

Ecological studies of the Hawaiian hoary bat on Maui – An update

ESRC Meeting
24 January 2019



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Mist-netting



Diet



Acoustic



Telemetry



Conclusions



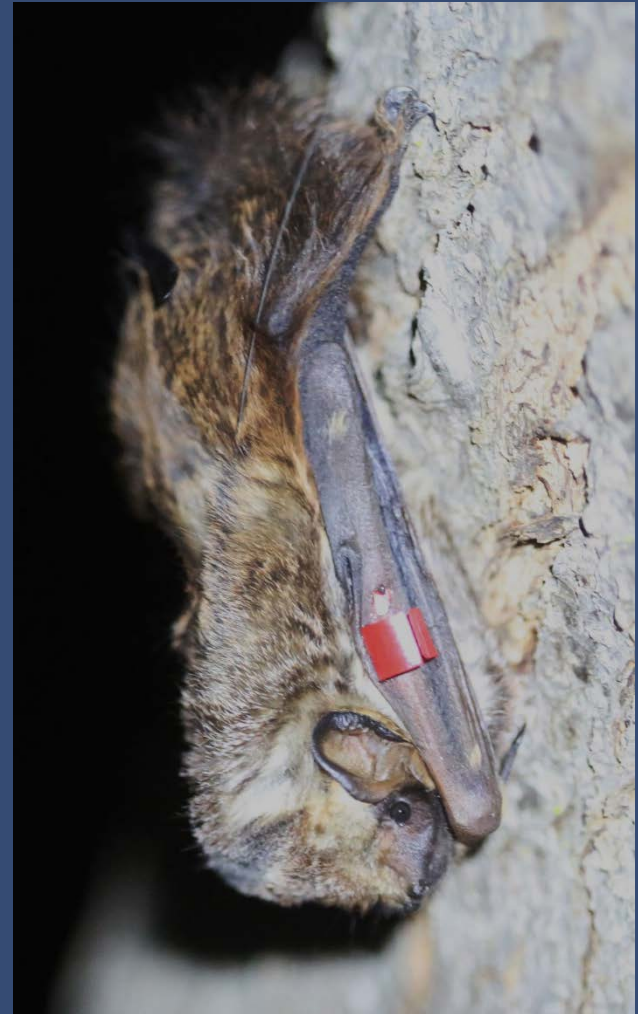
USFWS Recovery Plan 1998 makes research a key to recovery

We hypothesized that the population's limiting factors are complex

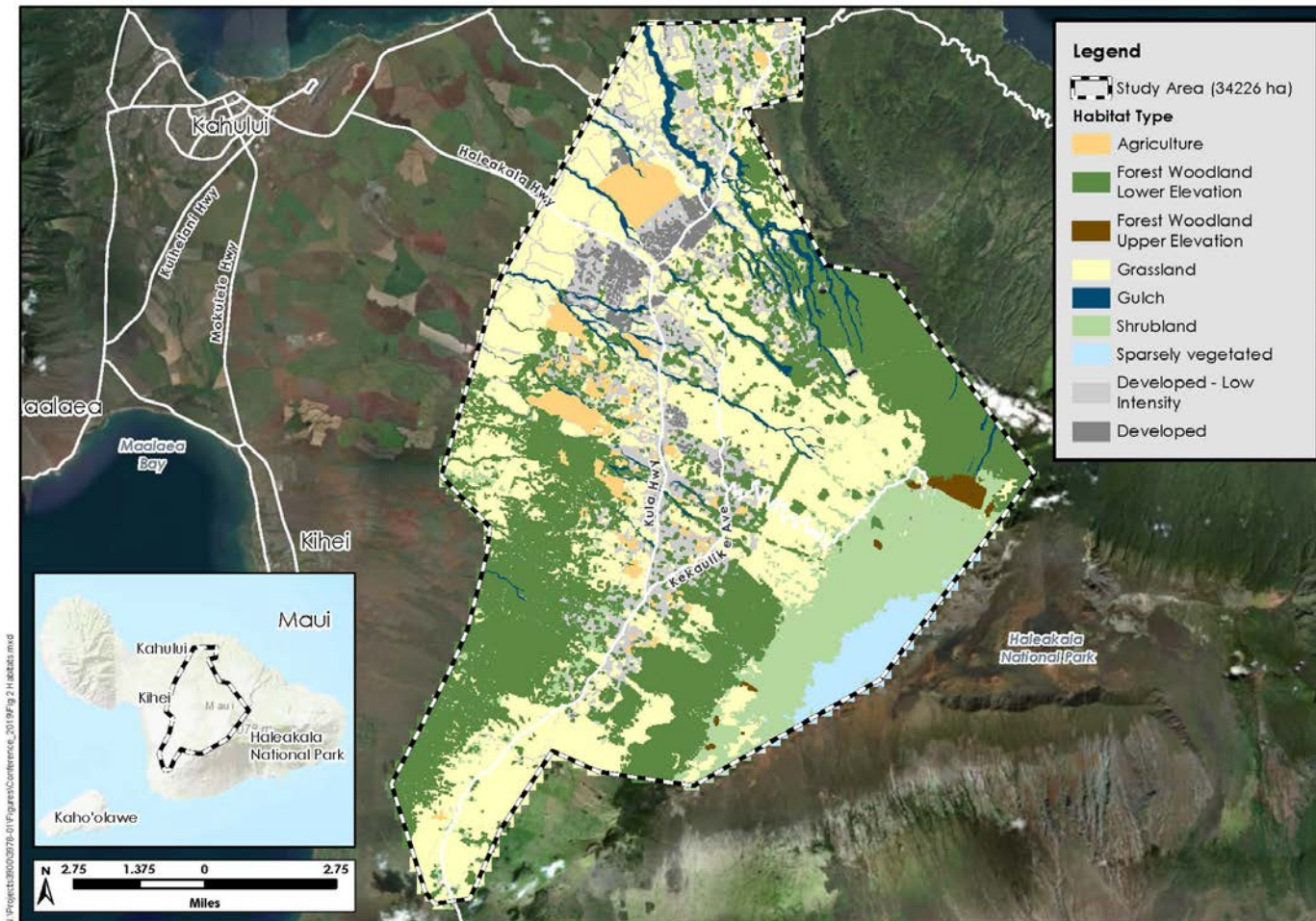


Approach

- Study area 9 habitats
- Acoustic monitoring
- Mist-netting
- Telemetry
- Diet analysis



Nine Habitats; 34,226 ha



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Figure 2. Habitats within Study Area

Ecology of the Hawaiian Hoary Bat (3978-01)

January 2019



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Acoustic Monitoring



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Acoustic Monitoring - Methods

SM4 bat detectors



Bi-monthly

9 habitats

3 nights

5 replicates / month



317 total deployments



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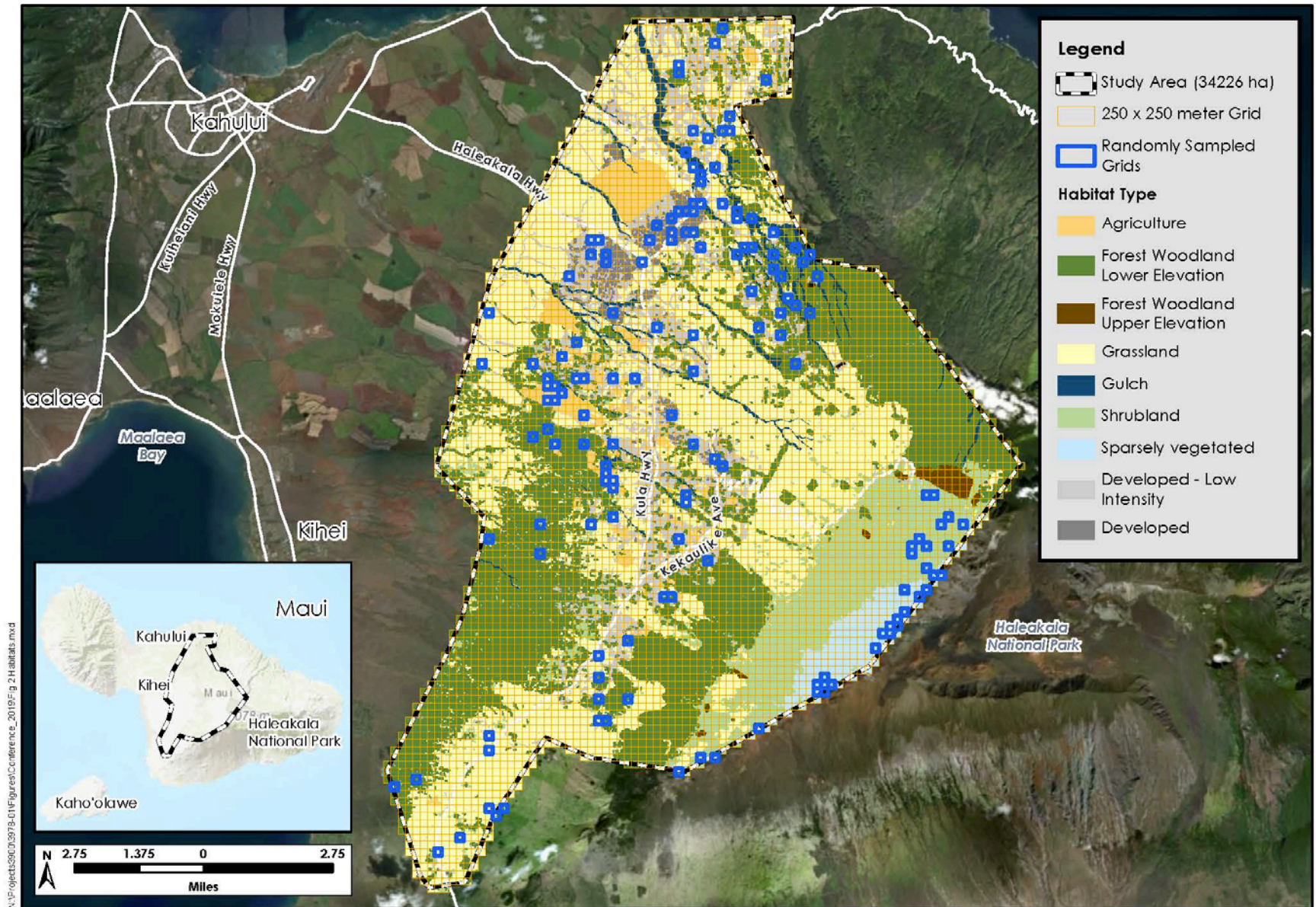
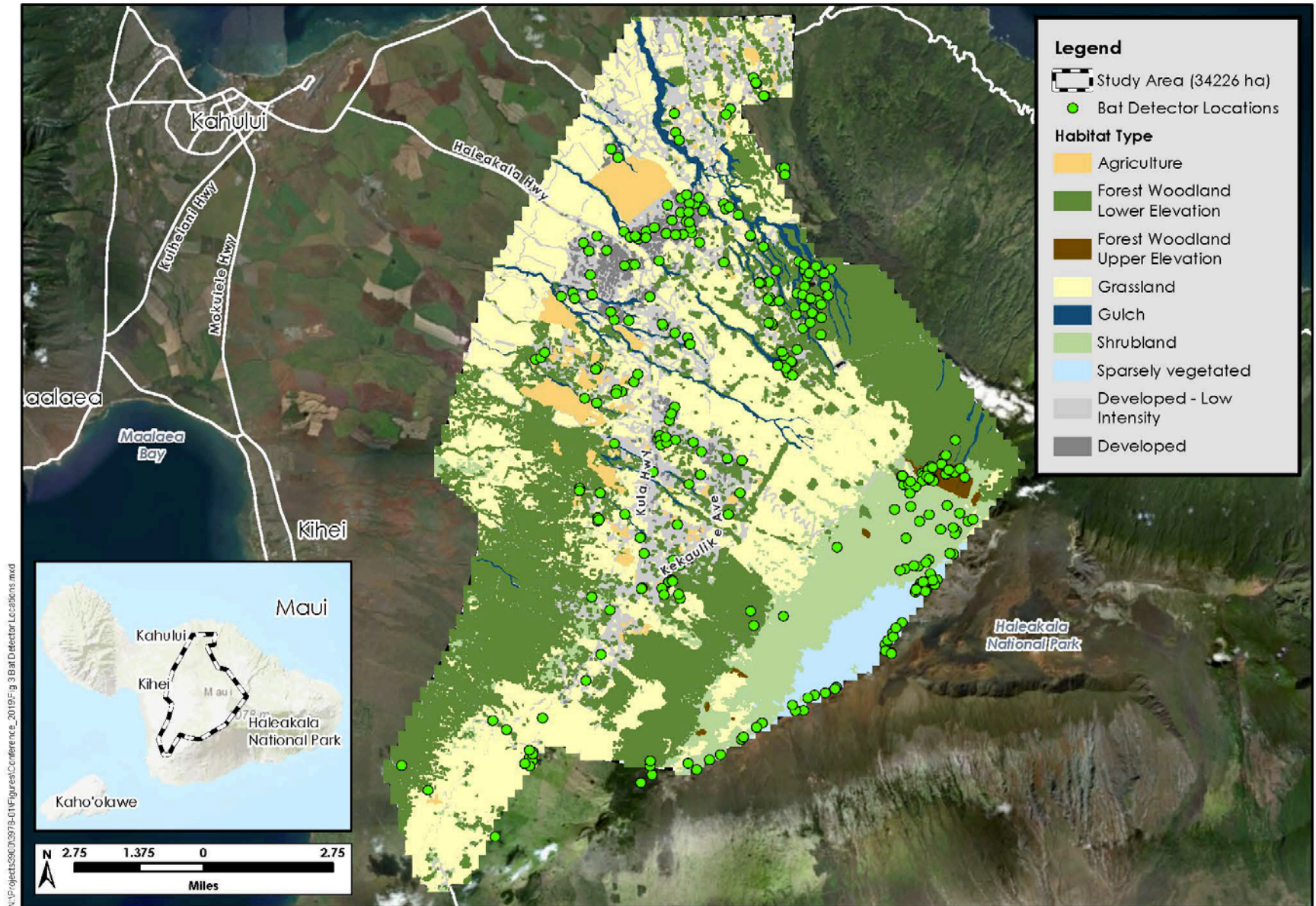


Figure 5. Study Area Grid
Ecology of the Hawaiian Hoary Bat (3978-01)
January 2019





N:\Projects\3978-01\Figures\Conference_2019\Fig 3 Bat Detector Locations.mxd



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Figure 3. Bat Detector Locations
Ecology of the Hawaiian Hoary Bat (3978-01)
January 2019

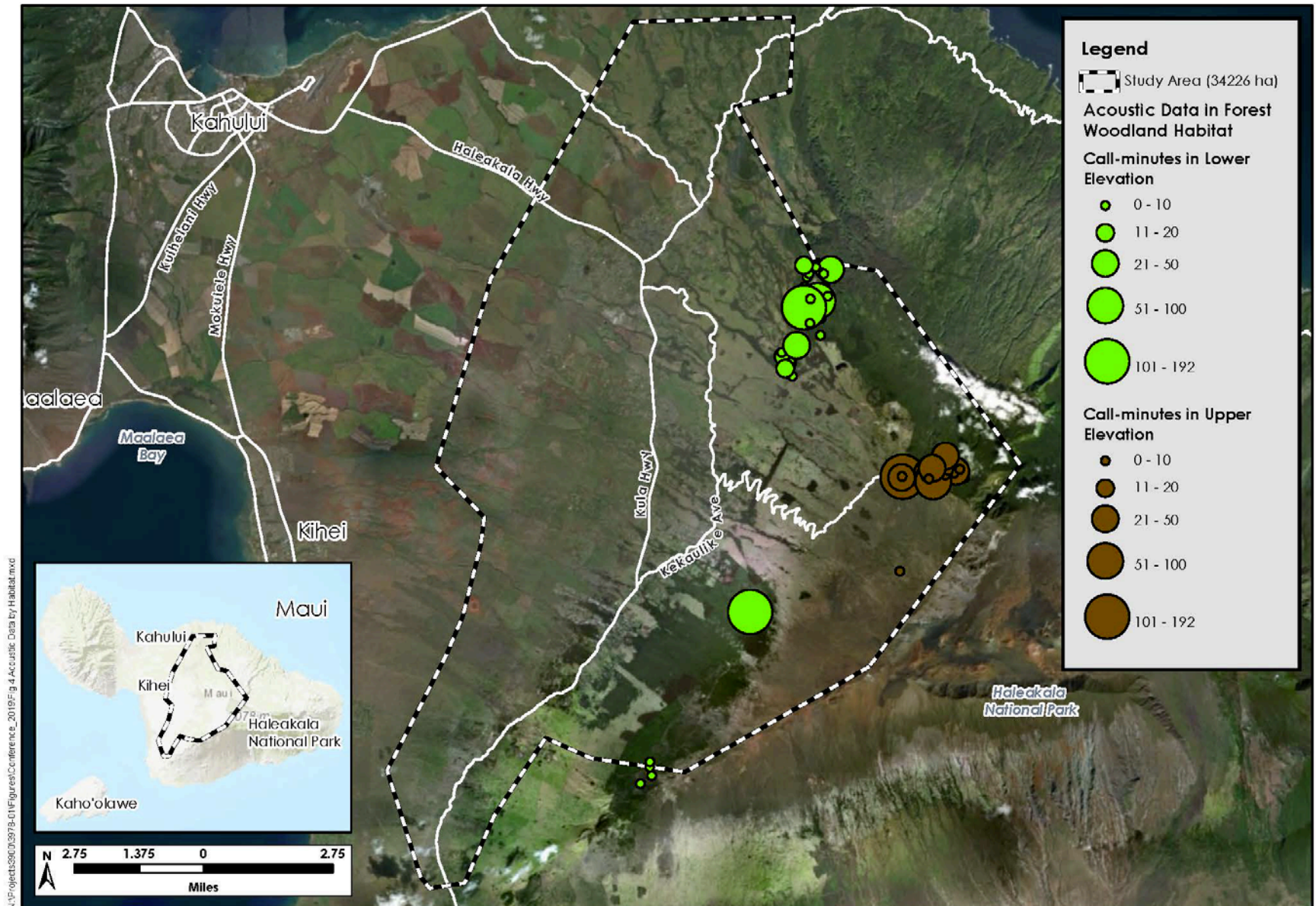


Figure 4. Acoustic Data in Forest Woodland Habitat
 Ecology of the Hawaiian Hoary Bat (3978-01)
 January 2019



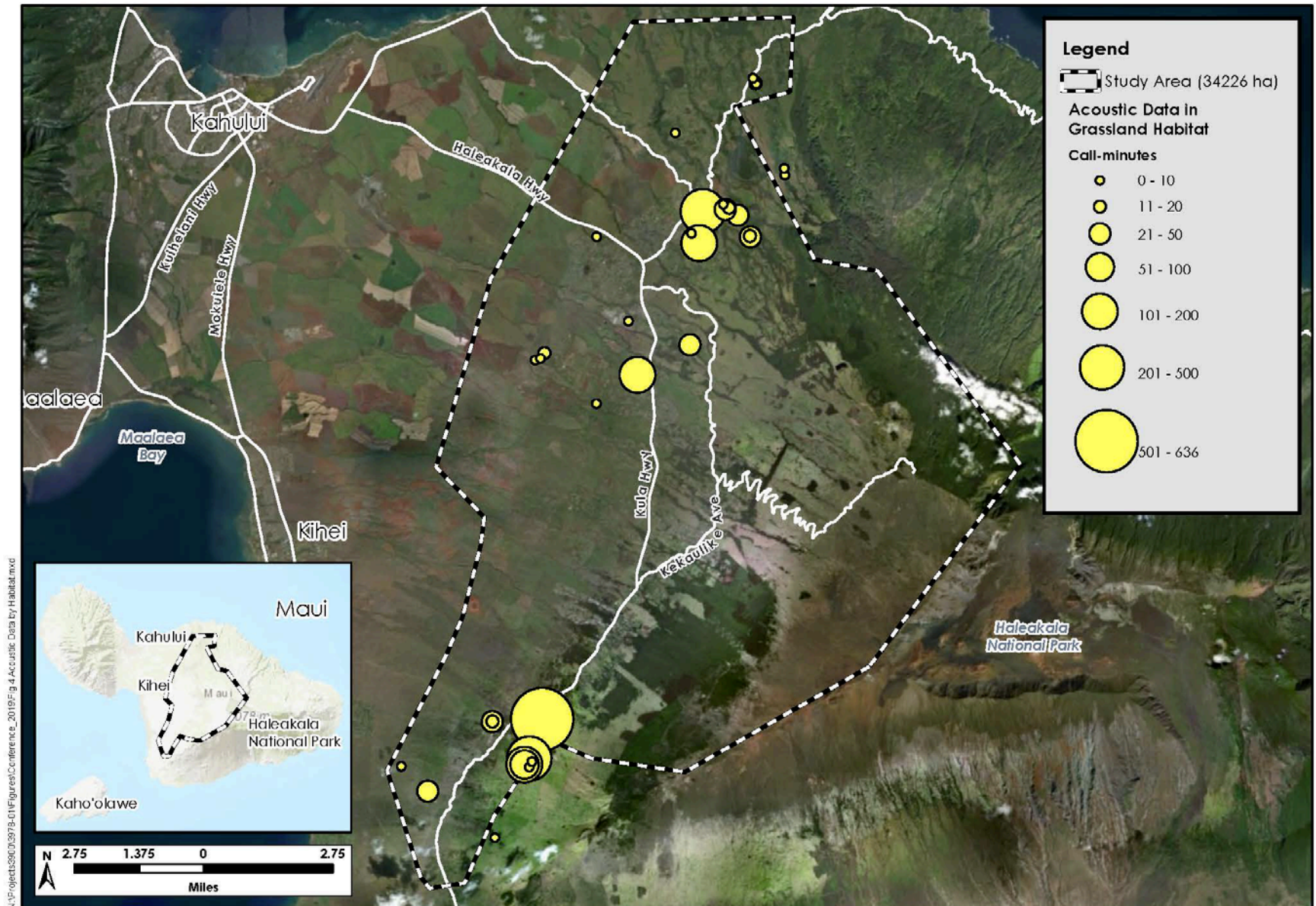


Figure 4. Acoustic Data in Grassland Habitat
 Ecology of the Hawaiian Hoary Bat (3978-01)
 January 2019



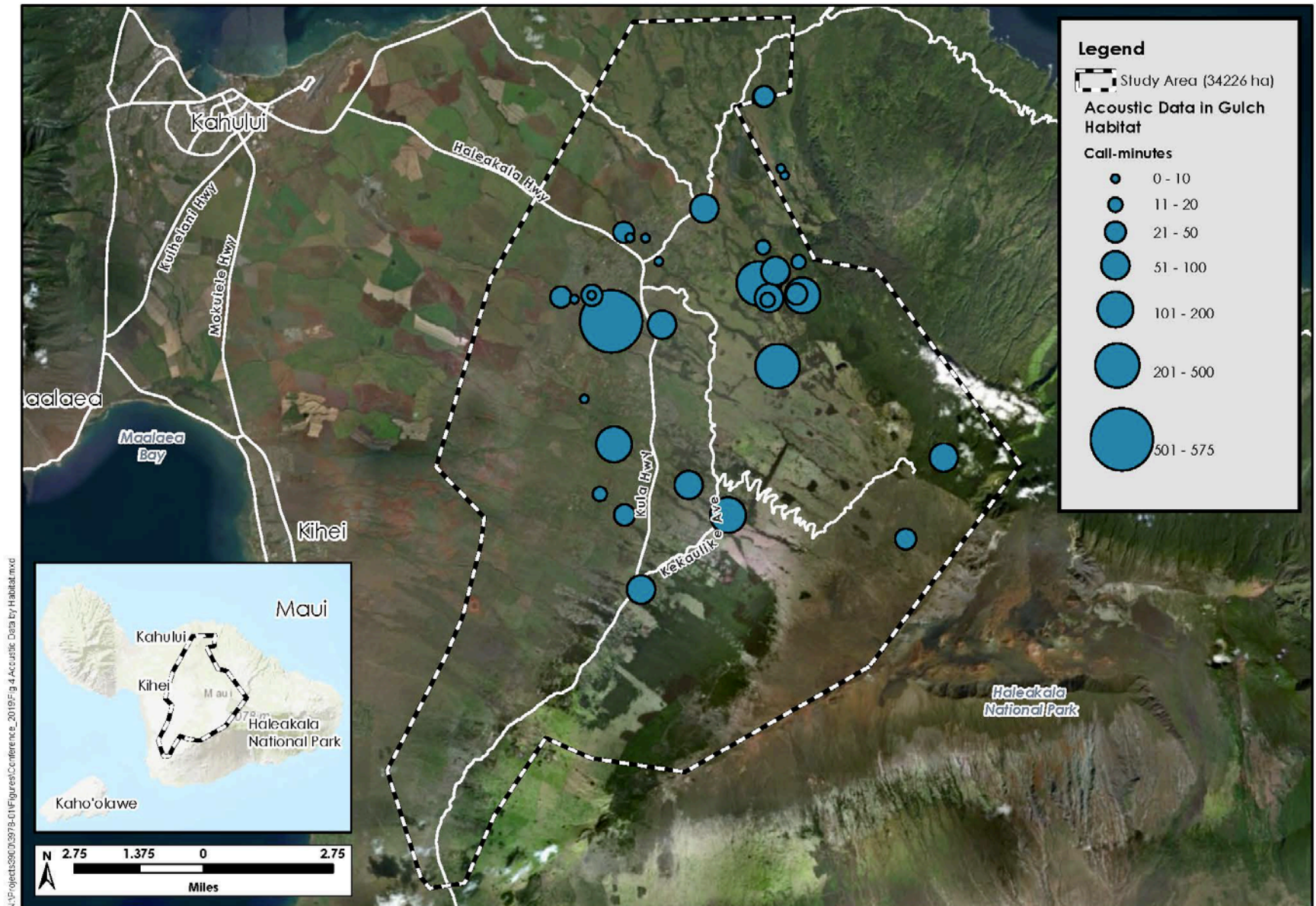


Figure 4. Acoustic Data in Gulch Habitat
 Ecology of the Hawaiian Hoary Bat (3978-01)
 January 2019



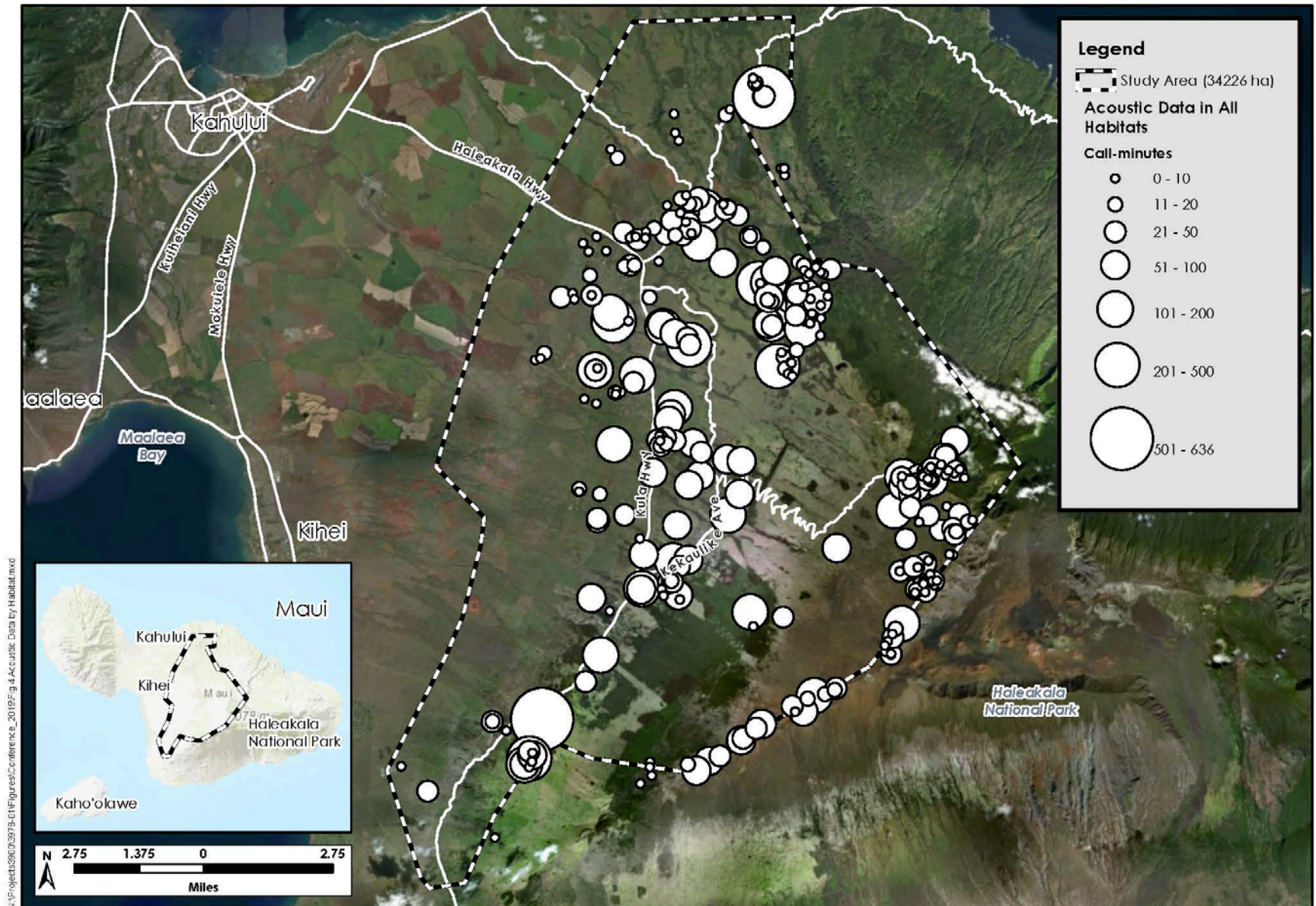
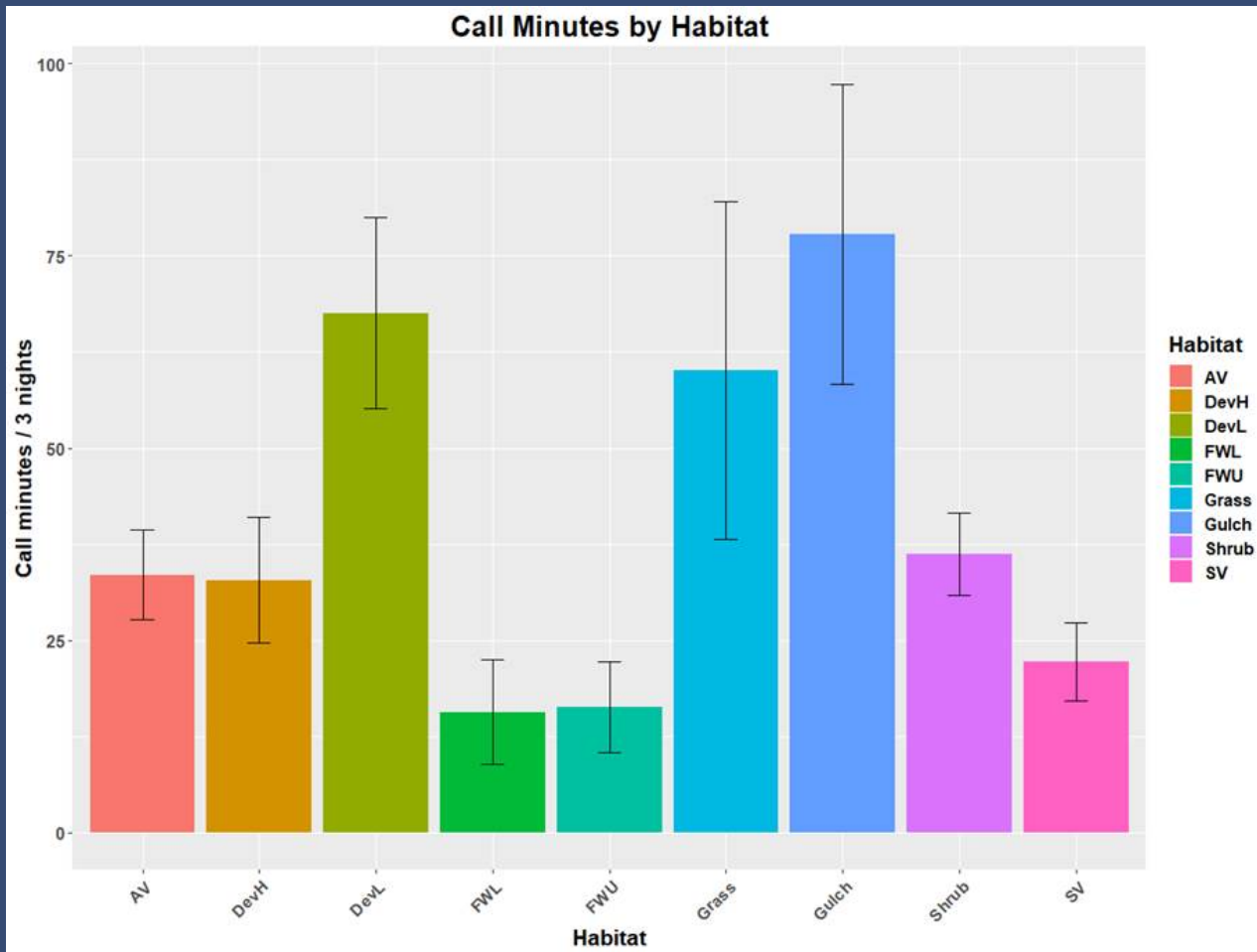


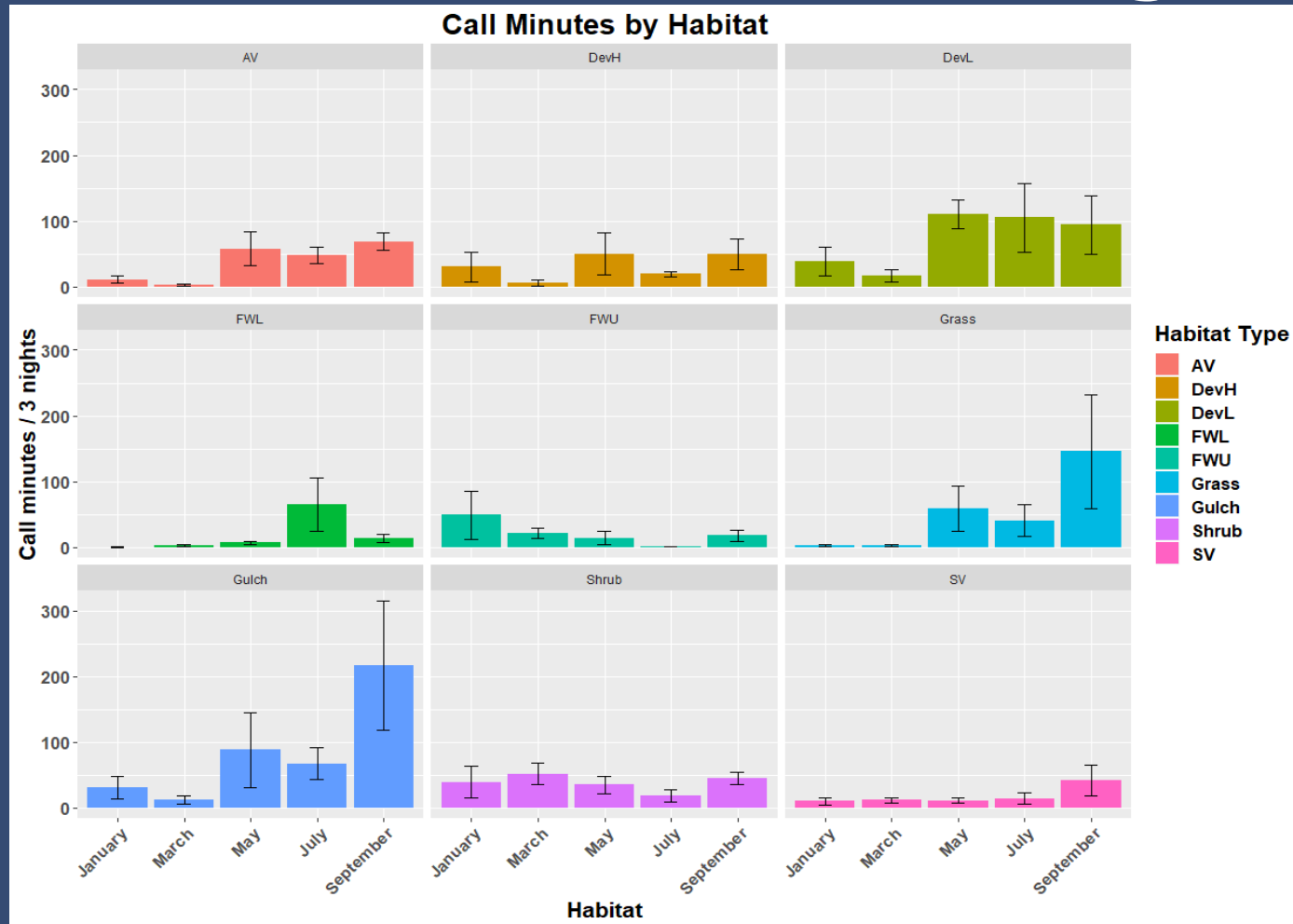
Figure 4. Acoustic Data in All Habitats
 Ecology of the Hawaiian Hoary Bat (3978-01)
 January 2019



Acoustic monitoring

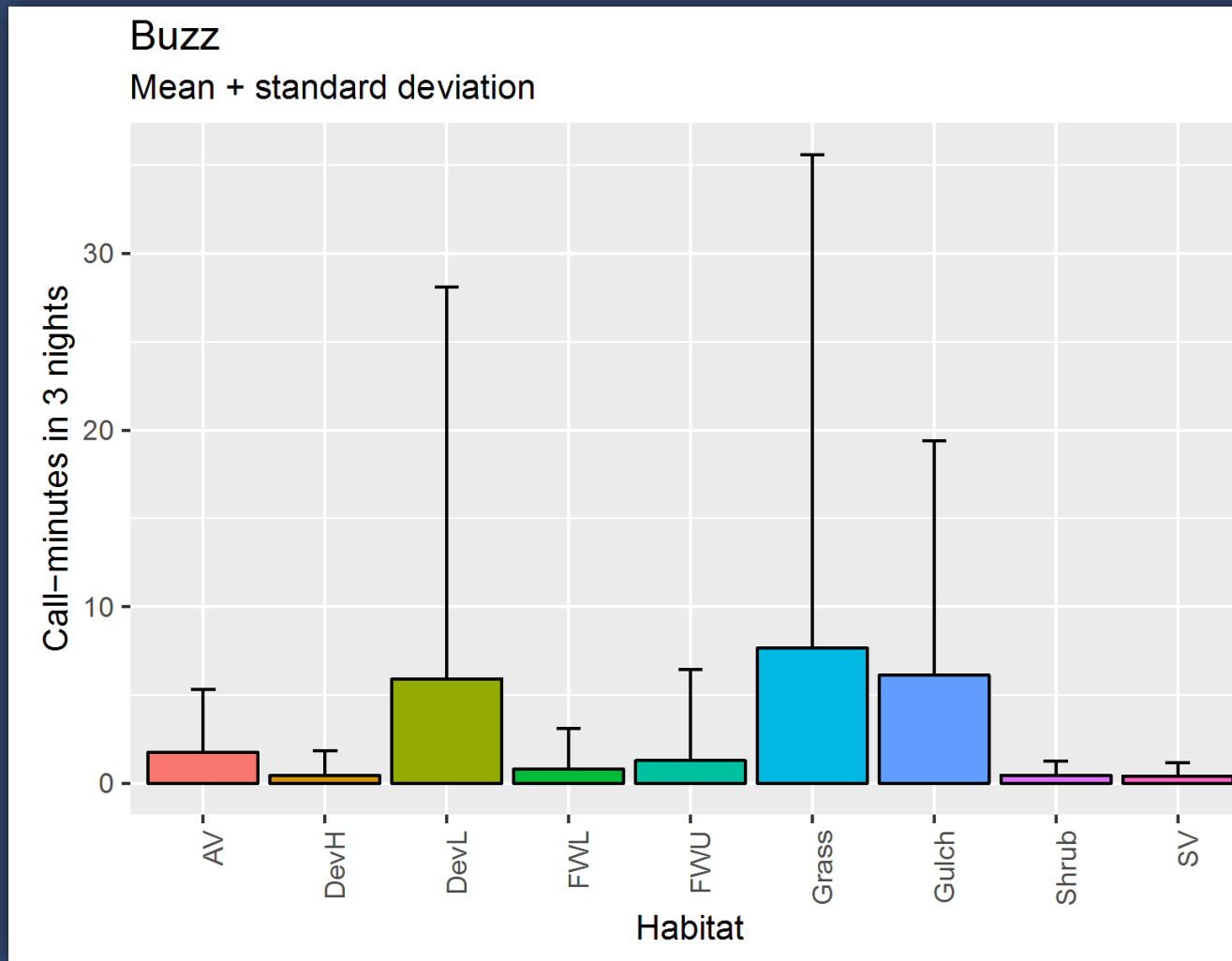


Acoustic Monitoring



Call minutes by habitat based on the raw data means and Standard Error.

Acoustic monitoring



Acoustic monitoring – Take Homes

Insect abundance * Habitat structure



Bat activity is higher in:

- Grasslands, Gulches, Low density developed
- Driven by foraging (buzzes)

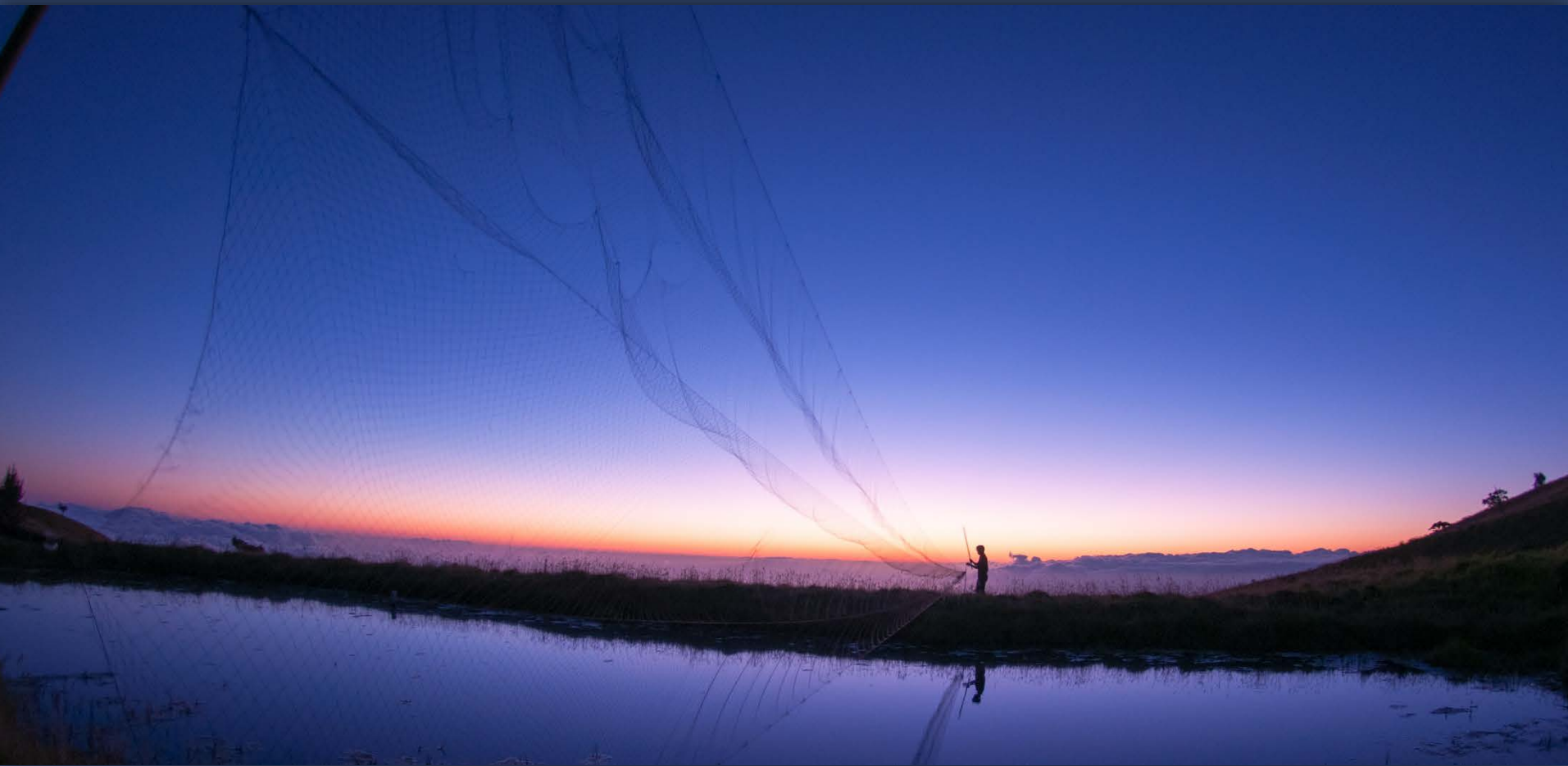
Shared features of landscapes are:

- Open (easy to fly and locate prey)
- Warmer temperatures (insects fly)

Not easy to model variation within a habitat.

- That's the point!
- Foraging prospects are not expected to be constant in time or space

Mist-netting



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Mist-netting



Diet
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Acoustic
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Telemetry
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Conclusions
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Mist-netting

HT Harvey introduced the use of acoustic lures and high nets (macronets or triple highs) to Hawaii in 2013.

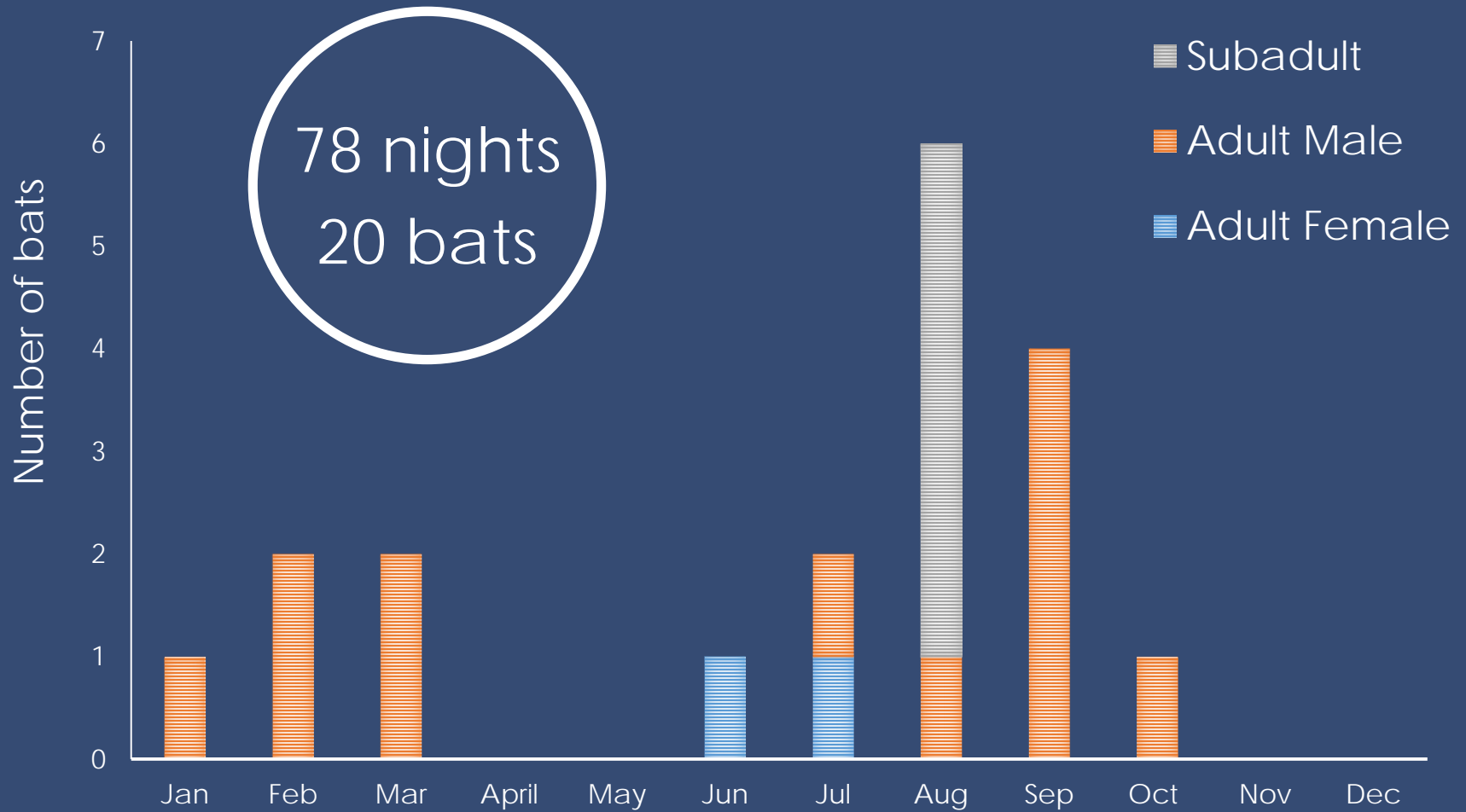


Avisoft high definition playback



100 ft. X 30 ft. tall macronet in Kula

Mist-netting



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Radio-telemetry



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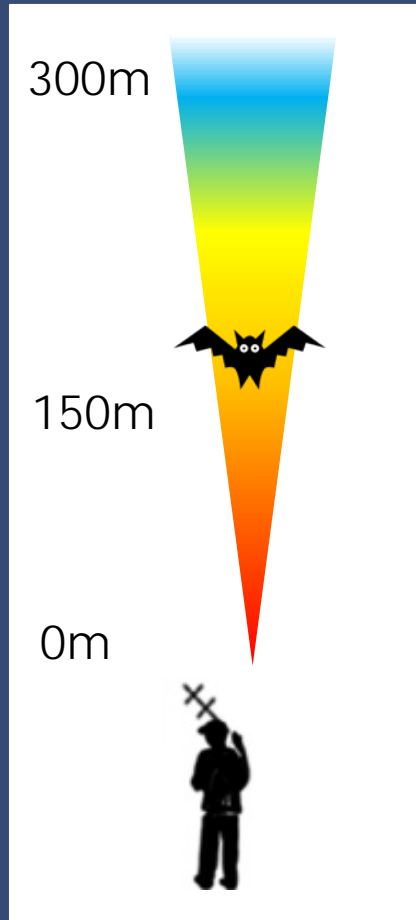


Conclusions

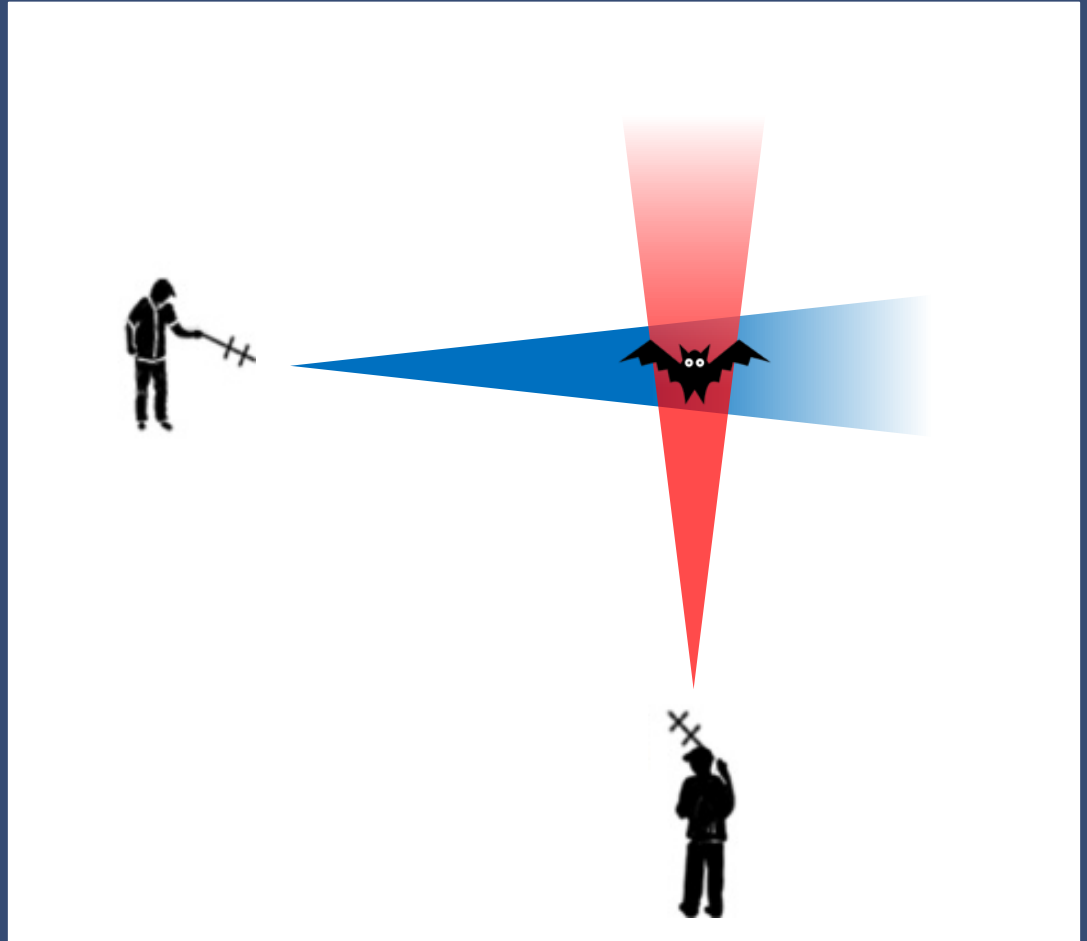


Radio-telemetry

USGS STUDY



OUR STUDY - Triangulation



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Radio-telemetry



16 Bats Radio-tagged:

- 2 Adult female
- 11 Adult male
- 3 Subadult

11 Ranges mapped

Bats tracked 5.3 +/- 1.5 d

Snapshots



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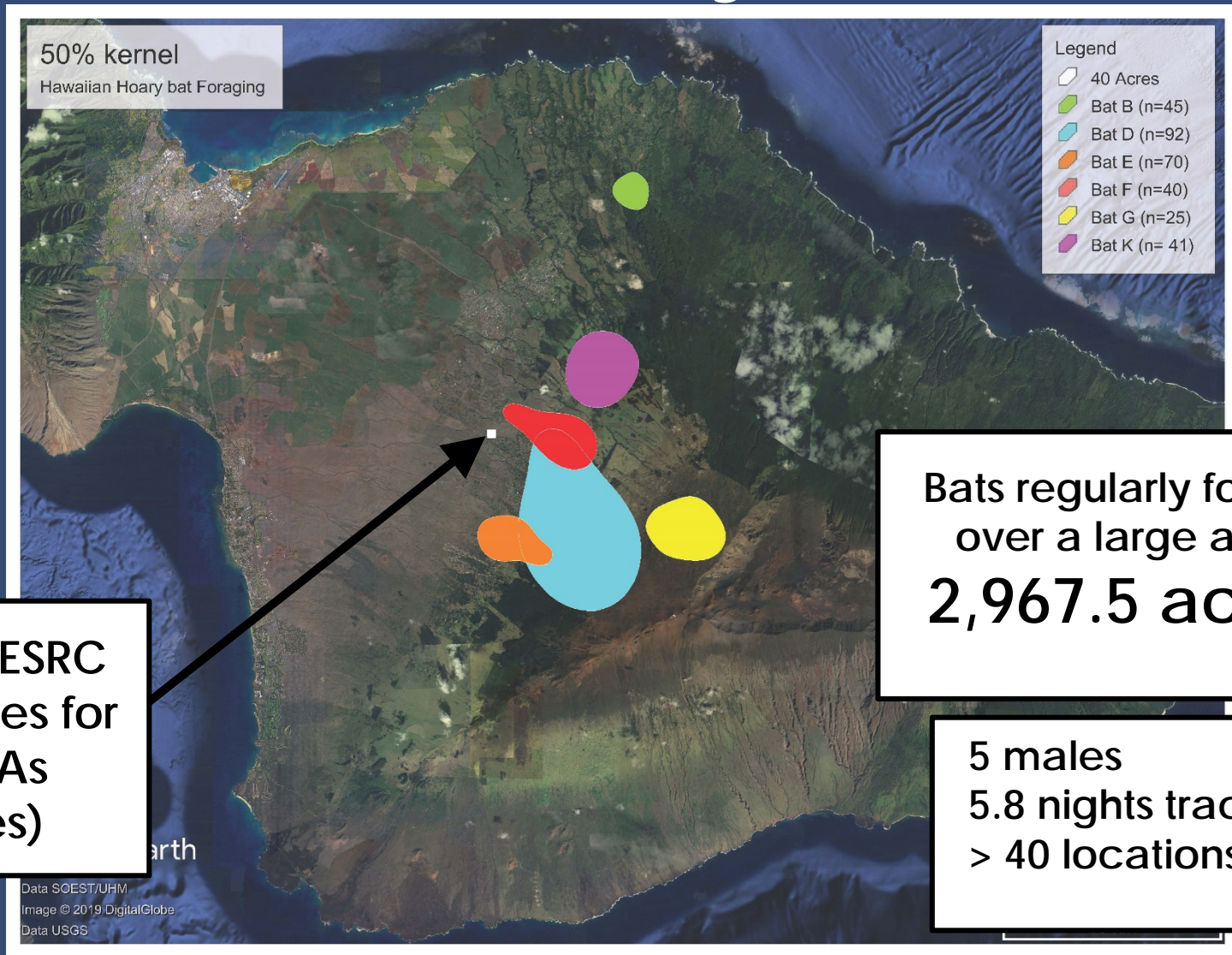
Telemetry



Conclusions



Radio-telemetry -Results



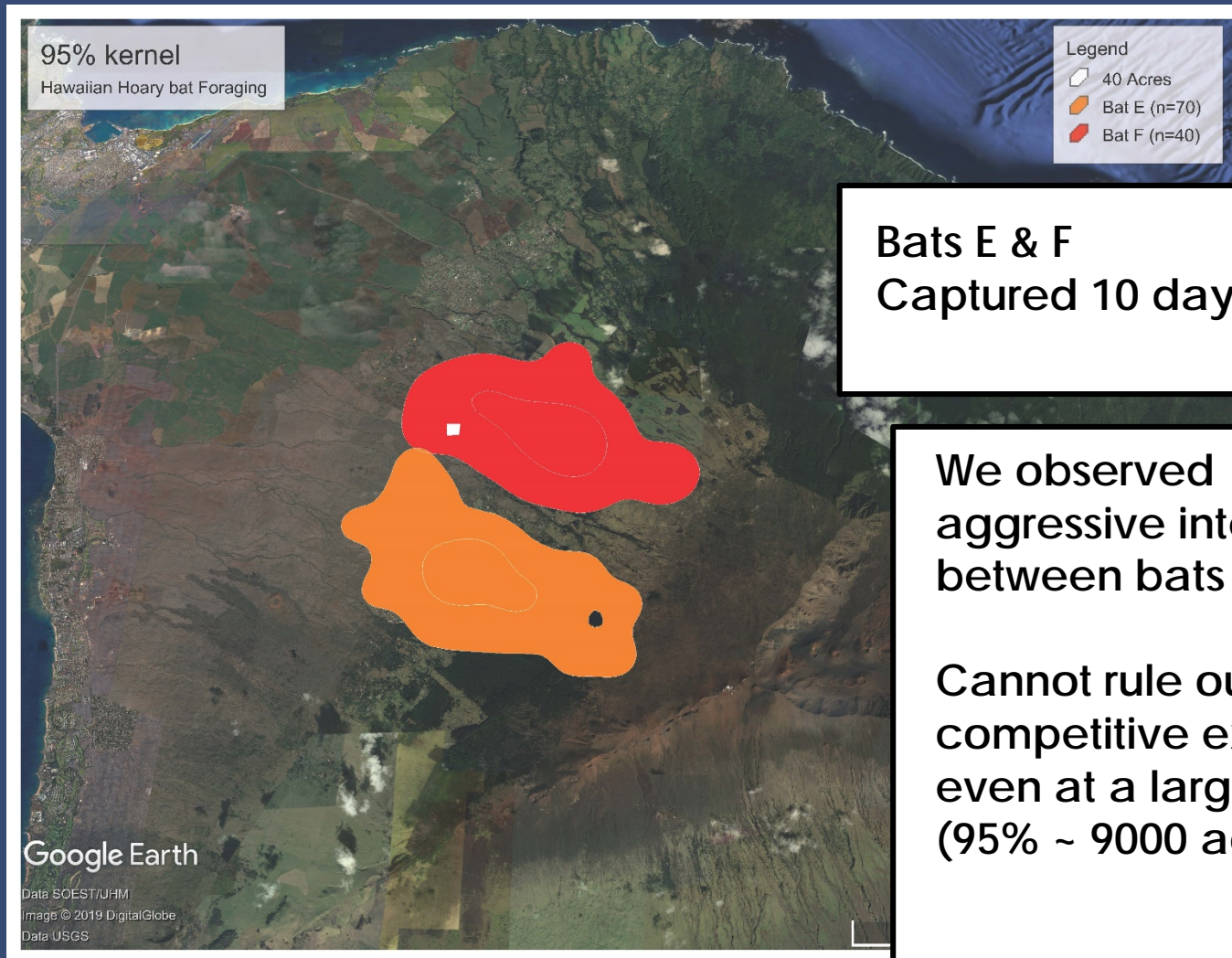
Current ESRC
guidelines for
bats CUAs
(40 acres)

Bats regularly forage
over a large area
2,967.5 acres

5 males
5.8 nights tracking
> 40 locations



Radio-telemetry



Bats E & F
Captured 10 days apart

We observed
aggressive interactions
between bats

Cannot rule out
competitive exclusion,
even at a large scale
(95% ~ 9000 acres)



Radio-telemetry – Take Homes



- Each bat tracked for short period of time as compared to the whole year
- Bats can use varied habitats with different levels of human impact
- Ephemerality and abundance of insects will determine habitat use

Diet Analysis



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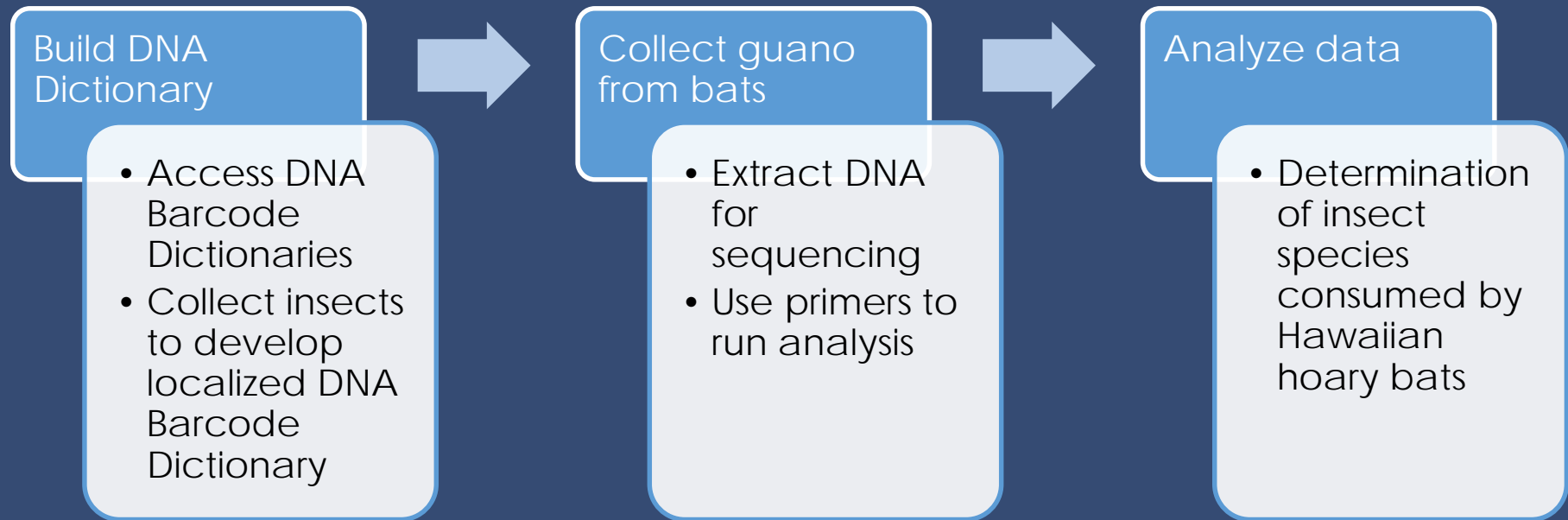


Conclusions

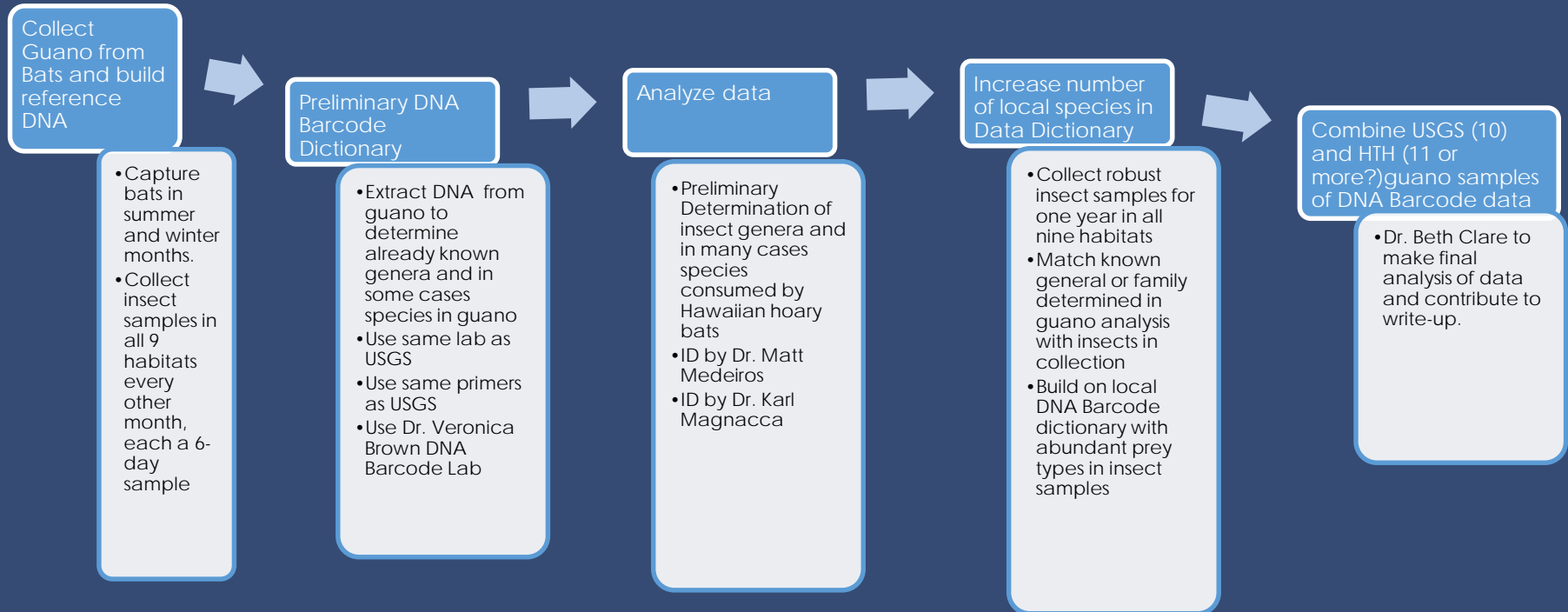


Diet – DNA Barcoding of Guano

Typical sequence of steps



Diet – DNA Barcoding This Study



Diet analysis

UV light collection trap

Bi-monthly
9 habitats

Samples shipped to
entomologist for
identification



Diet analysis

Guano from ½ of bats

11 samples for DNA
barcoding



Additional mist-netting
(without tracking) could
dramatically improve
sample size

Need more times of night &
capture habitats to
generalize results

Conclusions – The Big Picture

ISLAND SCALE management

Good News: highly
mobile and capable of
using fragmented
landscapes



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Conclusions

Conclusions – The Big Picture

Bats use LARGE foraging areas in short periods of time

Bats' activity is highly variable. Requires a better understanding of how spatial / temporal changes in insect prey drives foraging



Mahalo!



The Nature Conservancy



Native Nursery, Kamaole Ranch, Ulupalakua Ranch, Haleakala Ranch, Maui Nui Farms, Maui Bees, Ali'i Kula Lavender Farm

Deb Bauer, Andrea Buckman, Kelly Bryce, Monroe Bryce, Lois Campbell Terry Chang, Mark Damon, Kerri Fay, Dominic Gambino, Geoff Haines, Joseph Imhoff, Hadley Luis, Debra Lordan, Mary Jane Gaper, Linsey Manuel, Wisa Miller, Molly O'Grady, Evan Ryan, Rob Parsons, Zach Pezzillo, Michelle Smith, Andrei Stanescu, Monte Tudor-long, Doc Vitale, Heather Wade, Ian Wade, John Wilson, Jamie Woodburn, Bonnie Young and many more small landowners.



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Questions?



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Mist-netting



Diet
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Acoustic
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Telemetry
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Conclusions
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