

Shedding light on the Alaka'i plateau: habitat modeling for endangered honeycreepers

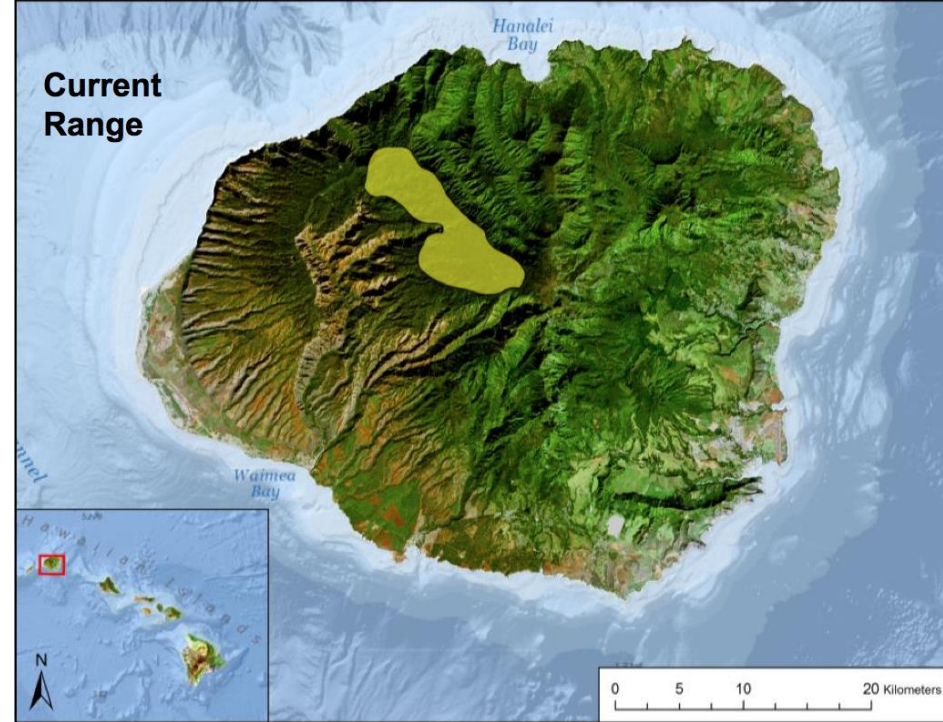


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Study Area

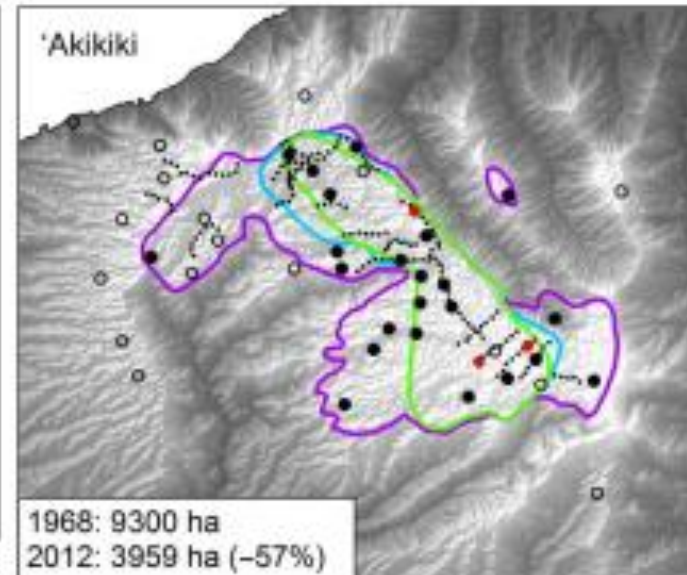
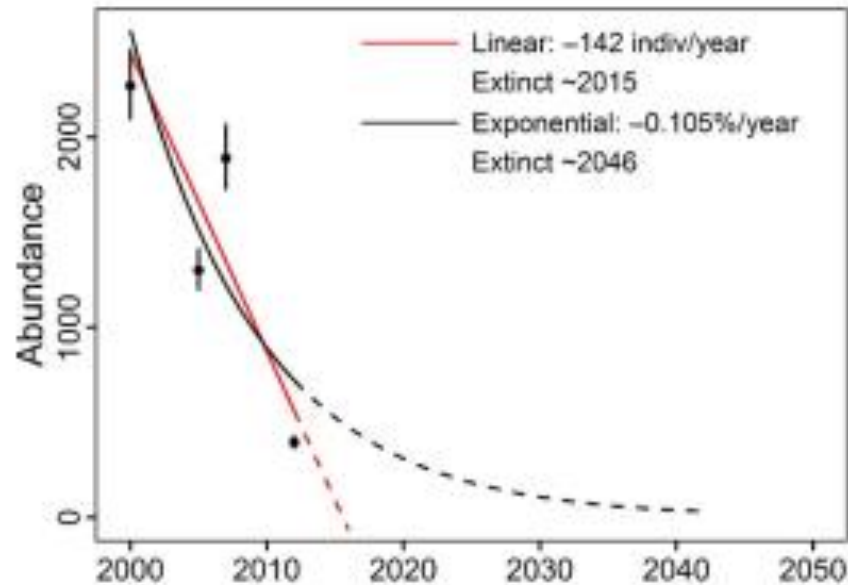
- Kauaʻi is home to more single-island endemic passerine birds than any other Hawaiian island¹
- Alakaʻi Plateau (130 km²) home to Kauaʻi's 8 remaining native forest birds
 - High elevation swamp, ~11 meters of precipitation each year
 - consists of rugged, remote, roadless terrain.



'Akikiki (*Oreomystis bairdi*)

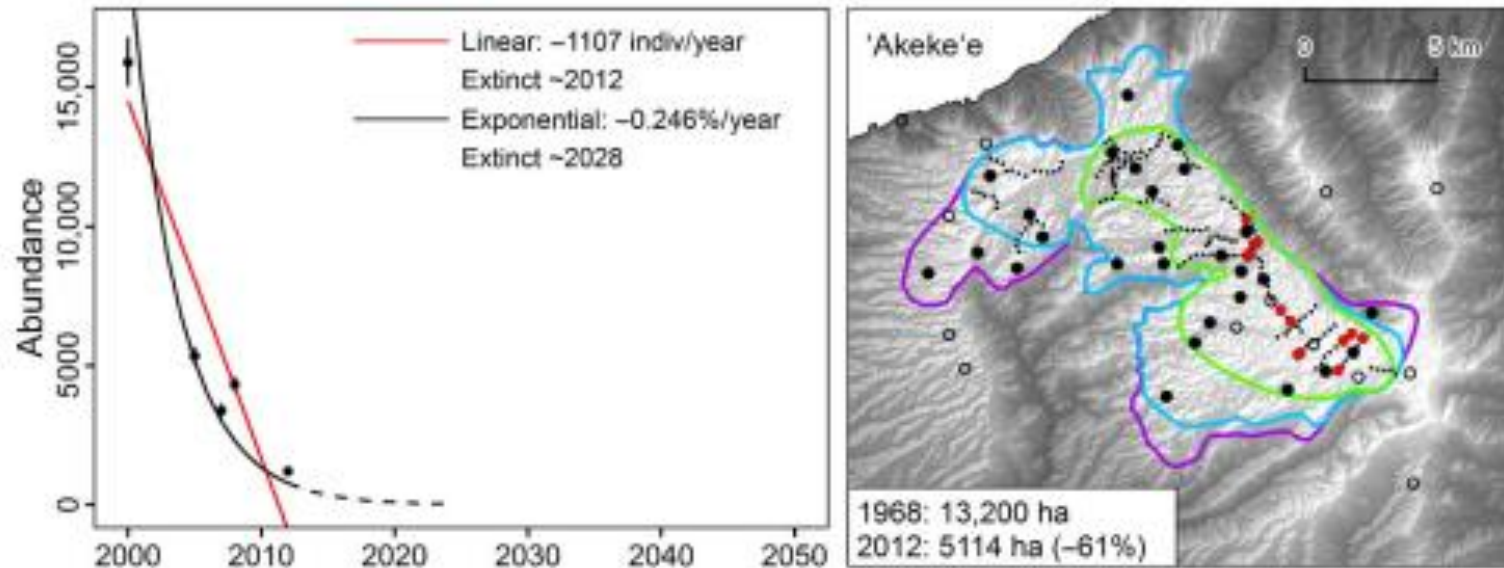


- Small grey and white insectivorous honeycreeper, endemic to Kaua'i
- Once inhabited forests down to sea level
- Population size estimated at 468 individuals
- Occurrence was positively correlated with mean canopy height and canopy density ²



'Akeke'e (*Loxops caeruleirostris*)

- Crossbilled honeycreeper, 'Ōhi'a specialist
- Occupancy positively correlated with mean canopy height and maximum DBH of 'Ōhi'a trees²
- Listed as endangered in 2010
- Much is yet to be known about the species breeding biology and natural history



Field Data Collection Methods

- Over 5,000 person-hours spent nest searching from 2012-2017
- Occurrence locations were also recorded on handheld GPS units for both species



88 Nests

3,607
Occurrences



22 Nests

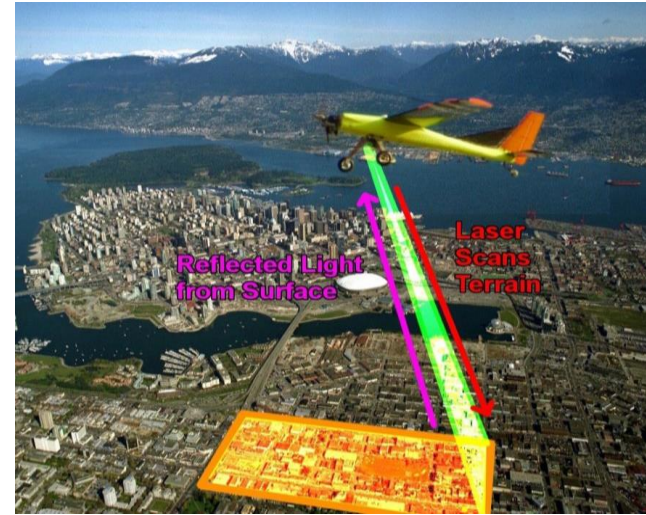
1,581
Occurrences



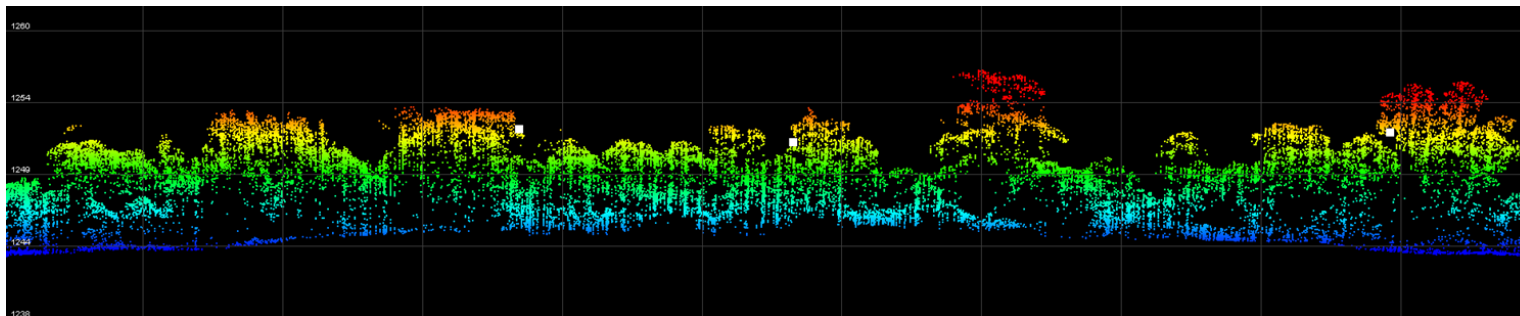
Lidar Data Collection and Metrics

Environmental Layers
Elevation
Canopy Height
Canopy Density
Slope
Topographic Wetness Index
P25
P50
P75
P90

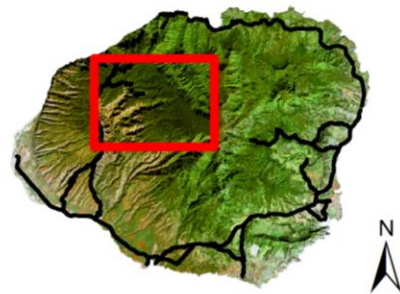
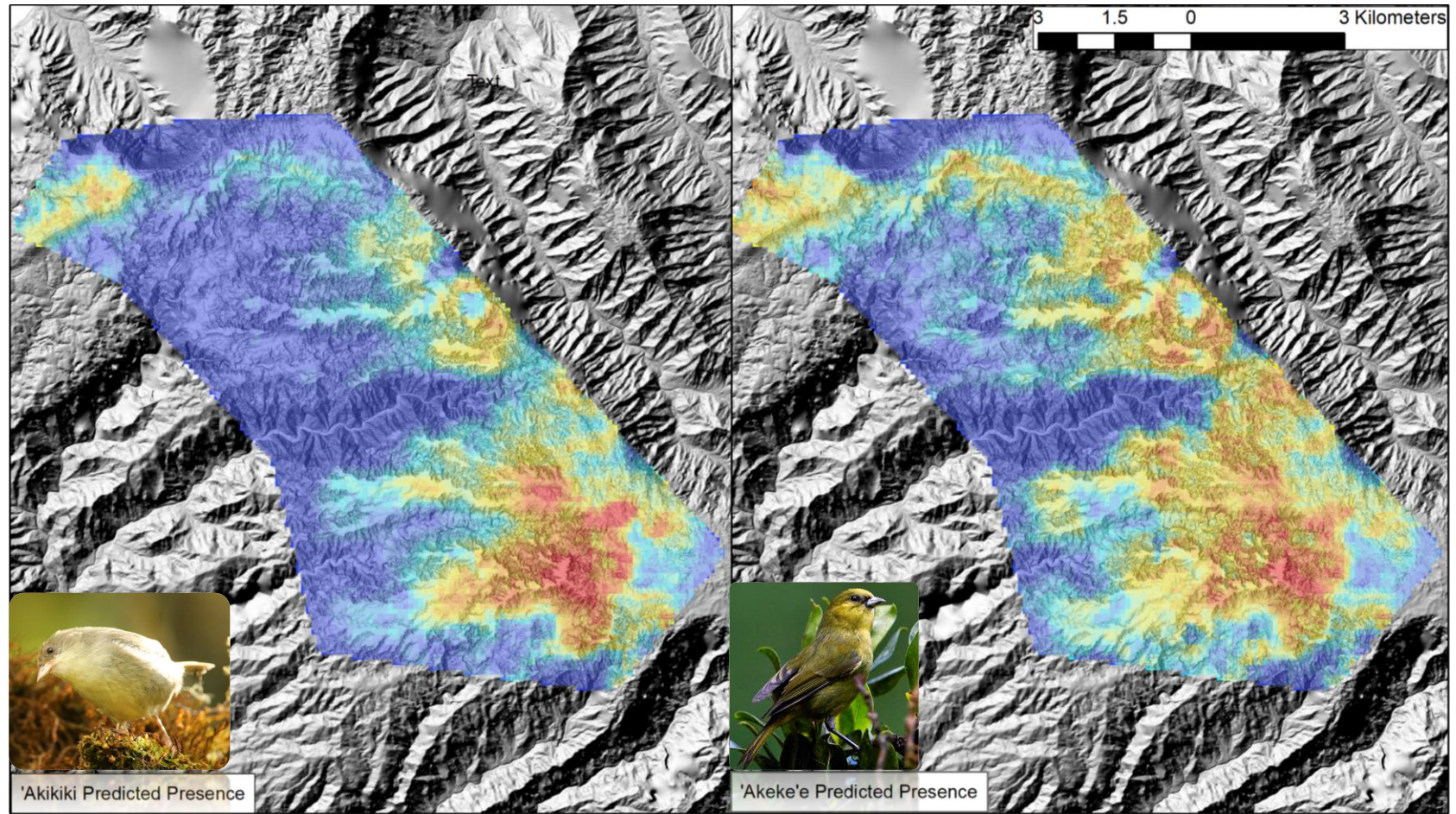
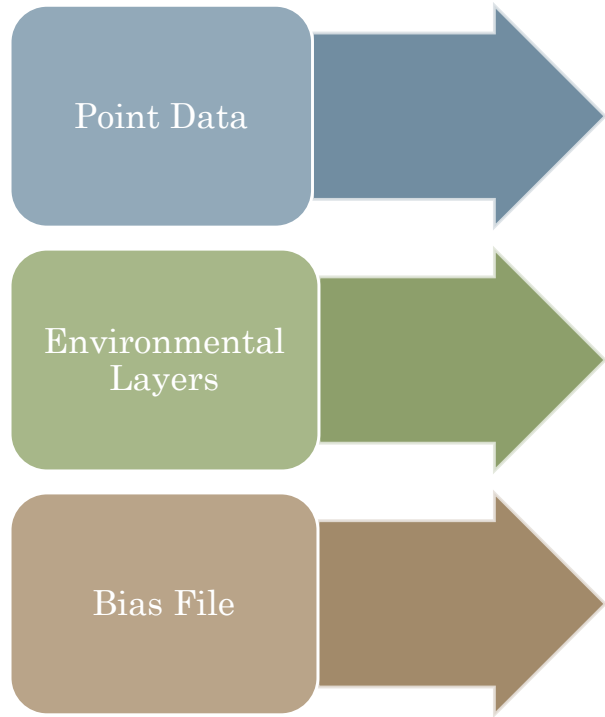
Sub-canopy complexity



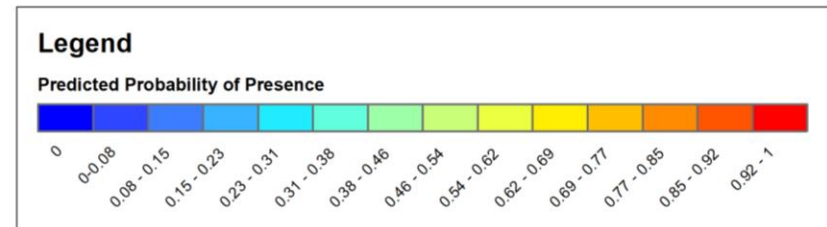
- Light Detection and Ranging (LiDAR) flown over 69.5 km² area in spring 2017
- LiDAR metrics were developed for forest structure and sub-canopy topography



Maximum Entropy (MaxEnt) Modeling

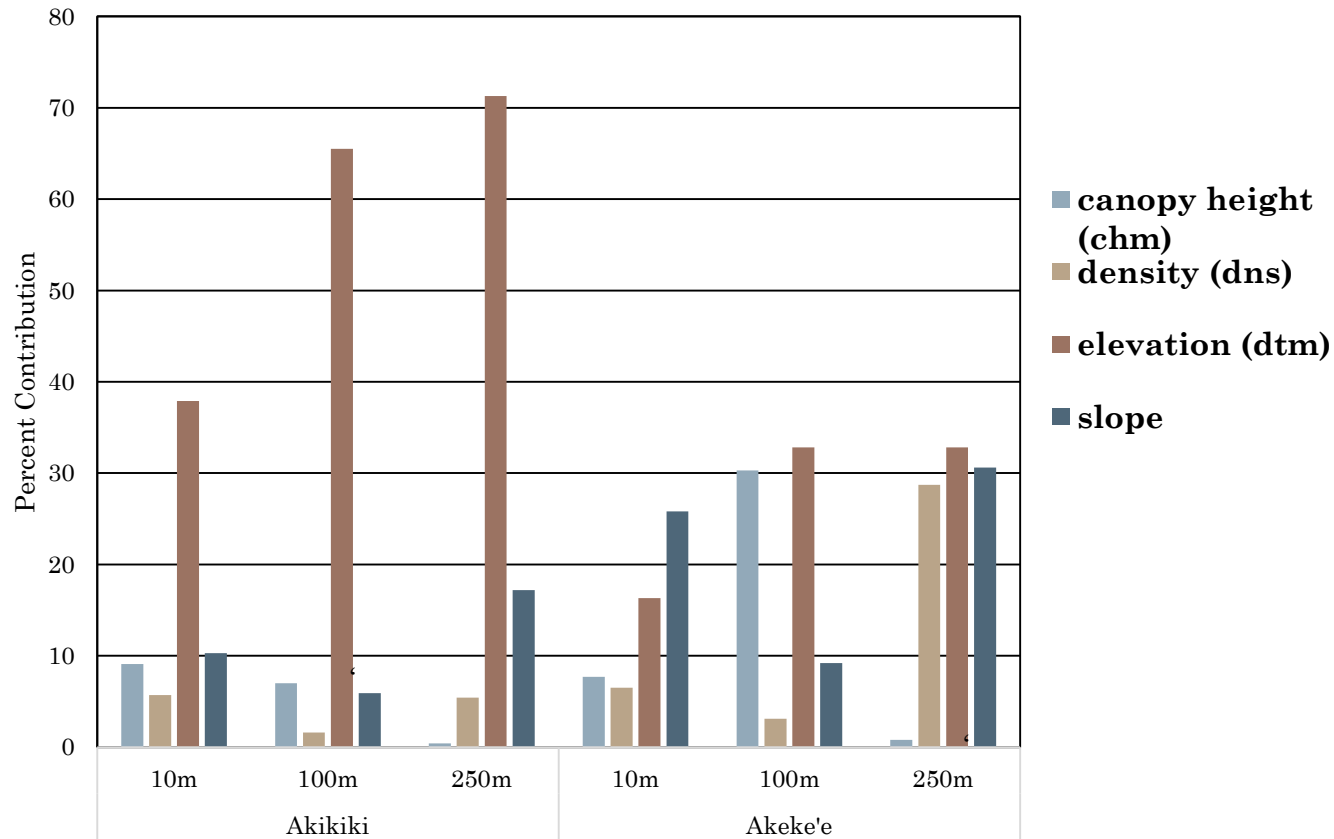


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Data from Kaua'i Forest Bird Recovery Project



Importance of Elevation and other Environmental Factors

Variable Importance for Nest Sites



- Only environmental layers with greater than 20% contribution displayed
- Elevation by far the most important for 'Akikiki at all scales
 - 'Akikiki prefer higher elevations than 'Akeke'e on average
 - P90 ~22% contribution at the 10m scale
- Canopy structure and topography factors for 'Akeke'e
 - Flatter surfaces
 - Denser and higher canopy

How much suitable habitat is left?

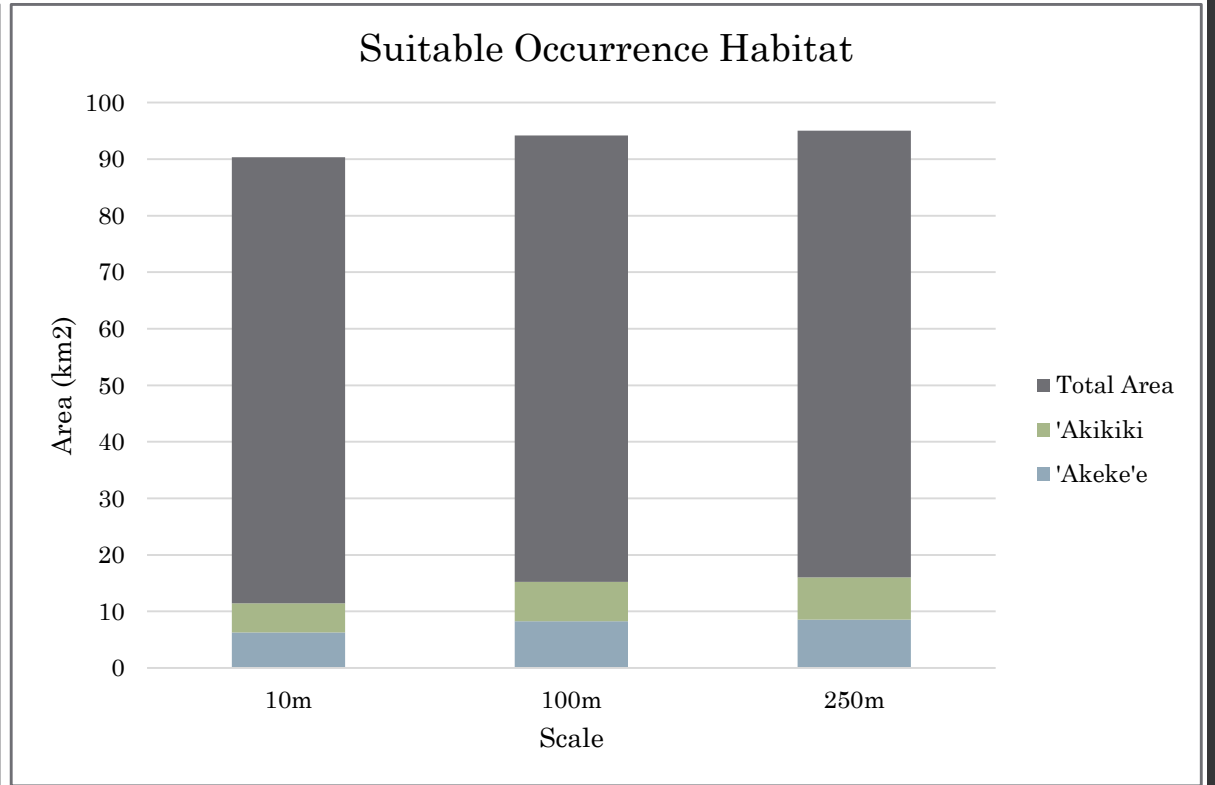
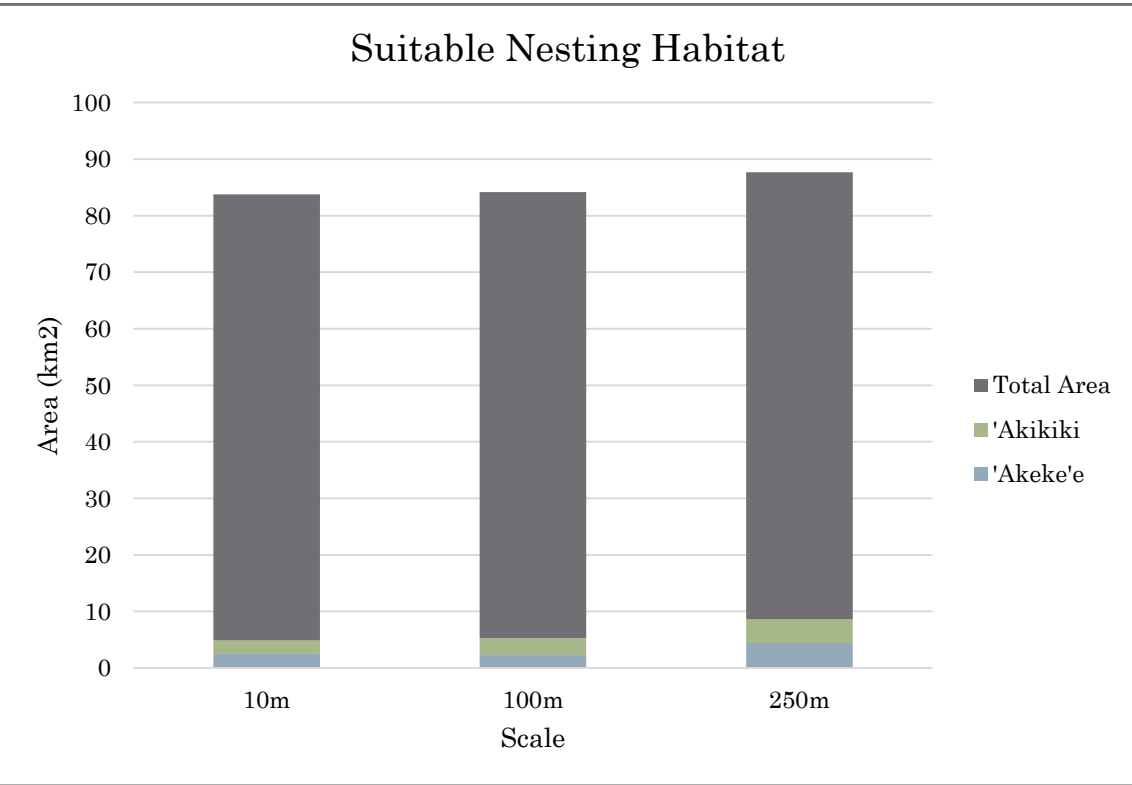


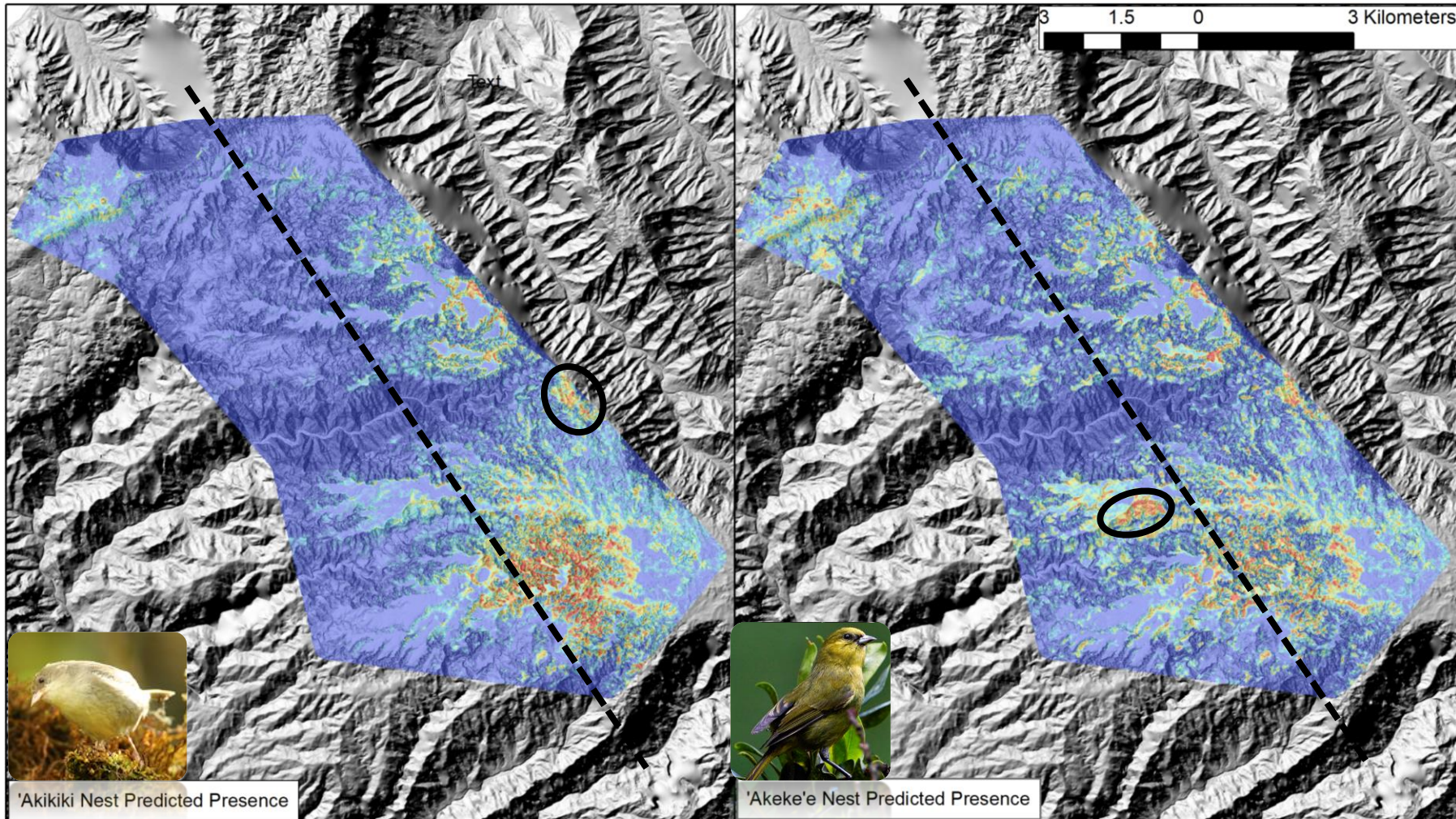


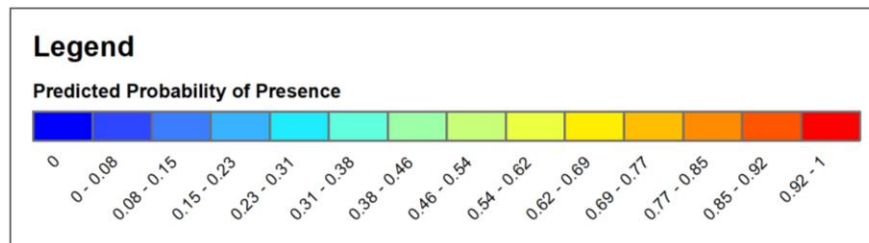
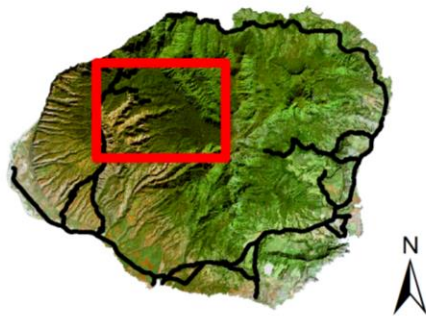
Table 1. Percent of model area with a predicted probability of presence ≥ 0.75

		Species	Point Type	10m	100m	250m
	'Akikiki	Nests		3.01%	3.81%	5.30%
		Occurrences		6.52%	8.85%	9.41%
	'Akeke'e	Nests		3.19%	2.85%	5.61%
		Occurrences		7.97%	10.49%	10.83%

Predictive Model for Nests at 10m scale



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2018 Data as Ground-Truthing

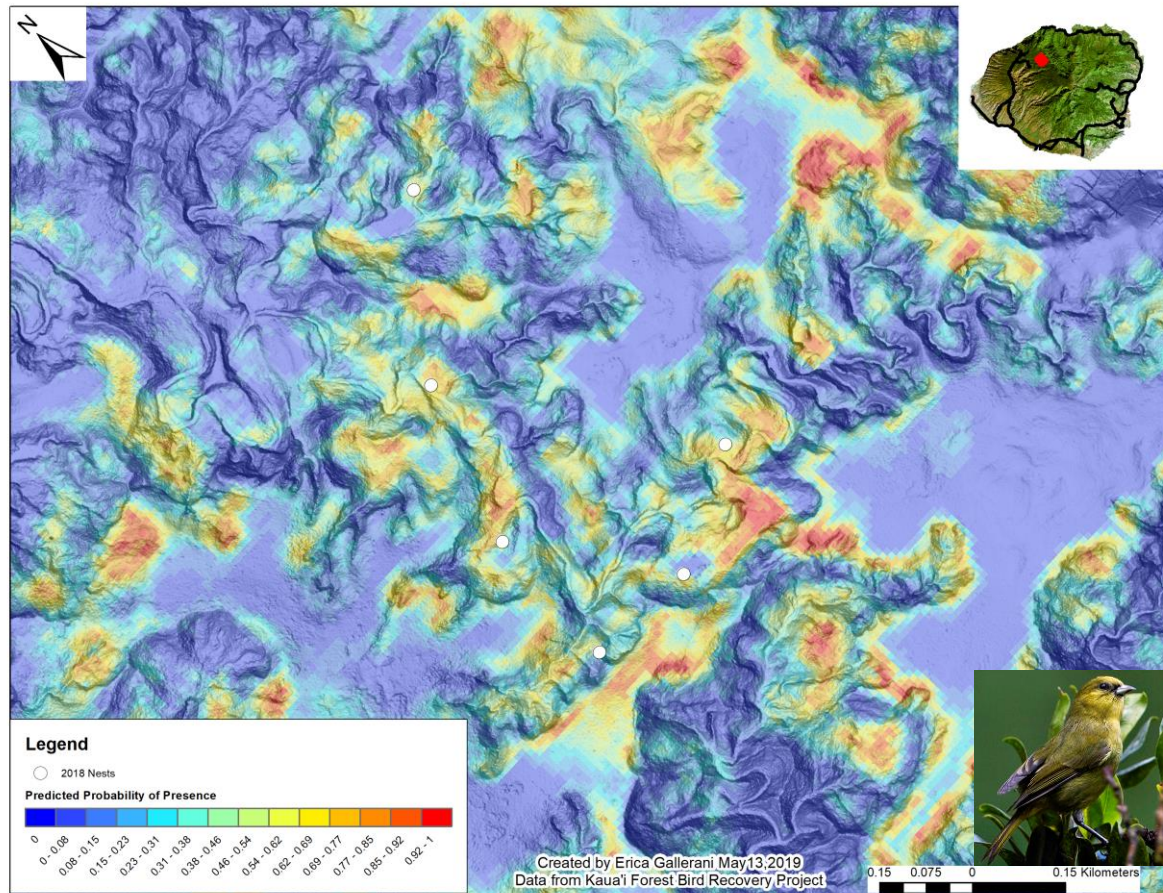


Table 2. Model output values associated with nests (at the 10m scale) and occurrences (at the 100m scale) from 2018

Species	Point Type	Number of Points	Average Value
'Akikiki	Nests	27	0.83
	Occurrences	744	0.78
'Akeke'e	Nests	9	0.58
	Occurrences	496	0.79

Conclusions

- Airborne lidar can quantify endangered species nest locations
- Previous population estimates are not conservative, if anything given these new models they're generous
- Elevation was consistently the most important metric for predicting both species nest locations and occurrences
 - Implications for avian malaria
- Significant relationships with forest structure metrics
 - Implications for habitat conservation and restoration
- Comparison to results of Behnke et al 2015

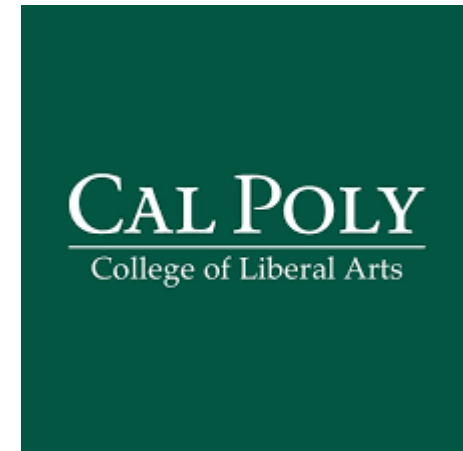


Future Works

- Create models for all native forest birds on Kaua'i
- Future modeling to include climatic metrics and remote sensing metrics such as NDVI to estimate productivity and heterogeneity on Kaua'i³
- Similar modeling in habitat on other islands such as Maui and Big Island
 - Implications for potential translocation plan for 'Akeke'e



Mahalo!



Cited Sources

1. Paxton, E. H., R. J. Camp, P. M. Gorresen, L. H. Crampton, D. L. Leonard, and E. A. VanderWerf. 2016. Collapsing avian community on a Hawaiian island. *Science Advances* 2:e1600029
2. Behnke, L., A. H., Liba Pejchar, and L. H. Crampton. 2015. Occupancy and habitat use of the endangered Akikiki and Akekee on Kauai Island, Hawaii. *The Condor* 118:148-58.
3. Fricker, G. A., J. A. Wolf, S. S. Saatchi, and T. W. Gillespie. 2015. Predicting spatial variations of tree species richness in tropical forests from high-resolution remote sensing. *Ecological Applications* 25:1776-89