Maui Parrotbill - ©Eric VanderWerf

Survival estimates of the endangered Maui Parrotbill (*Pseudonestor xanthophrys*) and the Maui Alauahio (*Paroreomyza montana*)

Julia C. Garvin[1], John P. Vetter[1], Hanna L. Mounce[1], Eric A. VanderWerf[2], Kirsty J. Swinnerton[1,4], Haley E. Breniser[1], C. Dusti Becker[1], David L. Leonard[3]

[1] Maui Forest Bird Recovery Project, Makawao, HI, USA [2] Pacific Rim Conservation, Honolulu, HI, USA [3] Hawaii Department of Land and Natural Resources, Division of Forestry and Wildlife, Honolulu, HI, USA, [4]Current address: Island Conservation Canada, Kelowna, BC CANADA

Maui Alauahio ©Oahu Nature Tours Inc./ Michael Walther

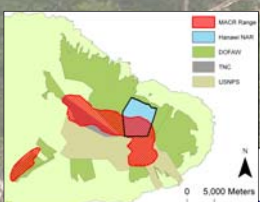
INTRODUCTION

Hawaiian bird species have suffered declines due to introduced mammalian predators, avian disease, and habitat destruction/degradation. Current population estimates are derived from statewide surveys based on point counts which perform poorly when applied to rare and cryptic forest species.[1] As a result, the status of many Hawaiian forest birds is poorly known, and demographic data are needed to help assess population viability. We used mark-recapture data to estimate and compare survival rates in the federally endangered Maui Parrotbill and Maui Alauahio or Maui Creeper, both of which are endemic to the island of Maui.

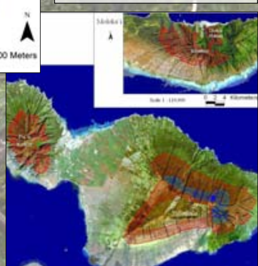
Maui Parrotbill
1986 population estimate[2] 502±116
Long life span (≥ 14 yrs)
Long juvenile dependency (> 1 year)

Maui Alauahio
1986 population estimate[2] 34,839±2,723
Long life span (≥ 14 yrs)
Shorter juvenile dependency (2-3 months)

Predictions for Survival Rates
Parrotbill > Alauahio (greater parental investment)
Adults > Hatch-years (HY; typical of vertebrates)
Males > Females (higher reproductive costs)



Left: Current range of Maui Alauahio[3]. Historically found on both East and West Maui.



Right: Current (blue) and recovery range (red) of Maui Parrotbill[4]

METHODS

During 1994-2007 birds were captured in mist nets and banded with unique color combinations and USFWS bands. We made standard measurements, identifying age and sex when possible (often difficult in Maui Alauahio). Color-banded individuals were resighted each field season.

We analyzed the mark-recapture-resight data in Program MARK[5] 5.1 using Cormack-Jolly-Seber models to investigate possible effects of age, sex, and year. We selected models using Corrected Akaike's Information Criterion adjusted for overdispersion (QAICc).

RESULTS

Maui Parrotbill (Table 1)

•Survival was lower in hatch-years (0.76 ± 0.09) than in adults (0.84 ± 0.04), although this did not reach statistical significance.
• Survival did not differ between the sexes, and sex did not affect resight probability (p).
•Survival did not appear to differ among years, but small samples in some years hindered estimation.
• Resight probability varied greatly between years.

Maui Alauahio (Table 2 & 3)

Among known-age individuals (Table 2):
•Survival varied among years.
•Survival was lower in hatch-years (0.64 ± 0.07) than in adults (0.78 ± 0.06)
•Resight probability was higher in hatch-years (0.71 ± 0.06) than in adults (0.41 ± 0.20)

Among known-sex adult individuals (Table 3):
•Survival varied among years
•Survival was higher in males (0.67 ±0.07) than in females (0.61 ± 0.08), although this did not reach statistical significance.
•Resight probability was lower in females (0.49 ± 0.10) than in males (0.73 ± 0.06).

Table 1. Most parsimonious models for the **Maui Parrotbill** (All individuals N = 103)

Model	ΔQAICc	AICc Weight	No. Parameters
Phi(.) p(t)	0.00	0.57	13
Phi(age) p(t)	1.72	0.24	14
Phi(sex) p(t)	2.28	0.18	14
Phi(age+sex+t) p(age+sex+t)	10.73	0.00	28
Phi(t) p(t)	10.87	0.00	23
Phi(.) p(.)	59.46	0.00	2

Adjusted for c-hat = 1.19 with SE = 0.01

Table 2. Most parsimonious models for the **Maui Alauahio** restricted to **known age** individuals (HY and adults; N = 179)

Model	ΔQAICc	AICc Weight	No. Parameters
Phi(t) p(.)	0.00	0.36	8
Phi(t) p(age)	0.03	0.36	9
Phi(age+t) p(.)	0.90	0.23	9
Phi(t) p(t)	5.60	0.02	13
Phi(age+t) p(age+t)	6.11	0.02	15
Phi(.) p(.)	8.11	0.01	2

Adjusted for c-hat = 1.48 with SE = 0.05

Table 3. Most parsimonious models for the **Maui Alauahio** restricted to **known sex** individuals (adults only; N = 121)

Model	ΔQAICc	AICc Weight	No. Parameters
Phi(t) p(sex)	0.00	0.57	9
Phi(sex+t) p(sex)	1.73	0.24	10
Phi(t) p(.)	2.38	0.17	8
Phi(sex+t) p(sex+t)	7.75	0.01	15
Phi(t) p(t)	9.84	0.00	13
Phi(.) p(.)	12.25	0.00	2

Adjusted for c-hat = 1.20 with SE = 0.04

Nestling Maui Parrotbill

HY Maui Alauahio

CONCLUSIONS

As predicted, survival was higher in Maui Parrotbills than in Maui Alauahio. Given the differences in annual reproductive output of these species, this result was not surprising. Depredation of nesting females by rats also may be a greater threat to alauahio as the species nests closer to the ground than parrotbill[6].

In both species survival was lower in HY than in adults, which is common in bird species with altricial young. Although the sample size of HY parrotbill was small (n = 7), we suspect the age effect is real based on field observations of HY birds. Low resight probability in some years (likely due to variable resight effort) may have resulted in an overestimation of survival in parrotbill HY.

Survival did not differ between the sexes in parrotbill, but male alauahio had higher survival than did females, possibly due to predation of nesting females by rats.

These survival estimates for two rare species of honeycreeper will contribute to assessment of population trends. Data from MFBRP's parrotbill nesting studies show low nest success rates (0.32 ± 0.27), highlighting the need for urgent conservation effort given the extremely small population size. This study will help focus such efforts, and provide a template for estimating survival rates in other similarly rare and cryptic species.

REFERENCES

[1]Camp, R. J., M. Gorresen, B. L. Woodworth, and T. K. Pratt. 2003. Forest bird distribution, density and trends at Hakalau Forest NWR, Hawaii. Report to Hakalau Forest NWR, USFWS.
[2]Scott, J. M., S. Mountainspring, F. L. Ramsey, and C. B. Kepler, editors. 1986. Forest Bird Communities of the Hawaiian Islands: Their Dynamics, Ecology, and Conservation. Allen Press Inc., Lawrence.
[3]Hawaii Forest Bird Interagency Database
[4]U.S. Fish and Wildlife Service. 2006. Revised Recovery Plan for Hawaiian Forest Birds. Region 1, Portland, OR.
[5]White, G. C., and K. P. Burnham. 1999. Program MARK. Bird Study 46:S120-139.
[6]Baker, H., and P. E. Baker. 2000. Maui 'Alauahio (*Paroreomyza montana*) in A. Poole, and F. Gill, editors. The Birds of North America, No. 504. The Birds of North America, Inc., Philadelphia, PA.

ACKNOWLEDGEMENTS

We would like to thank Jamie Bruch, Stuart Pimm, Thane Pratt, and John Simon for their research on or in conjunction with our study populations, David Duffy for his management of MFBRP, and Lenny Freed for his consultation. We would also like to thank the following organizations whose personnel, land, and funding made this study possible: Haleakala National Park, Hawaii Department of Land and Natural Resources, University of Hawaii, U.S. Fish and Wildlife Service, and U.S. Geological Survey.