Effectiveness of A24 Automatic Traps for Landscape Level Rodent Control

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ABSTRACT: Beginning in 2009, the Army's Natural Resource Program on O'ahu implemented the first of three ecosystem-scale rat trapping grids of traditional snap traps in the Waianae Mountains using the model outlined in The New Zealand Department of Conservation's current best practices for kill-trapping rats. Traps were generally checked every two weeks, but bait often remained palatable for just a few nights due to slug interference. Because of the amount of labor required for single set traps, trials with Goodnature A24 self-resetting traps were conducted from 2014-2016. Early findings showed that traps were malfunctioning at a rate of ~25% and there were major deficiencies with the bait and bait-delivery system. In 2016 the bait system was improved when Goodnature developed the automatic lure pump that continually releases fresh bait for ~4-6 months. Other improvements were also made to the A24 trap to decrease the malfunction rate. In 2017, we replaced more than 1,300 snap traps at all ecosystem-scale grids with 1,000 A24s. Tracking tunnels were used as an independent monitoring system to determine rat control effectiveness. At all sites, rat activity measured in the tracking tunnels has been low (less than 15%) for over 18 months. In this paper we discuss the results of the transition from single- to multi-set rat traps, highlights some successes and obstacles, and describes grid spacing and applicability to other sites.

KEY WORDS: A24, CO_2 gas longevity, Goodnature, Hawaii, island invasive pest species, rodent management, self-resetting traps, tracking tunnels, Victor snap traps

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INTRODUCTION

The impacts of invasive rodents on Hawaii's native flora and fauna have been extensively documented (Banko et al. 2019, Shiels et al. 2019). Despite long-standing efforts to reduce or eliminate the threat of rodents, particularly in areas of high conservation value, these efforts rarely achieve rodent eradication or protected species benefits at a landscape scale (Duron et al. 2017). As part of their ongoing efforts to manage populations of the federally endangered Oahu Elepaio, several endangered Hawaiian tree snail species, and numerous endangered plants, the U.S. Army Natural Resource Program (ANRP) currently conducts the largest rodent control program in the State (ANRP 2013, 2018). This rodent control program represents a significant investment of resources (staff time, project funds). In an effort to maximize the rodent control program's biological value and cost effectiveness, over the last five years ANRP has implemented and assessed numerous rodent control methods, including rodent birth control, single set lethal traps, diphacinone bait and, most recently, self-resetting lethal traps, including Goodnature A24s (ANRP 2018, Shiels et al. 2019). Although recent advances in the use of birth control and rodenticides have occurred, these tools are not appropriate for most sites due to implementation challenges and existing label restrictions; therefore, lethal traps remain the most common form of rodent control for ANRP.

Goodnature A24s are lethal, self-resetting traps that can humanely dispatch up to 24 rodents before needing servicing. Although the initial cost of each trap is significantly higher than single-kill rodent traps, the product design is advertised as allowing a long re-baiting interval (up to 6 months), thereby reducing staff time spent on regular checking and servicing of traps (Gillies et al. 2014, Carter et al. 2016, Shiels et al. 2019).

Our goal in this study was to 1) assess the effectiveness of rat control using A24 traps in Hawaii forest lands, and 2) provide recommendations of features needed to improve rodent control success using A24 traps in large grids and within an adaptive management context. The information from our study will be used to inform future A24 implementation projects, including the ANRP's rodent control program.

METHODS

Project Set-up

This study occurred on the island of Oahu, Hawaii, and included three of the largest of ANRP's 36 rodent control sites: Ekahanui, Palikea, and Kahanahaiki (Table 1). Rodent control at all three of these sites was historically conducted through the use of Victor snap traps, but converted to the use of A24s at varying years between 2014 and 2017. At each of the sites, the A24s were installed in a grid formation with slight variations as needed due to site terrain. All A24s were baited using Goodnature's chocolate rat lure via a Goodnature Automatic Lure Pump (ALP), which is a baiting mechanism that slowly pushes fresh bait into the trap over a six-month period to maintain a constant level of bait palatability.

Each of the three trap grids was installed concurrently

Table 1. Number of hectares, grid spacing (i.e., the spacing between traps following a grid pattern), and number of A24 traps at the three study sites (Ekahanui, Palikea, and Kahanahaiki) on Oahu Island, Hawaii.

Site Name	Area	Grid Spacing	# of A24s
Ekahanui	100 ha	100m × 50m	306
Palikea	20 ha	50m × 25m	100
Kahanahaiki	40 ha	75m × 50m	75

with an overlapping grid of tracking tunnels. Tracking tunnels are a common and effective independent monitoring tool used to evaluate an index of rodent activity in a project area (Pender et al. 2013, Shiels et al. 2019). When activated on a quarterly basis, each tracking tunnel was baited with peanut butter for a 24-hour period. At the conclusion of the 24 hours, the tracking card was removed from the tunnel and read to identify footprints for determining the presence of rats and mice. It is not possible to distinguish between the foot tracks of *Rattus rattus* and *R. exulans* due to the similarity of their appearance. Mouse tracks are easily distinguishable from rat tracks based on size, and because there is only one mouse species in Hawaii, the small mouse tracks are of the house mouse (*Mus musculus*).

A24 trap grids were checked, re-baited and serviced every four months. Data collected at every check included 1) presence of bait, and 2) presence of CO_2. A lack of bait indicated that the trap was no longer attractive to rodents, thus the trap was no longer effective. A lack of CO_2 indicated that the piston within the trap was no longer able to fire (even if the trap was attractive to rodents), thus the trap was no longer effective. If a trap was malfunctioning or otherwise deemed to be in non-working condition, the trap was removed and replaced with another A24. Traps that were suspected of leaking CO_2 but that were otherwise working were left in place and re-checked at the next four-month interval check.

Analysis of Information

To create a comparable data set from the three sites, we removed all data collected prior to the Fall of 2017, which was when the last of the three A24 grids was installed. Therefore, each site had a final data set of Fall 2017 to February 2020. All data was compiled by site and for each of the three sites, we then analyzed the following measures:

- Percent of traps by check that were out of CO_2
- Percent of traps by check that were out of bait
- Percent rat activity by check
- Percent mouse activity by check

RESULTS

Percent of A24 Traps by Check that were Out of CO_2 (CO_2 Failure Rate)

Over the A24 trapping period, we found that trap failure due to the loss of CO_2 was relatively low, with the percent traps that experienced failure staying lower than 10% during the majority of testing intervals (Figure 1). However, beginning in the summer of 2019, we documented an increasing failure rate of A24s at Ekahanui. This increasing trap failure rate was not documented at the other two study sites.

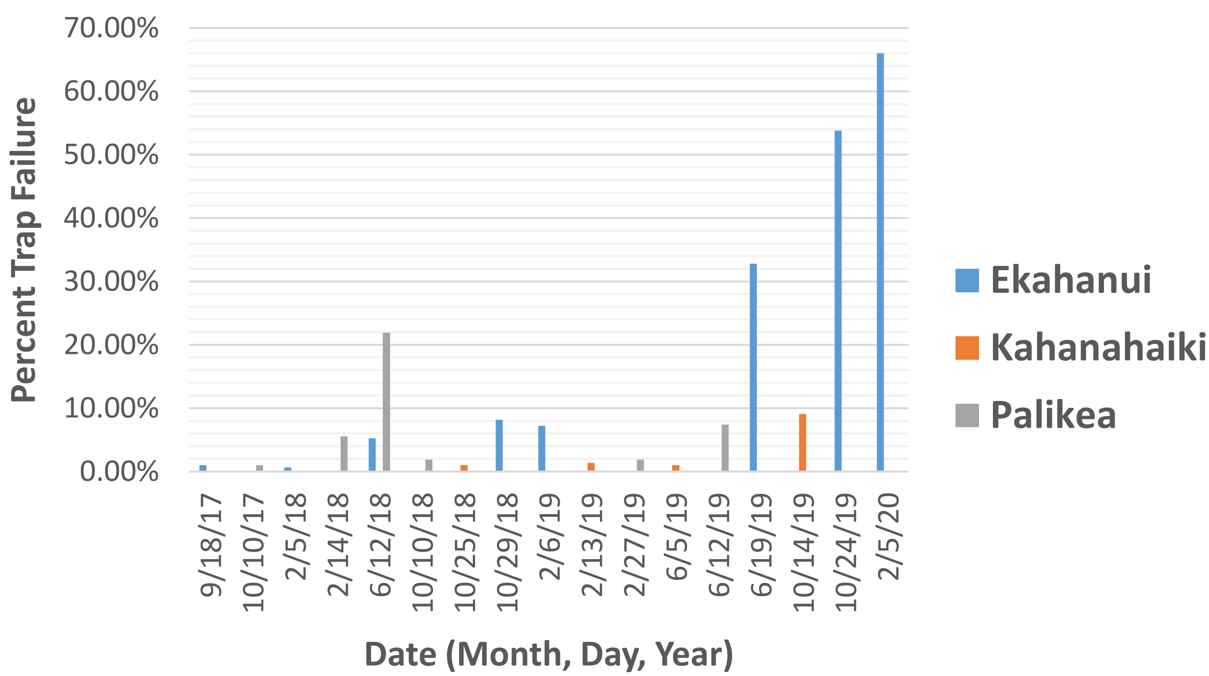
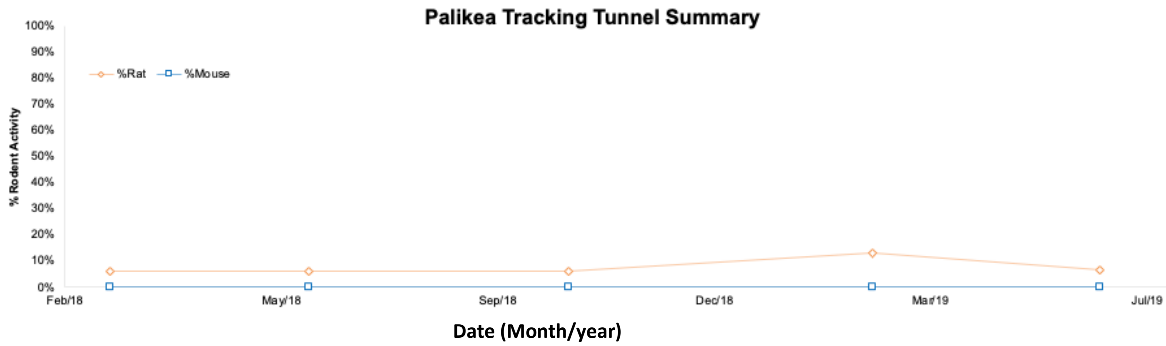
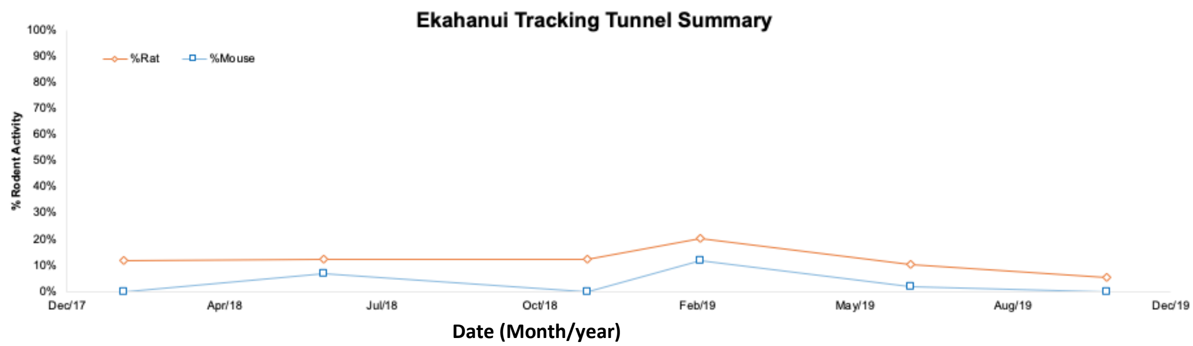


Figure 1. A24 trap CO_2 failure rate at the three study sites between fall 2017 and February 2020, Oahu Island, Hawaii. Failure rate was calculated as the number of failed traps out of total number of traps across all three sites.



A)



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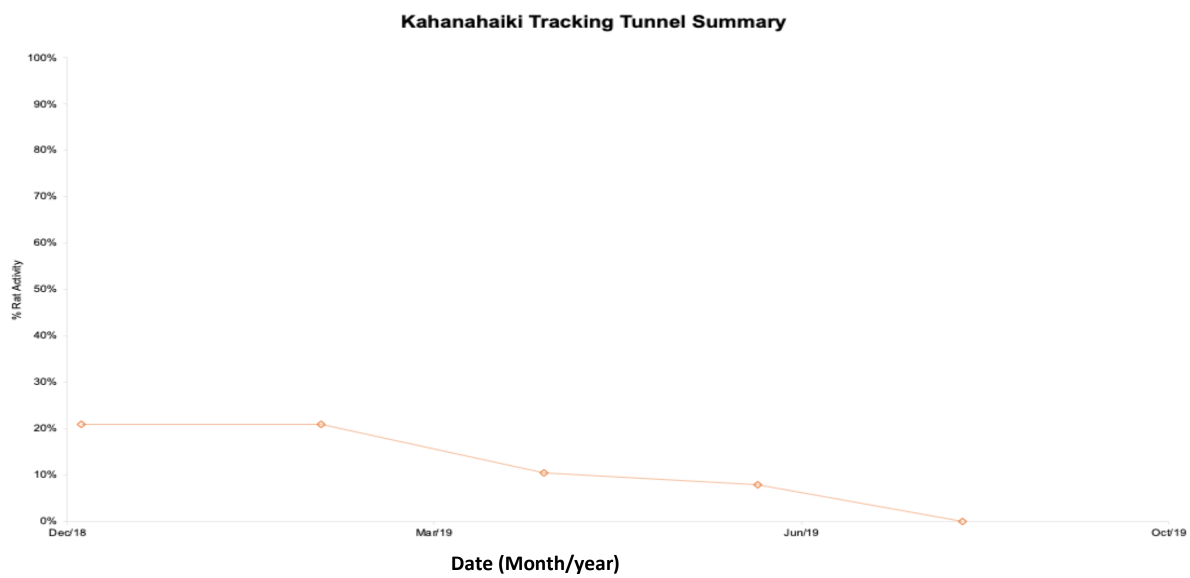

C)

Figure 2. Percent rat and mouse activity (percentage of tracking tunnels that indicate the presence of rats or mice) across the three study sites (A-C). Rat control using A24 traps had begun prior to the first sampling date on each graph.

Percent of Traps by Check that were Out of Bait

Early in the study period, we identified a large percentage of traps that were no longer active at our four-month check due to lack of bait (approximately 60% of traps had bait remaining at the next check). Field observations indicated that the high incidence of bait removal was due to several species of invasive slug (including *Limax maximus*) spoiling with slime or consuming the bait. Rather than continue with the same baiting and trap check methodology, we pursued alternatives that would reduce bait palatability for slugs. Trials were conducted from late 2018 to late 2019. Results of these bait trials are presented separately (Bogardus et al. 2020). Based on the results of these trials, all A24 bait used at all three sites was converted to a new formula by late 2019.

Percent Rat Activity by Check

Over the analysis timeframe, rat and mouse activity (which is an index for population relative abundance) at all three sites stayed below 25% and at times approached zero

(Figure 2). Mouse activity data is not available for the Kahanahaiki site due to data accessibility.

DISCUSSION

Overall, this analysis indicates that the use of A24s has relatively low failure rates due to CO_2 loss. While initial bait loss due to slug consumption was high, changing the formula of bait to make it less palatable to slugs, while maintaining palatability for target rat and mouse species, is likely to result in higher bait longevity (Bogardus et al. 2020). Collectively, this information supports a longer interval between trap checks, thereby reducing staff labor costs. Based on this information, the ANRP is planning on moving toward exclusive use of A24 traps for most sites and implementing trap check/servicing intervals of every six months.

The 30-60% trap failure rates at Ekahanui over the last six months of the study period indicate there may be unknown factors influencing the failure rates at this location. We are currently consulting with Goodnature to troubleshoot possible mechanical or site-specific biological factors such as insects. Identification of such trap failures allows for real time adaptive management techniques that help avoid loss of trapping efficacy. Although it is likely that further refinement of A24s could allow for longer trap check intervals, ANRP has determined that checking each trap a minimum of every six months is essential for identifying and addressing changes via adaptive management.

Our study also indicates that the large-scale A24 grids are effective at maintaining rat and mouse activity levels below 25%, and often even lower. Although the historic efficacy data for the three sites has not been fully analyzed, an anecdotal overview indicates that the use of Victor snap traps over the same physical area with two-week trap check intervals were not able to achieve similar levels of efficacy on a consistent basis (activity rates were consistently higher than 25%) (ANRP 2018). Ultimately, the goal of ANRP's trapping effort is to reduce predation pressure on threatened and endangered species; thus, achieving a higher level of efficacy is a primary factor in determining future trapping methodology. In the future, we will continue to collect data that allow us to analyze trapping efficacy (as determined by rat and mouse activity levels) with target endangered species survival and productivity; however, the rarity of the species and the challenges of collecting this information make it impractical for making large-scale trapping decisions in real time.

Although the purchase of A24s constitutes a higher initial investment than single-set traps like Victor snap traps, A24s allow massive labor cost savings as they are checked and serviced each 4-6 months versus Victor snap trap servicing each two weeks (Pender et al. 2013). Given that trapping to protect many of Hawaii's endangered species are long-term (multi-year) endeavors that often require sustained effort over more than five years, the cost efficacy of A24 trap usage is especially apparent. Specific replacement intervals for A24s have not been determined, yet Goodnature currently provides a two-year warranty on each trap and they state that some traps have been documented in good working order after 10 years whereas most traps fail at varying times between year 3 and 10. A24 trap lifespan is therefore a factor that should be considered in long-term project planning when considering using the A24 traps.

Collectively, the implications of this study have influenced the future trajectory and plans for trapping under the ANRP. Although the use of A24s comes with new challenges and unknowns, the ability to achieve landscape level predator control is realized with a high level of efficacy and a reduction in long-term labor costs. Such cost savings have allowed ANRP to reallocate limited time and resources toward additional high priority conservation activities (i.e., invasive weed control, endangered species outplanting, new snail protective enclosures). Additionally, the cost value from the use of A24s has allowed ANRP to expand rodent trapping into additional areas, thereby increasing the total percentage of the landscape with active and continuous rodent control and increasing connectivity between conservation units.

Implications for Broader Projects

The ANRP anticipates that other projects will experience similar benefit from the transition of traditional snap trap grids to the use of A24s. However, the extent of efficacy and cost benefits will likely vary by project and geographical area. Based on ANRPs continued use of A24s in large grids, we have compiled a set of considerations for programs that are beginning to implement A24s:

- Overall trapping program efficacy is strongly influenced by grid size. The larger the grid, the more rodent home ranges will occur within it and therefore the more effective it will be at reducing rodent activity.
- The use of A24s is most effective when paired with an independent monitoring system (tracking tunnels, chew cards, or a systematic camera trapping grid). Trap kills (as detected by cameras or counters) cannot provide managers with the information necessary to implement real-time adaptive management. An independent monitoring system will provide important information on the efficacy of trap grids in reducing rodent activity, seasonal variations in rodent activity, and unexpected changes that would influence trapping methodology.
- It is advised to monitor the rodent population at the trap site before the trapping initiates, and to have a nearby reference plot for each trap grid. The reference plot would use the same independent monitoring devices as the trapping plot and have both trapping and reference plot monitored at concurrent intervals. In most areas that ANRP conduct rodent control, there are no available reference plots comparable to the trapping grid because it would often mean leaving natural resources unprotected from rodent predation and damage (a risk that is not acceptable). In such cases where a nearby reference plot is not present, it is important to at least monitor rodent activity at the trapping grid prior to when trapping initiates.

Incorporating reference plots and monitoring before trapping will help prove that the rodent populations are indeed being suppressed by the chosen trapping methodology.

- Although the ANRP is moving toward trap checks on a 6-month interval, each program should tailor their trap check timeline based on the needs of their project and site-specific conditions. Programs should initiate implementation of A24s with a 1-month trap check, then extend the trap check interval over time based on bait longevity and CO_2 use. Trap check intervals should not extend beyond the point in time when more than 20% of traps in a grid have run out of bait or CO_2.
- All ANRP grids use the Goodnature Automatic Lure Pump. While not presented in this paper, the use of ALPs has greatly increased bait longevity and palatability over that of the previous Goodnature static lures. Projects should not expect similar results as the ANRP study if not using ALPs with their A24s. If projects using A24 static lures are documenting low trapping efficacy (via an independent monitoring system) or poor bait quality/quantity at trap check intervals, they should significantly reduce trap check intervals so that re-baiting occurs on a more frequent basis or implement the use of ALPs.

Although ANRP maintains the most extensive A24 grids in the state of Hawaii, there are limitations to the data and analysis. We intend to continue collecting, analyzing, and providing information on the use of A24s with the anticipation that these efforts will increase the collective capacity of the vertebrate pest communities and Hawaii conservation community. Priorities for further data collection and analysis include:

- Correlation of trapping methodology and efficacy with resource response (increase in survival and reproduction of threatened and endangered species).
- Comparison of trapping efficacy and trap check intervals over various project areas and habitat types (wet forest, grassland/shrublands, coastal strand, mesic, sub-alpine).
- Further analysis of long-term trap failure rates and replacement timelines.
- Reduction of non-target species bait consumption.

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