University of St Andrews
CREEM Centre for Research into Ecological and Environmental Modelling
The University of St Andrews is a charity registered in Scotland : No SC013532

Improved inference in point-transect models: applications to Hawaiian forest birds

Richard Camp[1,2], Len Thomas[1] and Stephen Buckland[1]
[1]Centre for Research into Ecological and Environmental Modelling, The Observatory, University of St Andrews, St Andrews, Scotland
[2]Pacific Island Ecosystems Research Center, U.S. Geological Survey, Hawai`i National Park, USA

USGS science for a changing world

Spatio-temporal density surface modelling

Research collaborators: D.L. Miller[1]
[1] Centre for Research into Ecological and Environmental Modelling, The Observatory, University of St Andrews, St Andrews, Scotland.

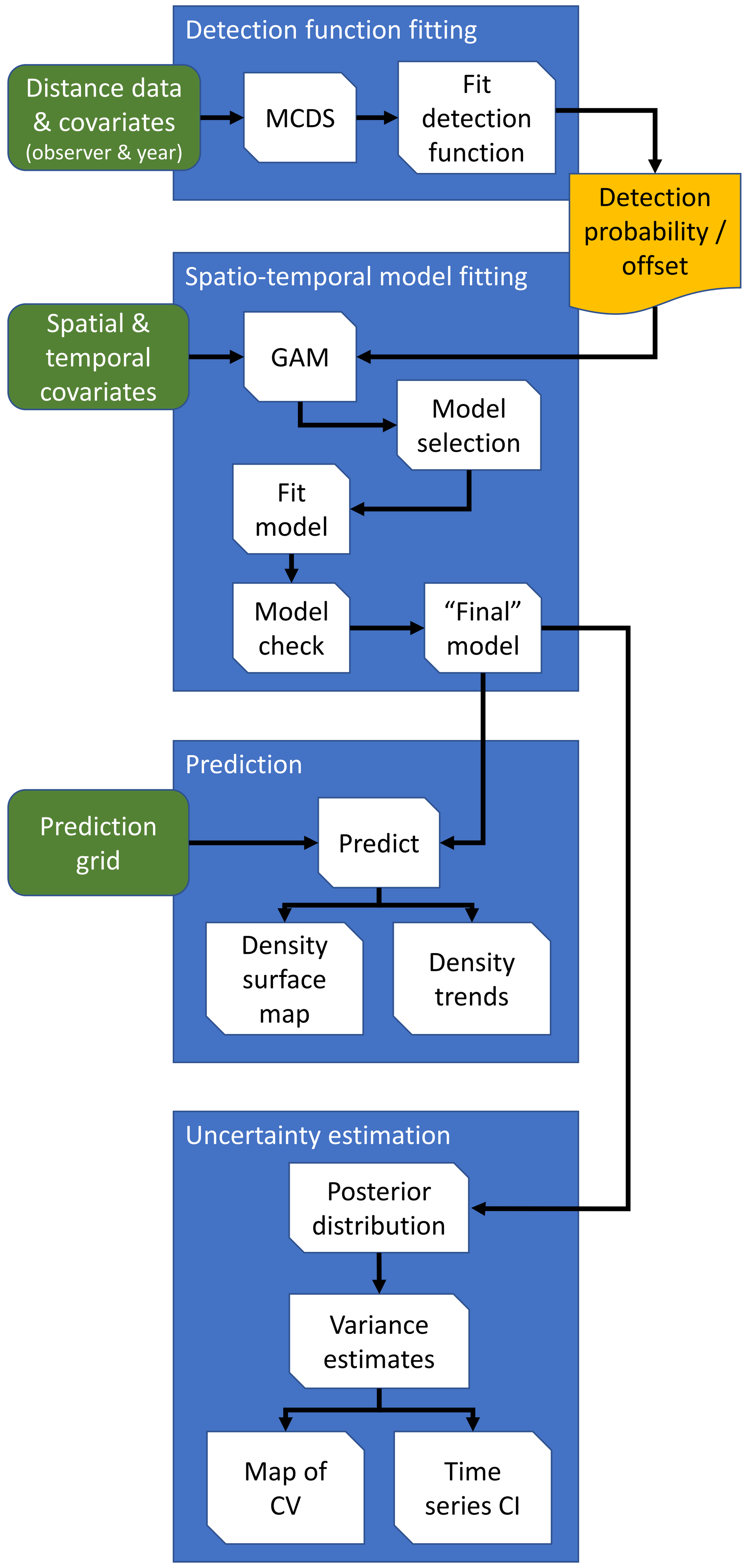
Figure 1. Hawai`i `Ākepa (*Loxops coccineus*)

Objectives:

- Assess spatio-temporal patterns in densities of Hawai`i `Ākepa (fig 1)
- Account for imperfect detection
- Model densities using a GAM
- Estimate uncertainty

Methods:

- Analysis flow chart



Results:

Figure 2. Spatio-temporal patterns

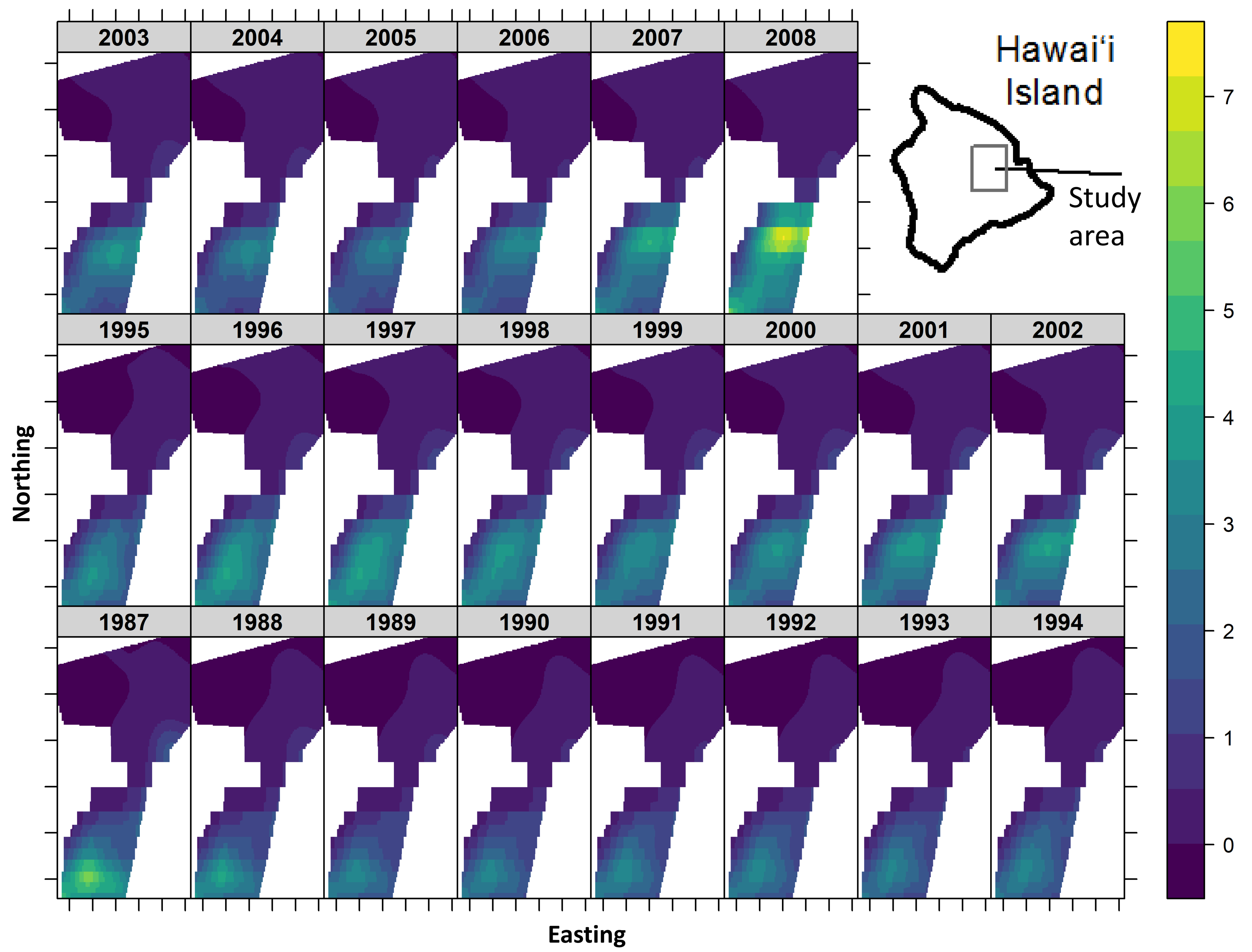
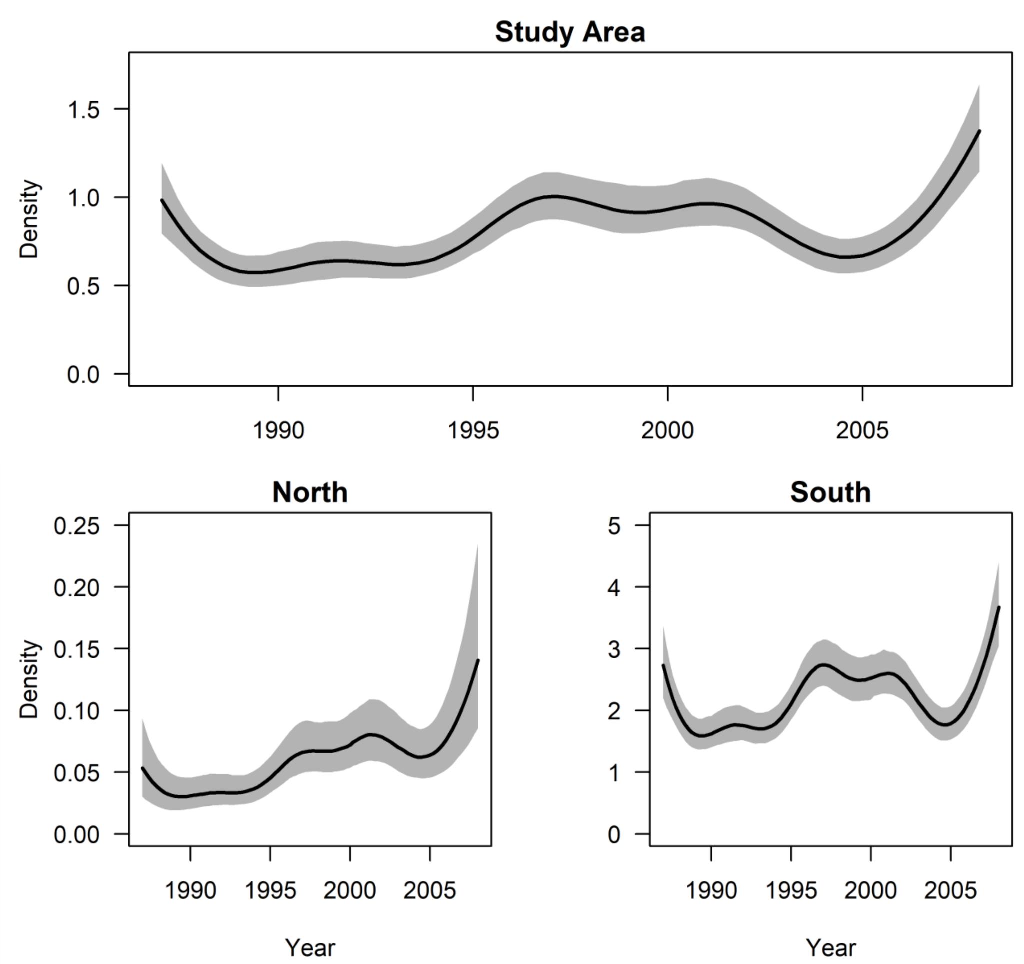


Figure 3. Temporal trends for A) study area, B) North and C) South portions



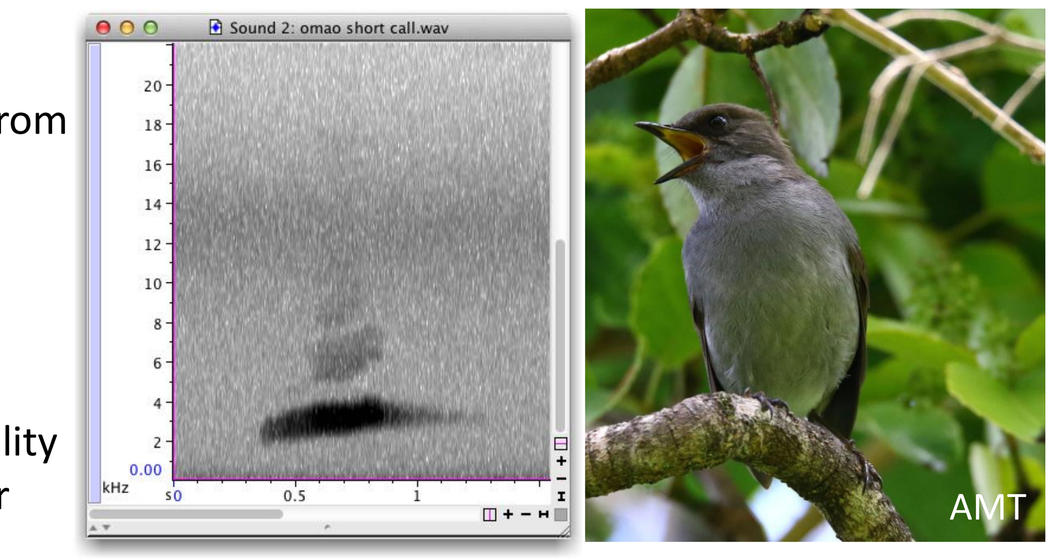
Conclusions:

- Subtle changes occurred in the north where densities increased and expanded into devoid areas (fig 2)
- High density in the south-west diminished & diffused to then reform to the north-east (fig 2)
- Generally, density increased between 1987 and 2008 (fig 3A)
- Northern trends generally increased, but are low (fig 3B)
- Southern trends fluctuated increasing rapidly (fig 3C)
- Pending research: generate map of CV; propagate error variances

Bioacoustic monitoring with measurement error

Research collaborators: E. Sebastián-González[1,2], A.M. Tanimoto[1], P.M. de Oliveira[1], B.B. Lima[1], T. Marques[4,5] and P.J. Hart[1]
[1] Department of Biology, University of Hawai´i at Hilo, Hilo, Hawaii, USA.
[2] Current address: Applied Ecology Department, Miguel Hernández University, Elche, Alicante, Spain.
[3] Hawai´i Cooperative Studies Unit, University of Hawai´i at Hilo, Hawai´i National Park, Hawai´i, USA.
[4] Centre for Research into Ecological and Environmental Modelling, The Observatory, University of St Andrews, St Andrews, Scotland.
[5] Centro de Estatística e Aplicações, Departamento de Estatística e Investigação Operacional, Faculdade de Ciências, Universidade de Lisboa, Lisboa, Portugal.

Figure 4. `Ōma`o (*Myadestes obscurus*) & sonogram



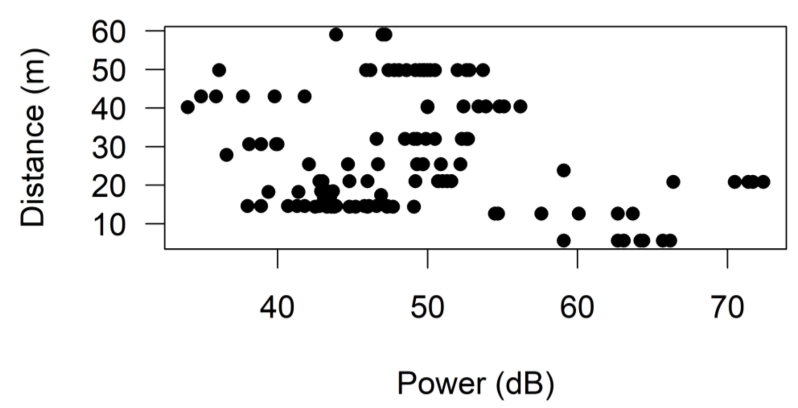
Objectives:

- Obtain accurate densities from a set of single acoustic recorders by:

$$\hat{D} = \frac{n(1-\hat{f}_p)}{\hat{p}_v K a \hat{T} \hat{r}}$$

- Estimate detection probability
- Correct measurement error

Figure 5. Data distance by power

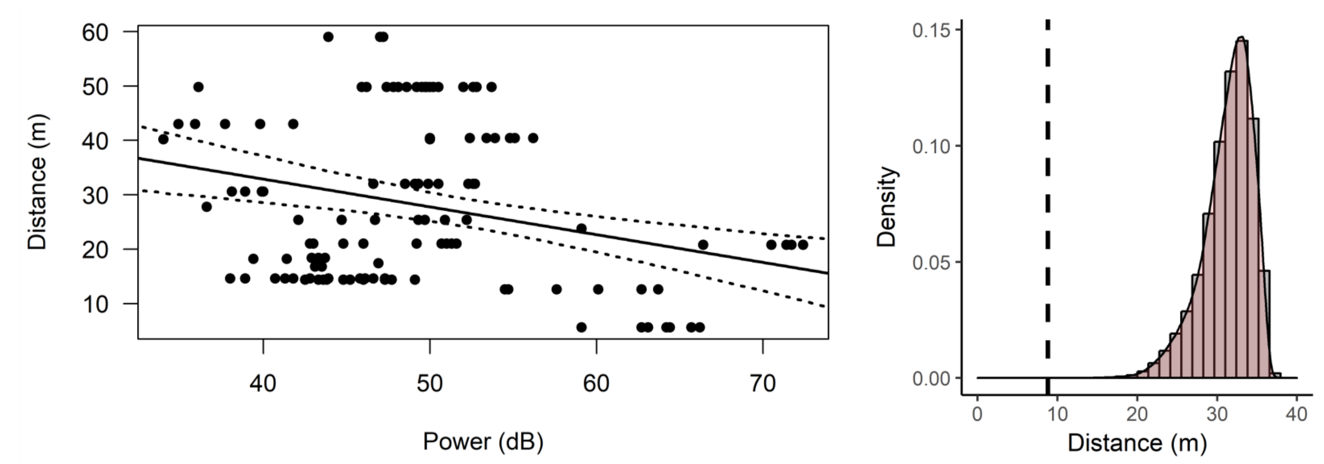


Methods:

- Collect and match songmeter vocalizations to individual birds (fig 4)
- Measure distance (m)
- Determine relationship between distances and power (dB) (fig 5)

Results:

Figure 6. A) Distance-power relationship, B) uncorrected distance distribution



Conclusions:

- GLM gamma identity-link model fitted to data (fig 6A)
- Uncorrected detections ranged from 8.8m to 38.3m (fig 6B)
- Pending research: model covariates individual, rain & wind; generate measurement error corrected distances; estimate density

Acknowledgements and References:

- Funding was provided by the University of St Andrews and U.S. Geological Survey
- Bird count data was collected by Hakalau Forest National Wildlife Refuge and volunteers, and acoustic data was collected by the University of Hawai`i at Hilo, Lohe Bioacoustics Lab
- Analyses followed procedures detailed in Borchers et al. (2010; DOI 10.1007/s13253-010-0021-y), Buckland et al. (2015; ISBN 3319192191), Marra et al. (2012; DOI 10.1111/j.1467-9574.2011.00500.x), Miller et al. (2013; DOI 10.1111/2041-210X.12105), Sebastián-González et al. (In press), and Wood (2017; ISBN 9781498728331)