Effect of Rodent Reduction on Numbers of Forest Birds in a Hawaiian Rainforest

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Introduction

Nest predation by alien rodents is one reason native bird populations in the Hawaiian Islands are decreasing (USFWS 2006). Therefore, effective mitigation of rat predation is considered an essential component of endangered species recovery programs (USFWS 2006).

Since 1996, the Maui Forest Bird Recovery Project has controlled rodents in a portion of the Hanawi Natural Area Reserve on east Maui. This program reduces black rat (*Rattus rattus*) numbers by 99% (Malcolm *et al.* 2008).

To determine if rodent reduction enhances survival and production in forest birds, we compared the relative abundance of native and non-native species on a rodent reduction grid and in an untreated (control) area within Hanawi.

Methods

Our two study sites, HR3 and Frisbee Meadows (FSB) (Fig. 1), are located in native montane rainforest dominated by ohia (*Metrosideros polymorpha*). FSB has no rodent reduction. HR3 has a 26-ha grid with diphacinone bait stations and snap traps located every 50 m throughout the area. Target rodents include black rat (*Rattus rattus*), Polynesian rat (*Rattus exulans)* and Norway rat (*Rattus norvegicus).*

All bird abundance data were collected from January to June during 2009 and 2010 at elevations between 1500 m and 1900 m. In 2009, 101 randomly selected line transects of 500 m were completed within the HR3 rodent reduction grid. In 2010, 6 permanent transects were established. At FSB there were 6 permanent 500 m transects surveyed in both years.

Along the transects, we recorded the number of Maui Alauahio (*Paroreomyza montana*) and their group sizes. We expected that encounter rates and group sizes of Alauahio on the rodent reduction transects would be greater than along control transects.

To estimate relative abundance of all forest bird species, 40 standard point counts (Scott *et al.* 1986) were replicated in each study area, twice in 2009 and three times in 2010. Point counts result in independent birds per station (BPS) estimates, which we pooled. We completed whole model analyses with JMP software to examine count responses by year and by study site.

Common Name	Species Code	Scientific Name	Trophic Guild	Response to Rodent Reduction
Apapane	APAP	*Himatione sanguinea*	Nectar	None
Hawaii Amakihi	HAAM	*Hemignathus virens*	Invertebrates/nectar	None
Iiwi	IIWI	*Vestaria coccinea*	Nectar	Increase, P < 0.0001
Akohekohe	AKOH	*Palmeria dolei*	Nectar	None
Maui Alauahio	MAAL	*Paroreomyza montana*	Invertebrates	None
Maui Parrotbill	MAPA	*Psuedonestor xanthophrys*	Invertebrates	None
Japanese White-eye	JAWE	*Zosterops japonicus*	Invertebrates	Increase, P < 0.0001
Japanese Bush-warbler	JABW	*Cettia diphone*	Invertebrates/nectar	None
Red-billed Leiothrix	RBLE	*Leiothrix lutea*	Invertebrates/fruits	Increase, P < 0.0001

Table 1. Response to rodent reduction in nine species based on point counts.

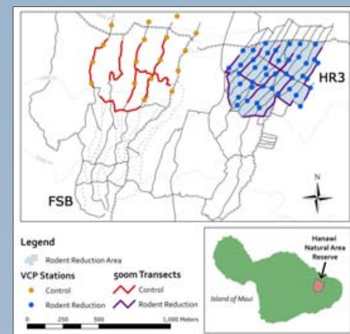

Figure 1. Map of HR3 and FSB with 500 m transects and point count stations. Inset of Hanawi reserve within Maui Island.

Results

500 meter Transects

In 2009, we surveyed 101 unique transects on the HR3 rodent reduction grid and repeated the 6 transects at the FSB control site at least 10 times. We converted detections to Alauahio per hour, because observers varied in the time taken to cover 500 m. Mean Alauahio per hour on the rodent reduction grid was 5.9 ± 0.3 (SE) versus 3.8 ± 0.3 (SE) in the control area (t = 4.65, p< 0.0001). Alauahio groups greater than two tended to be more prevalent on the rodent reduction grid than in the control area (Chi-square = 6.3, df = 3, p < 0.10).

In 2010, the 6 transects at each site were sampled three times. Alauahio encounter rates showed no difference between sites and averaged 3.0 ± 0.5 (SE). Group size distributions on and off the rodent reduction grid also showed no difference in 2010.

Point counts

Nine bird species had counts sufficient for statistical analyses (Table 1).

One native and two non-native bird species responded positively to rodent reduction (RR) (Table 1, Fig. 2). Endangered species showed no difference by treatment or year (Fig. 3.) Four species differed significantly in relative abundance between years (Fig. 3).

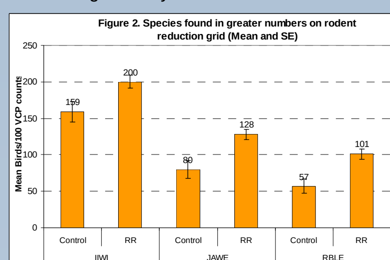

Figure 2. Species found in greater numbers on rodent reduction grid (Mean and SE)

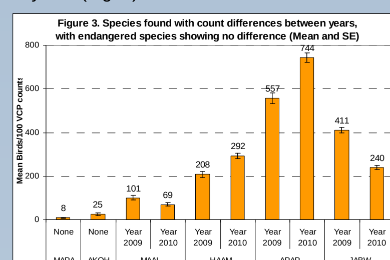

Figure 3. Species found with count differences between years, with endangered species showing no difference (Mean and SE)

Discussion

Transect results from 2009 are statistically superior to 2010 due to larger sample sizes. Group size differences suggest that Alauahio reproductive success is higher on the rodent reduction grid than in the control area. Additional data are desirable to reconcile the lack of replication of these results in 2010.

We selected Alauahio for monitoring on transects as a proxy for the Maui Parrotbill (*Psuedonestor xanthophrys*), an endangered forest bird whose low detection rates provide little statistical inference. As expected transects and point counts did not show any difference in Parrotbill relative abundance in response to rodent reduction. However, Parrotbill pair success (number of juveniles/pair/year) improves with rodent reduction, ranging from 0.60 to 0.80 on the HR3 grid versus 0.33 to 0.41 in the entire FSB control area (MFBRP unpublished).

According to point counts, two non-native species benefited from rodent reduction, raising concern that interspecific competition could affect native species. Alauahio do have diet overlap with the three non natives, and Foster (2005) found that Japanese White-eye had the most overlap. In order to have competition, food resources must be limited and reproduction must be lacking. Given Alauahio did not decline with the increase of non-natives, competition with non-natives appears neutral. Rodent reduction should lower competition by increasing arthropod food availability (Foster 2005). It also improves forest health by reducing seed predation by rodents.

Predator control has proven to be an ally for recovering bird populations all over the Pacific (VanderWerf 2009). In order to sustain native birds for years to come, expanding rodent reduction in the Hawaiian Islands is recommended for native forest habitats. Monitoring species response to this will also need to be continued.

Acknowledgements

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Literature Cited

Foster JT. 2005. Exotic bird invasion into forests of Hawaii: deomography, competition, and see dispersal. University of Illinois at Urbana-Champaign: 78-102.

Malcolm TR, Swinnerton KJ, Groombridge JJ, Sparklin BD, Brosius CN, Vetter JP, Foster JT. 2008. Ground-based rodent control in a remote Hawaiian rainforest on Maui. *Pacific Conservation Biology* 14: 206-214.

Scott JM, Mountainspring S, Ramsey FL, Kepler CB. 1986. Forest bird communities of the Hawaiian islands: their dynamics, ecology, and conservation. *Studies in Avian Biology* 9: 37-40.

U.S. Fish and Wildlife Service. 2006. Revised Recovery Plan for Hawaiian Forest Birds Region 1, Portland, OR.

VanderWerf EA. 2009. Importance of nest predation by alien rodents and avian poxvirus in conservation of Oahu Elepaio. *The Journal of Wildlife Management* 73.5: 737-746.