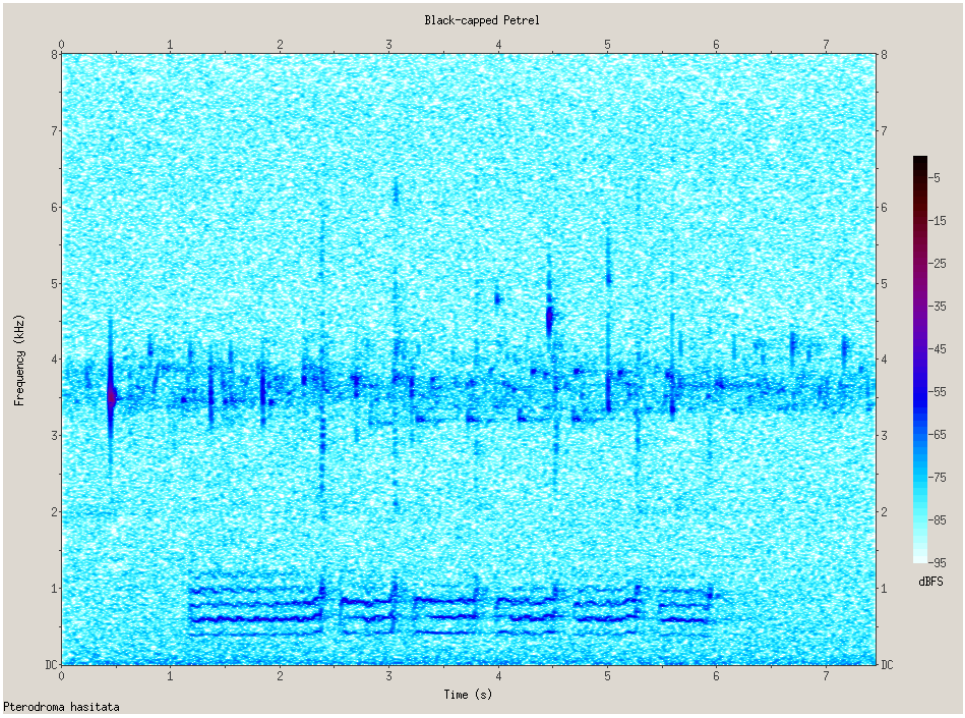

Acoustic monitoring of diablotin activity on Hispaniola: Pilot data and potential next steps

January, 2014

For: Ernst Rupp, Grupo Jaragua
Jim Goetz, Cornell University
Adam Brown, Environmental Protection in the Caribbean
Anderson Jean, Société Audubon Haiti
Joel Timyan, Société Audubon Haiti
Jennifer Wheeler, US Fish & Wildlife Service
Holly Friefeld, American Bird Conservancy

By: Matthew McKown, Conservation Metrics
matthew.mckown@conservationmetrics.com

Introduction

The status and breeding distribution of the diablotin (Black-capped Petrel, *Pterodroma hasitata*) is poorly documented. What is clear is that a combination of factors including introduced predators, human harvesting, habitat loss, and natural disasters have led to dramatic population declines throughout its former breeding range in the Caribbean basin. Today, the only documented breeding sites for the species are located in the mountains of Haiti and the Dominican Republic on Hispaniola.

The species' elusive behavior, cryptic nest sites, rugged breeding habitat, and relatively low population densities have complicated efforts to find and monitor extant breeding aggregations. Recent work on Hispaniola by Grupo Jaragua (Ernst Rupp, Jesus Almonte, Esteban Garrido, Rene Jeune, Gerson Feliz, Jose Luis Castillo, and Jairo Isaa Arache Matos), Jim Goetz (Cornell), Society Audubon (Joel Timyan, Anderson Jean and Beauduy Jean-François) and Environmental Protection in the Caribbean (EPIC; funded in part by the USFWS and the American Bird Conservancy) has greatly increased the available information about breeding sites, flight corridors and threats on that island. These advances have resulted from a lot of hard work with traditional field surveys. A number of novel techniques, however, have also contributed new data about the species including radar surveys, camera traps, and passive acoustic sensors.

Here we briefly summarize an analysis of acoustic data collected by the research team working on Hispaniola in 2012 and 2013. We end with some suggestions for how to expand the acoustic survey effort to:

1) survey potential breeding habitat on Hispaniola and elsewhere to detect diablotin vocal activity at undetected breeding aggregations;
2) test correlations between acoustic activity rates and the relative abundance of diablotine burrows at breeding sites, and
3) monitor collisions with man-made structures in flight corridors.

Results: 2012 – 2013 pilot acoustic surveys

Survey effort

Sensors were deployed at two sites, Loma del Toro and Hoyo del Diablo, both in the Sierra de Bahoruco on Hispaniola.

A total of 1,857 hours were recorded over 205 survey nights at these sites in 2012 and 109 hours of recordings collected over 31 nights at the Hoyo del Diablo site in 2013 (Table 1).

Table 1 Acoustic survey effort

Survey Site	*Year*	*Survey Nights*	*Total Hours*
Hoyo del Diablo	2012	143	1126
	2013	31	109
Tower	2012	62	731
	2013	-	-

The sensor deployed at the Loma del Toro tower appears to have failed during the 2012/2013 breeding season.

Vocal activity

Unfortunately, differences in how the acoustic sensors were programmed (i.e. recording schedules, sampling rates, deployment periods, microphone gain, battery capacity, and clock settings) complicated our analysis process. **The data presented below should therefore be interpreted with caution!**

Having said that, one clear conclusion of the pilot project is that diablotin vocalizations can be detected successfully with automated classification software despite the complex natural soundscapes found at survey sites (Figure 1). We are therefore confident that a more coordinated survey effort in 2013/2014 can provide rigorous and comparable results.

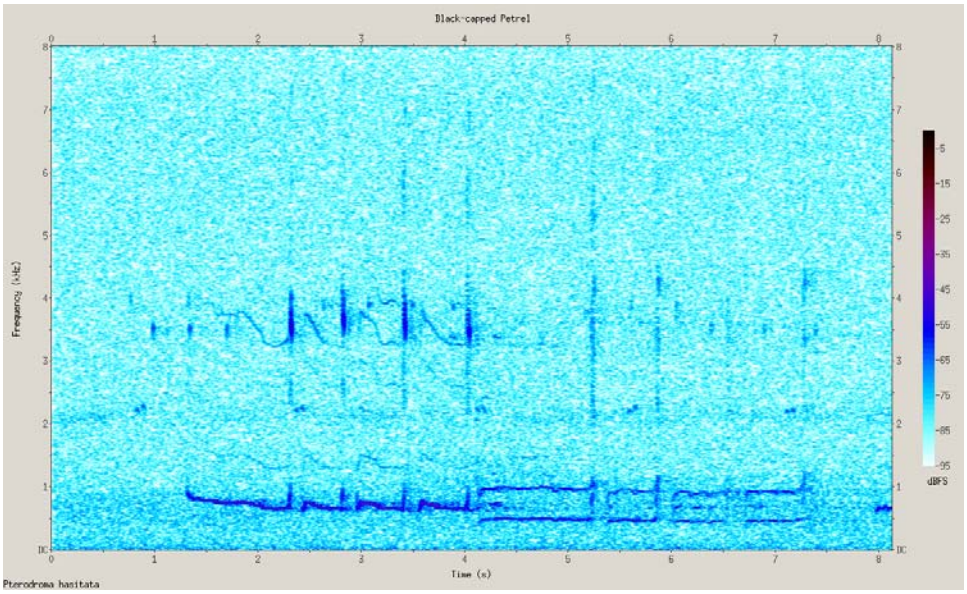

Figure 1: Diablotin vocalizations from two individuals recorded at the Hoyo del Diablo survey site.

We chose to limit our analysis to data recorded from 1 hour to 4 hours after local sunset, a period when Hawaiian Petrels (*Pterodroma sandwichensis*), Juan Fernandez Petrels (*P. externa*), and many other congeners are most vocal (although not all!). Visual comparisons of a selection of dusk and dawn recordings from the Loma del Toro data set appeared to confirm the validity of this assumption (although a more thorough assessment in future years will help to confirm this quantitatively).

Within the dusk period, our data showed that diablotin calling rates peaked about 2.5 hours after local sunset (Figure 2).

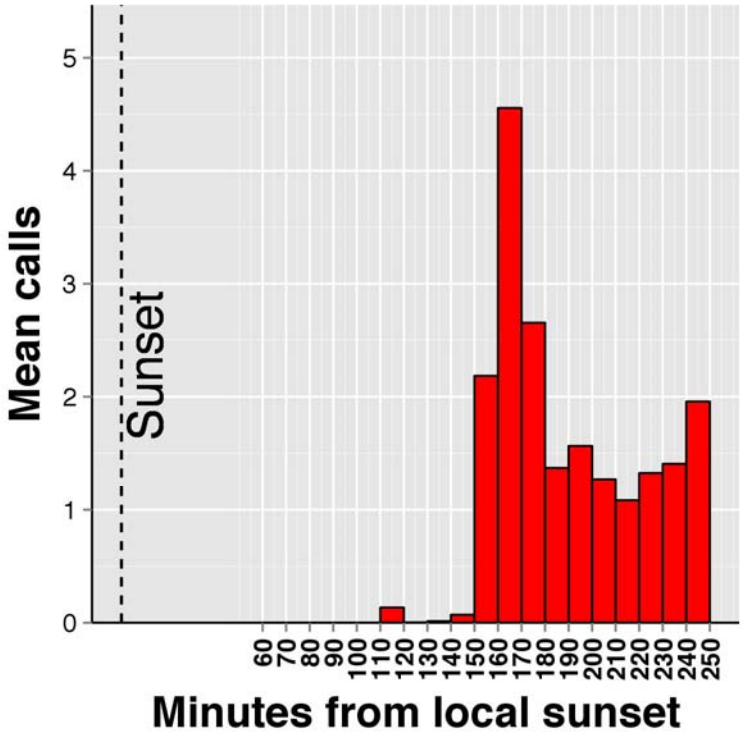

Figure 2 Diablotin vocalizations were first detected around two hours after sunset, and peaked 30 to 40 minutes after that.

A total of 32,962 diablotin calls were detected in the dusk subset (both survey sites, both seasons). If the data collected over both breeding seasons is assessed together, we see that activity was detected over a period of 142 calendar nights (from November 14 to April 5). This fits well with the breeding phenologies for other *Pterodroma* petrels. For example, Simons et al. (Birds of North America, 1998) report Hawaiian Petrel (*Pterodroma [sandwichensis]*) fledglings on Haleakala (Maui, HI) roughly 250 days after initial courtship. Non-breeding individuals reportedly attend the colony for roughly 190 days. If we assume that non-breeders are a large component of acoustic activity at Loma del Toro, the pronounced decline in activity in early April suggests that courtship activity might begin in early October (~190 days before April).

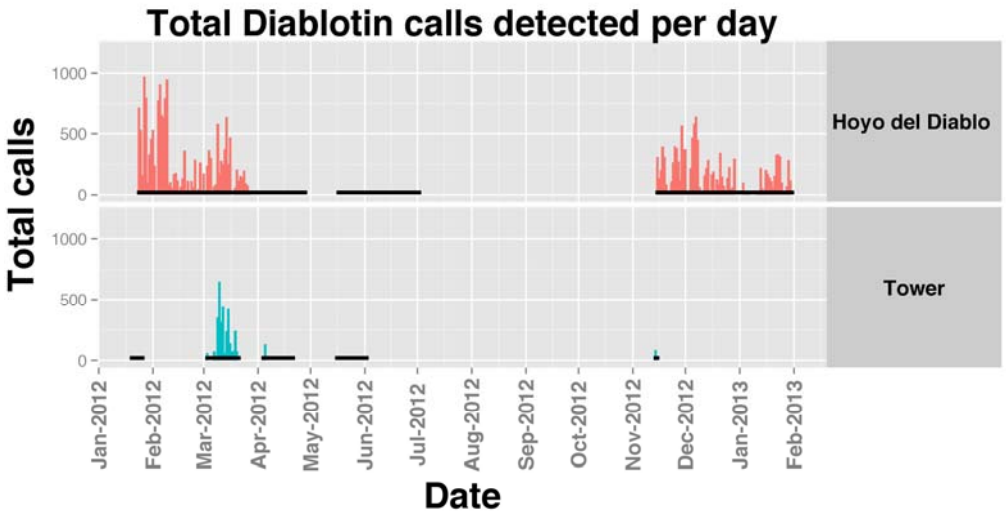

Figure 3: Total diablotin calls detected by day and site (**black bars** on x-axis show survey periods). In the 2011/2012 breeding season, sensors detected calls from the date of deployment in January to early April. In the 2012/2013 breeding season, calls were detected immediately in mid-November 2012.

Relative rates of acoustic activity

Activity rates in March 2012, a period when both sensors were running concurrently, did not differ significantly between the survey sites (t= -0.7988, p=0.43; Figure 4). Again, these results should be interpreted with caution given the different settings on both acoustic sensors. Any assessment of whether activity rates differ between breeding and non-breeding sites, or questions about potential attraction to the communication tower will need to be addressed after more comprehensive surveys.

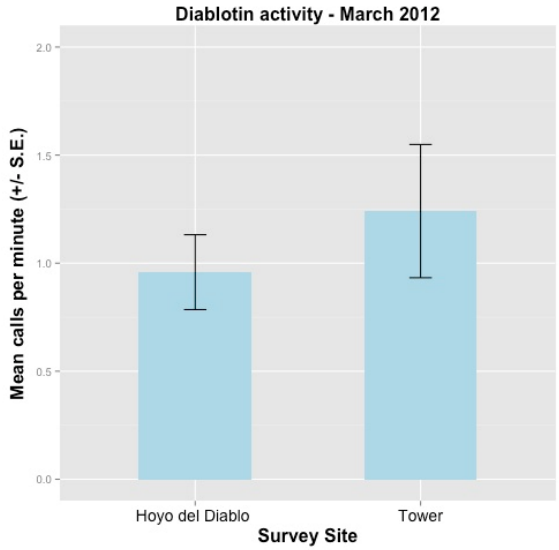

Figure 4 Mean diablotin call rates did not differ significantly between survey sites in March 2012 (t-test, p>0.05).

Pilot Project Proposal

Project: Acoustic monitoring of Diablotin activity on Hispaniola – 2013/2014

Goals:

1) To collaborate with partners to design standardized survey protocols and parameters;
2) Quantify acoustic activity at known breeding sites; and
3) Explore for new, unknown breeding sites on Hispaniola.

Details:

- 6 new sensors (for a total of 8 on Hispaniola)
- 3- 4 calibration survey sites (9 months per point)
- 9 exploratory sites (3 roving units deployed for 1-month period)
- 1 unit at cell-phone tower
- Recording schedule (22 kHz, mono):
    - 5-hour block after sunset;
    - 1 minutes every 10 minutes after that until dawn

Deliverables:

- Consultation, planning with local collaborators,
- Sensor recording schedules and recording parameters,
- Deployment protocols, help with survey design,
- Consultation with field staff during survey period,
- Analysis of 2 day Song Meter checkout period before deployment,
- Interim reports (Feb., Jun.)
- Copy of raw detection data, and other measures (In a CSV spreadsheet file).
- Map of detections;
- Report summarizing analysis of 2013 monitoring results.

Project Rational

The 2012/2013 pilot confirmed that acoustic monitoring can detect and quantify diablotin activity at sites in the Loma del Toro area. The next steps should be to address two fundamental questions:

1) Can acoustic monitoring be a cost effective and logistically simple way to survey for new breeding sites on Hispaniola?
2) Do acoustic metrics (mean calls per minute) provide a valid index for comparing the relative abundance of diablotines across sites and through time?

Preliminary data from acoustic surveys conducted on the island of Kaua'i in Hawaii (with Kaua'i Endangered Seabird Recovery Project) have indicated that acoustic monitoring can be an effective tool for monitoring other elusive petrels including the Hawaiian Petrel (*Pterodroma sandwichensis*). For example helicopter deployed acoustic sensors have helped the Kaua'i Endangered Seabird Recovery Project (KESRP) to identify new breeding sites on that rugged island. Furthermore, by comparing call rates measured at these exploratory sites to call rates measured at surveys sites with rough burrow density estimates (calibration sites), KESRP can begin to characterize the relative size of these new breeding sites (small, medium, large).

In addition, research with other *Procellariiformes,* the Wedge-tailed Shearwater (*Puffinus pacificus*) have been shown acoustic metrics of activity to be significantly correlated with breeding burrow densities at colony sites across Hawaii (McKown et al. unpublished data) and in the Capricornia Cays, Australia (McKown et al. unpublished data). These data show that Wedge-tailed Shearwater breeding densities can be estimated within 20m of the acoustic sensor (Figure 5).

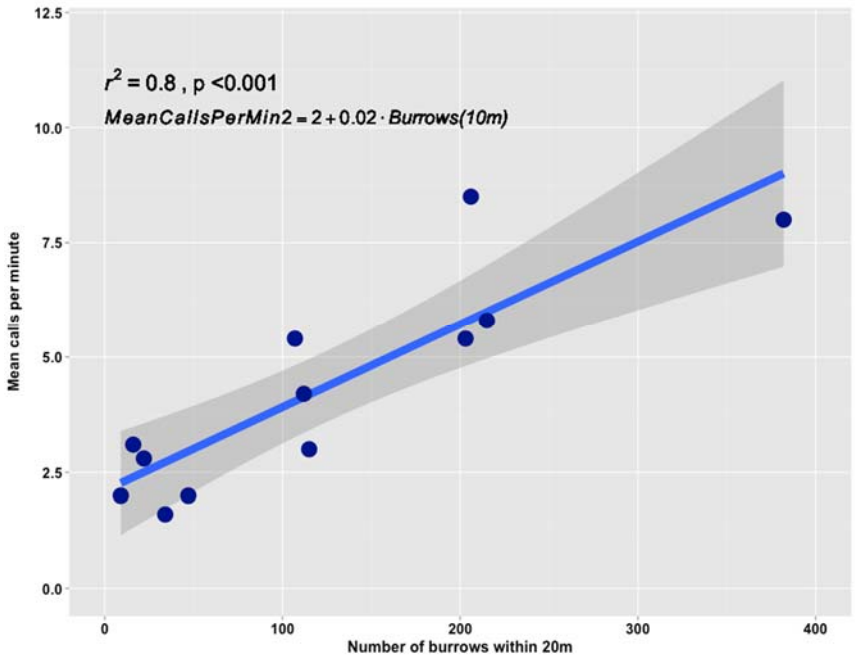

Figure 5: Metrics of acoustic activity at Wedge-tailed Shearwater sites in Hawaii are significantly correlated with burrow densities within 20m.

Given the results from other acoustic monitoring efforts, and the data gathered on Hispaniola during the pilot season, it seems sensible to expand the acoustic survey effort in 2013/2014. Specifically, we propose to:

- help to develop standardized recording schedules, parameters, and hardware (see details below);
- work with partners to deploy sensors at 3-4 sites with known breeding aggregations (i.e. within 100 m of large, medium, low density breeding sites and possibly a transition site) from Dec. 2013 to May 2014;
- work with partners to deploy sensors at ~12 exploratory sites for 1-month survey periods from Dec. to Mar. (using 3 roving units);
- monitor collisions with guy wires at cellphone tower identified in Haiti; and
- redeploy units at sites in Sep. 2014 to determine arrival times.

This work would be carried out in concert with other planned monitoring efforts, and be directed in the field by partners with intimate knowledge of the species.

Collaboration Details

Key roles and responsibilities - The project will be a continued collaboration between Grupo Jaragua, Jim Goetz, Society Audubon, EPIC, ABC, and CMI. Sensors will be dedicated to the project for the 2013/2014 and 2014/2015 breeding seasons.

CMI will help to design the acoustic study, provide recording schedules, house acoustic data, process acoustic data, and provide summary reports of acoustic data. DATA WILL BE SHARED WITH PARTNERS.

Survey design/Field deployments - Grupo Jaragua, Society Audubon, EPIC and Jim Goetz will select survey sites, deploy and maintain sensors, document survey point data, and will help to estimate burrow densities at occupied sites.

Reporting - CMI will draft summary reports detailing the results from each season (An interim report and a final report). Reports will be submitted to partners for review/comment before final submission. Copies of detection data will be made available to all partners.

Initial recommendations on acoustic survey standards

- Standardizing sensor programs and hardware components
    - sampling rate 22 kHz, mic gain
    - five 1-hour blocks starting at local sunset, then 1 minute every 10 until local dawn (based on the same lat/long)
    - standard external battery packs

- Improving logistics:
    - standard datasheets
    - standard script for acoustic notes
    - protocols for data storage
    - plan for regular data transfer via ftp or “data mule”

- Data Standards:
    - Standard excel spreadsheet for documenting data about surveys locations and survey dates, and etc.
    - Standard metadata files to be included with recordings for long-term archiving