

Hawaiian hoary bat research currently proposed to offset incidental take incurred at wind farms in the State of Hawaii. Drafted by USFWS, November 18, 2015.

1). State-wide Acoustic Monitoring – Assessing Distribution and Occupancy Trends

A collaborative team, including members from: USFWS, DOFAW, USGS, Kawailoa Wind, LLC, SunEdison, LLC, WEST Inc., SWCA, and H.T. Harvey, is developing a standardized study design for a state-wide occupancy study. The goal is to establish baseline occupancy trends on Kauai, Maui, Hawaii and Oahu using a grid of acoustic detectors across the islands. The acoustic detectors will be purchased by Kawailoa Wind, LLC and SunEdison, LLC. Each entity will conduct the study on a designated island. USGS will cover Hawaii, H.T. Harvey will cover Maui, etc. WEST, Inc. was contracted to run an initial analysis for duration, grid size, and spacing elements of the study design. The output from this step was provided to the group and will be reviewed and refined by all parties involved. It will be a highly iterative process for each phase of the study. Mitch is managing proposals and contracts. Corinna is assisting with equipment and software standardization. Marcos will be instrumental in providing feedback for data analysis. DOFAW will assist with permits for land access. We are hoping USGS may assist with designing and managing a database for the extensive data collection.

Background:

- April 14-15, 2015 – Two-day ESRC Hawaiian hoary bat workshop. Research priorities established.
- June, 2015 - *A Plan for the North American Bat Monitoring Program (NABat)* (Loeb and others 2015) was published. The methodology described in this plan reflects desired study design and research efforts for the Hawaiian hoary bat.
- June 27, 2015 – Based on the NABat, USFWS sent a query to scientific experts, requesting feedback to guide the standardization of research methods.
- August 7, 2015 – H.T. Harvey sponsored “Bat Breakfast” in Hilo. USFWS synthesized query responses and the group discussed and further refined the study design to specifically address distribution and occupancy trends using acoustic detectors.
- August 25, 2015 – Call btw. USGS and USFWS to discuss study approach and roles. Call btw. SunEdison and USFWS to discuss initial steps.
- September 11, 2015 – Group conference call. WEST, Inc. contracted for initial step. Corinna testing equipment. Each entity will be responsible for an island. Entire effort will be iterative with all parties cooperatively working towards the best design and analysis.

November 16, 2015 – Power Analysis for Trend Detection in Hawaiian Hoary Bat Occupancy in the Hawaiian Islands provided to the group by WEST, Inc.

- 2). Power Analysis for Trend Detection in Hawaiian Hoary Bat Occupancy in the Hawaiian Islands – WEST Inc. (funded by Kawailoa Wind, LLC as partial fulfillment of Tier 2 and 3 bat mitigation obligations).
- Initial analysis to determine the approximate annual sample size of sites required to detect Hawaiian hoary bat occupancy trends of various magnitudes. WEST will reach out to other entities (e.g., USGS) for input on critical issues necessary to run simulations and finalize the design (e.g., grid cell size, probability of detection, temporal sampling frame).

3). Hawaiian Hoary Bat Mitigation Monitoring at the West Maui Mountains Watershed Partnership Project Site, Lahaina, Maui – H.T. Harvey

- Conduct acoustic monitoring upslope of the Lahaina restoration parcel for a comparison of activity between mitigation site and higher altitude where no restoration activities are occurring. – 1 year. NOTE: assumes Lahaina restoration project is approved for KWPII mitigation. Otherwise same parameters could be applied elsewhere.
- Prey availability study – 7 consecutive days every other month for one full year. Observe prey base response and bat activity during restoration.
- Radio-telemetry to assess roosting ecology – 1 month. Increase understanding of fine scale maternity roosting habitat. Help focus restoration actions to improve roosting habitat. Increase understanding of potential risks to pups at maternity roosts.

4). Radio-tracking of the Hawaiian Hoary Bat: A strategy to increase our understanding of roosting and foraging ecology in winter and summer – H.T. Harvey

- Radio-telemetry in the Alakai Swamp (winter) 2016-2017. Determine seasonal movements, home-range size, and roosting ecology.
- Radio-telemetry on Maui in the vicinity of Hwy. 377 (summer) during the 2016 maternity season.
- Prey availability study – collect data near mist-netting and radio-tracking sites with light traps and flight interceptor traps.
- Bat guano samples sent to USGS for insect barcoding.

5). Genetic Determination of Sex and Diet Composition in the Hawaiian Hoary Bat, Hawaii, Maui, and Oahu – USGS

- Use of next generation sequencing and metagenomics analyses to detect the insect diversity and quantifying the relative contributions of insect taxa in bat diets across differing habitats, season, and between sexes.

6). Hawaiian hoary bat Annual Home Range Movements, Habitat Use, and Roosting Behavior, Hawaii – USGS

- Study area spans the combined Wailoa-Wiluku-Waikaumalo watershed (including northern slope of Mauna Loa) and includes near sea-level to high elevation (> 3,500m) sites.
- Study objectives are to document: foraging/home range size, seasonal movement patterns, habitat use, roost fidelity and roost tree characteristics, mother-pup behaviors and pup survival rate. Includes winter and summer ranges over 2 annual cycles.

7). Evaluate Bat Use and Activity Patterns Over Time in the Vicinity of the Waihou Mitigation Area, Maui – USGS

- Acoustic monitoring and radio telemetry during 3 phases of restoration during years (approximately) 1-3, 8-10, and 16-18. Acoustic monitoring for the 1st 3 complete annual cycles. Radio telemetry targeted during 2-3-month period of greatest acoustic activity. Goal is to tag at least 8-12 adult bats per season. Study objectives are to determine bat

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core areas size and composition on Maui and evaluate bat use and activity patterns over time in the vicinity of the mitigation site.

- Insect prey base will be quantitatively assessed for finest taxonomic ID, number of individuals, and biomass for nocturnal flying insects during a 2 month period of peak annual activity corresponding to bat capture and radio-tracking during 2017/18. DNA bar-coding of insects collected at Waihou and also of insect fragments in bat fecal pellets collected during mist-netting.
- Plants will also be sampled to ID specific patterns of insects and host plants associated with restoration. Objective is to guide future propagation of plant species to increase host plants of important prey species.