
Photo by Brooks Rownd

Home Range Patterns of Maui Alauahio and Maui Parrotbill

Kelly J. Iknayan, Hanna L. Mounce,
and C. Dusti Becker

Maui Forest Bird Recovery Project, Makawao, HI


Photo by Mike Neal

Introduction

Home range and territory size varies among birds of the same species often reflecting intraspecific competition **(1,2)** and/or habitat quality **(3,4)**. Knowing the extent of variation in home range size in a given species may be helpful for conservation planning. For example, average home range sizes of endangered species are used to predict future populations in recovery areas.

We examine home range patterns in two insectivorous honeycreepers, the endangered Maui Parrotbill (*Pseudonestor xanthophrys*) and the Maui Alauahio (*Paroreomyza montana newtoni*). We evaluate the variation in home range sizes among individuals in relationship to sex and elevation in a Hawaiian rainforest study area.

Methods

In Hanawi Natural Area Reserve since 1992, Maui Alauahio (MAAL) and Maui Parrotbill (MAPA) have been captured in mist nets and marked with unique color combinations and USFWS aluminum bands. Locations of marked individuals were recorded on handheld GPS units at two study sites, HR3 and Frisbee (FSB), both located within Hanawi (Fig. 1).

We used data from 1995 through 2010 to estimate home ranges of individual Maui Alauahio with ≥ 10 resights/ yr and of individual Maui Parrotbill with ≥ 6 resights/ yr. Home range areas were estimated with a local convex hull (LoCoH) nonparametric kernel method**(5,6)** using the LoCoH Home range Generator template in ArcMap 9.3.1.

For LoCoH analysis, k-values were selected based on the minimum spurious hole covering (MSHC) rule(**5**). K-values were set as categorical constructs related to number of resights: k = 5 for 6-20, k = 7 for 21-30, and k = 10 for 31-40 resights.

Using JMP statistical software, we did whole model analyses (multiple linear regression and analysis of variance) to explore sources of variation in home range sizes. For each species we focused on effects of study site, year, individual, sex, k-value, number of resights, and the date range over which observations were recorded.

Partial ranges bordering or overlapping the edges of the study areas were significantly smaller than ranges fully within the study sites for both species ($p < 0.04$) and were excluded from analyses.

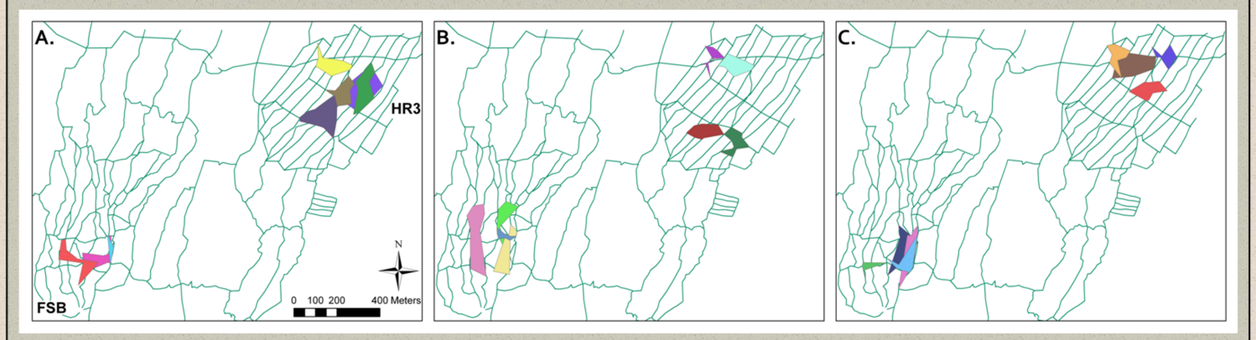

Figure 1.
A subset of samples of the MAAL home ranges used in analysis from 2009 illustrating individual variation.
A. Male home ranges. B. Female home ranges. C. Home ranges of individuals of unknown sex.

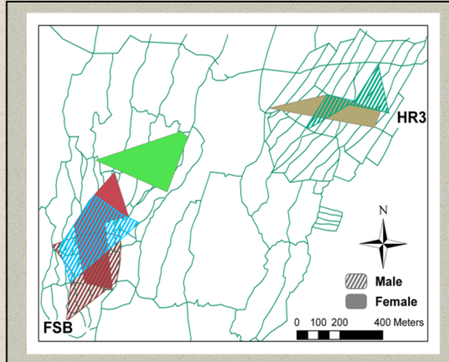

Figure 2.
Representative subset of MAPA home ranges from 2008. Males have lined fill; females solid fill.

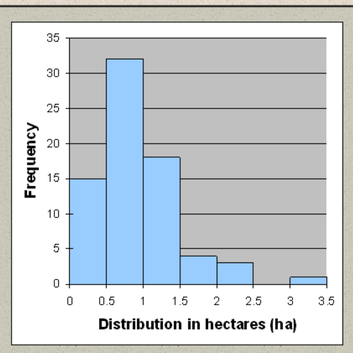

Figure 3.
Distribution of MAAL home range sizes in hectares

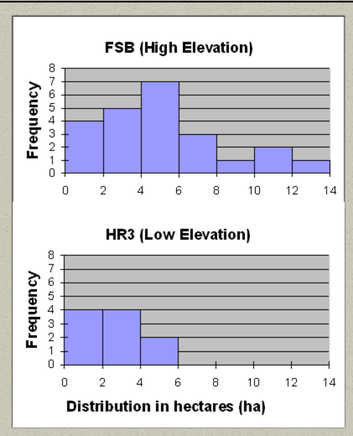

Figure 4.
Distribution of MAPA home range sizes in hectares at FSB and HR3

Results

For both species, variation associated with the individual bird, study site (elevation), sex, and k-value (see Figures 1 and 2) explained as much as 85% of the variation in home range sizes (Multiple Linear Regression, $p < 0.04$). Individual variation was the main source of variance in both species, and explained around 30% of the variation in home range sizes of Maui Parrotbill and 24% of variation in Maui Alauahio.

Maui Alauahio home ranges varied from 0.15 to 3.3 ha (mean = 0.92± 0.07 (SE) ha, $N = 73$) with 75% of ranges under 1.2 ha (Figure 3). Maui Parrotbill home ranges varied from 0.4 to 12.4 ha (mean = 4.4 ± 0.5 (SE) ha, $N = 33$) with 75% under 6 ha (Figure 4). No statistically significant sex differences were found in home range size for either species.

Maui Parrotbill home ranges at FSB (5.1 ± 0.61 ha) were significantly larger than those at HR3 (2.8 ± 0.92 ha; t-test, $p < 0.007$). Maui Alauahio home ranges did not differ by study site (Figure 4).

The number of resights used to estimate home range and the number of days to obtain them were positively correlated with home range sizes for both species (e.g. $r^2 = 0.10$ and 0.19, respectively for Maui Parrotbill home range sizes).

Discussion

Many bird species exhibit individual variation in home range sizes **(7)**. Thus, for conservation planning average home range may be a poor choice for estimating the number of birds likely to be supported by a habitat type. For example, our mean parrotbill home range size is nearly double what is currently used **(8)** for management purposes.

Given that home range size declines with greater food availability**(9)**, the increase of Maui Parrotbill home ranges with elevation may best be explained by ohia (*Metrosideros polymorpha*) morphology. At higher elevation, the size of ohia trees decreases**(10)**. Thus, less woody surface area is available for foraging per unit area at higher elevation. Since parrotbill have a more specialized foraging niche than alauahio, they may be more sensitive to declines in woody surface area. Because alauahio are generalist insectivores, they may be able to maintain the same distribution of home range sizes regardless of changes in woody surface area.

When possible, GIS mapping should be used in preference to home range averages for estimating spatial requirements of endangered birds. Identifying variables of habitat suitability that reduce home range size, especially in Maui Parrotbill, will lead to better planning of high quality restoration areas.

Acknowledgements

The Maui Forest Bird Recovery Project operates under the auspices of the Pacific Cooperative Studies Unit, University of Hawaii. Funds for this research were provided by the U.S. Fish and Wildlife Service and the Hawaii Department of Land and Natural Resources, Division of Forestry and Wildlife. We thank all the field crews of MFBRP for their hard work and dedication. We also thank ESRI for software donated through their conservation grant.

Literature Cited

(1) Krebs, J.R., 1971. Territory and breeding densities in the Great Tit. Ecology 52: 2-22.
(2) Myers, J.P., Conners, P.G., Pitelka and F.A. Pitelka, 1979. Territory size in wintering sanderlings: the effect of prey abundance and intruder density. The Auk. 96: 551-561.
(3) Carpenter, F.L., 1987. Food abundance and territoriality: to defend or not to defend? American Zoologist 27: 387-399.
(4) Pasinelli, G. 2000. Oaks (*Quercus* sp.) and only oaks? Relations betweeen habitat structure and home range size of the middle spotted woodpecker (*Dendrocopos medius*). Biological Conservation 93: 227-235.
(5) Getz, W.M.and C.C Wilmers. 2004. A local nearest-neighbor convex-hull construction of homeranges and utilization distributions. Ecography. 27: 489-505
(6) Getz, W.M., S. Fortmann-Roe, P.C. Cross, A.J. Lyons, S.J. Ryan and C.C. Wilmers. 2007. LoCoH: Nonparameteric Kernel Methods for Constructing Home Ranges and Utilization Distributions. . PLoS ONE 2(2): e207.
(7) Wiens, J.A., J. T. Rottenberry and B. Van Horne. 1985. Territory size variations in shrubsteppe birds. The Auk 102: 500-505.
(8) Pratt T.K., J.C. Simon, B.P. Farm, K.E.Berlin and J.R..Kowalsky. 2001. Home range and territoriality of two Hawaiian honeycreepers, the Akohekohe and Maui parrotbill. The Condor 103: 746-755.
(9) Schoener, T.W. 1983. Simple models of optimal feeding territory size: a reconciliation. The American Naturalist 121: 608-629.
(10) Cordell et al. 2000. Photosynthesis and Freezing Avoidance in Ohia (Metrosideros polymorpha) at Treeline in Hawaii. Arctic, Antartic, and Alpine Research 32: 381-387.