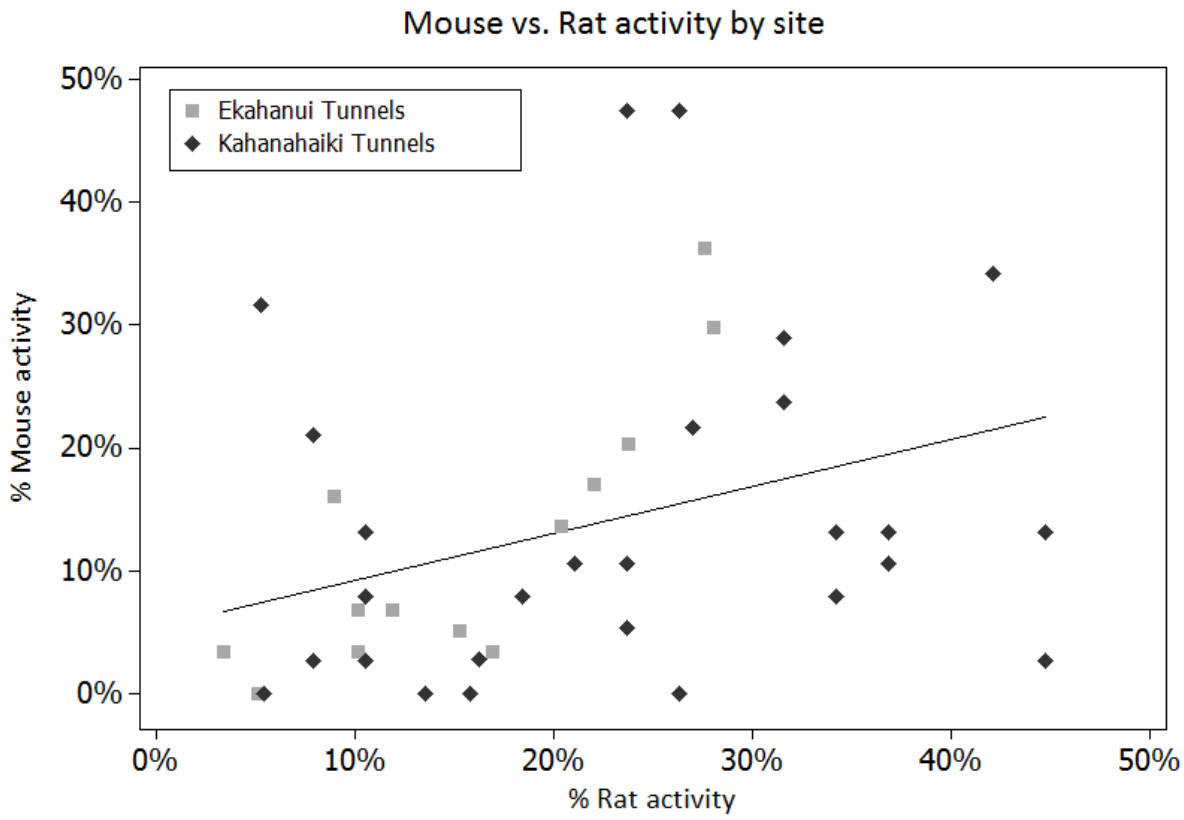

Figure 4. Percent of Mouse vs. Rat activity at tracking tunnels by site

6.4 ON-GOING TRIALS AT PALIKEA AND EKAHANUI

Although the significant amounts of data and research conducted on traps and bait in New Zealand is helpful for implementation in Hawaii, OANRP has documented difficulties and conditions that are not experienced in New Zealand. For example, bait removal by slugs and other invertebrates is a major issue that is not experienced to the same degree in New Zealand. Additionally, it is possible that black rats (*R. rattus*) in Hawaii spend more time in trees than black rats in New Zealand (Peters, pers. comm. 2013). Two questions OANRP asked over past years is whether or not rat control is improved by housing snap traps inside a protective box (typically placed on the ground) or whether uncovered snap traps mounted directly to trees is more effective. It is thought that perhaps the rats would encounter the traps more easily if they were in trees while the slugs would not encounter them as easily, reducing bait loss. DOC's best practice includes housing Victor® traps inside wooden boxes placed on the ground in order to exclude non-target species, guide target species, prevent accidental triggering, and maintain the integrity of the trap from weather (NZ DOC 2005).

At Ekahanui a trial is being conducted to assess if putting Victor® traps uncovered in trees is better than putting Victor® traps in trees with two different trap coverings: wooden boxes or greenhouse plant pots. This study will also look at catch of non-targets and determine whether covered traps will catch fewer non-targets relative to uncovered traps while maintaining the same efficacy for rats. The entire Ekahanui grid covers an area of 177 acres (72 ha). The grid consists of 620 Victor® snap traps that are housed in protective wooden boxes on the ground or placed in trees without boxes; there are 225 traps on the perimeter of the MU and 394 traps in the interior of the MU, all spaced 25 meters apart. For this trial, only a subset of traps (150) was used. 80 Victor® traps were placed in trees with no covering, 36 were

placed in boxes in trees, and 34 were placed in greenhouse plant pots in trees. Traps were checked every two weeks and catches were recorded.

At Palikea a trial was conducted to compare two different trap types, Victor® versus Ka Mate™, and to conduct a cost benefit analysis. The Palikea grid covers an area of 21 acres (9 ha). The grid consists of 180 Ka Mate™ traps: there are 98 traps on the perimeter of the MU spaced 12.5 meters apart and 82 traps in the interior of the MU spaced 25 meters apart along trails. Ka Mate™ traps were deployed in order to experiment with that style of trap and compare the trapping efficacy to Victor® snap traps. On June 5, 2014, staff replaced every other Ka Mate™ trap with a Victor® trap uncovered in a tree, for a total of 91 Ka Mate™ and 84 Victor® traps. Both trap types were then baited every two weeks using small pieces of coconut and observations were recorded. Peanut butter was not used for this trial as Ka Mate™ traps require the use of hard bait for proper trap function. Ka Mate™ traps are set by wedging coconut underneath the trigger. The bait is held in place by tension and the trap cannot trigger until the bait is removed. Victor® traps are set by placing the coconut securely on the yellow pan in-between the plastic triangle or by smashing into the little box on the trigger. Results of these trials will be included in next year's report.

6.5 FUTURE PLANS

Currently, OANRP is conducting limited small grid rat protection at several different rare plant populations. These consist of Victor® traps, A24 traps, or both. Visitation to these sites is often inconsistent and based on plant needs. Some sites get visited frequently while others sometimes only are visited once every couple of months. Control is usually conducted during the fruiting season for most species. Seasonal control, however, has morphed into year round control on some populations that have had basal girdling by rats, such as the *Schiedea* and *Hesperomannia* populations see figure 5.

Figure 5. Rat damage on *Hesperomannia arborescens* at Kapuna/Keawapilau.

Large scale grids of A24s may prove to be more cost effective and beneficial for MU wide rat control compared with large scale grids of victors. OANRP will use counter trials and tracking tunnel results from Kahanahaiki to determine future rat control at other MUs. Possible new sites for MU wide control include Makaha and Kaluaa. MU wide rat control at these areas would provide benefits for multiple species. For either site, tracking tunnels would be placed within the MU and a control site. Spacing would be determined from results at Kahanahaiki and would probably be approximately four A24s per hectare.

Over the next year, OANRP will continue using peanut butter beeswax more extensively. To maximize longevity and bait attractiveness to rats, OANRP will experiment with using the peanut butter beeswax as

supplemental bait; all Victor traps will be baited with a piece of the wax and also a fresh dab of peanut butter or other bait, such as Nutella®. This way, the traps will be highly attractive to rats while the first bait (e.g., peanut butter) is present and will remain baited with the wax after the peanut butter has been removed by insects or slugs.

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