RADAR SURVEYS FOR BLACK-CAPPED PETRELS ON DOMINICA: RESULTS FROM AN EXPEDITION DURING JANUARY AND FEBRUARY 2020

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INTRODUCTION

The Black-capped Petrel (*Pteredroma hasitata*) is a seabird species in the genus Gadly Petrel. Current distribution of the species includes known nesting colonies on the island of Hispaniola where the species nests on the Cordillera Central, the Sierra de Bahoruco, Massif de la Selle, and Massif de la Hotte (Simons *et al,* 2013; Brown, 2017). Radar and night-vision surveys on Dominica in 2015 detected petrel-like targets as well as observed flying petrels in multiple locations (Brown, 2015). Radar and night vision surveys in Jamaica in 2016 detected 2 petrel-like targets in the Blue Mountains (Brown, 2016). At-sea distribution of the petrel includes the western northern Atlantic, mostly between the Caribbean and Cape Hatteras and the Caribbean Sea, most often near Hispaniola but often ranging southwards to the Caribbean coast of South America (Satge *et al,* 2019).

The island of Dominica is the designate type locality for the Black-capped Petrel. Wide-spread in the early 1800's, the species was hunted and sold to the French colonies on both Guadeloupe and Martinique (Simons *et al,* 2013). Through the mid-1800's, petrels were documented to be nesting on Morne aux Diables, Morne Diablotin, and Morne Fou (Simons *et al.* 2013). While still believed to be nesting at this point, Black-capped Petrel populations diminished into the late-1800's and the last known nesting petrel was found in 1862 (Simons *et al,* 2013). Expeditions to locate nesting petrels continued through the 1900's, however no new nesting petrels were located (Simons *et al,* 2013). Records in the early 1930's of "great quantities" of Black-capped Petrels offshore of the capital Roseau as well as incidental records of hunted petrels being exported to the French colonies, provide evidence that the species persisted on Dominica through the 1930's (Simons *et al,* 2013).

An expedition to search for petrels on Dominica, led by David Wingate in October/November of 1964, found no evidence of nesting Black-capped Petrels (Wingate, 1964). Further, interviews of humans living near historic petrel nesting areas provided no further evidence that petrels persisted on Dominica (Wingate, 1964). Wingate (1964) provided some insight into where he thought petrels had nested on Dominica, "*Examination of the terrain suggested that the original breeding population occupied only a narrow zone at about 1,200m elevation on leeward and 1,000m on windward slopes of one or more of the higher peaks*."

In the 1970's, a well-documented effort was undertaken by the Dominica Division of Forestry and numerous non-profit foundations, to recover the populations of the endangered Sisserou Parrot (*Amazona imperialis;* Evans, 1991). As the teams surveyed forest tracts throughout Dominica, they encountered calling or flying Black-capped Petrels on numerous occasions: (1977) Petrels heard calling near Morne Diablotin, (1980) Birds heard in south part of island, (1982) Small numbers observed along southeast coast and flying inland after dark, (1984, April) flock offshore of Delices, (1989) Flying off coast near Morne Fous and potentially coming ashore, (1990) Adult bird found grounded, Roseau, and (1997) Birds observed flying over Morne Verte (Evans and James 1997).

More recently, additional sightings of Black-capped Petrels on Dominica included: (2007) in January, an adult petrel was observed walking across the road in the village of Trafalgar. (2007) In May a young petrel was found on the ground near the village of Padu and was brought into the Forestry offices and later died. (2013) A petrel was observed on the ground near the village of Padu and left there. (2015) A petrel was observed on the ground in the village of Morne Prosper and left there (*fide* Arlington James, 2015).

In 2004, ornithologist Anthony Levesque, with the French Reserve Naturelle in Guadeloupe, doing surveys of seabirds migrating by Guadeloupe, spotted seven Black-capped Petrels fly by the island of Guadeloupe towards Dominica (Levesque and Yesou, 2005).

Over the last 20 years, there have been four notable expeditions on Dominica, to look for Black-capped Petrels. An EPIC-led expedition in 2001 looked for nesting birds in burrows and listened for calling petrels at night, all near Morne Fou in the southern mountains. No petrels were detected (Brown and Collier, 2001). An EPIC-led expedition in 2010 listened for calling birds at night and, via boat, looked for petrels on the water. No petrels were detected (Lowrie *et al,* 2012). In 2015, an EPIC-led expedition used a marine radar unit, night-vision binoculars, and song-meter recording units to detect the presence of Black-capped Petrels. The team visited the island in January. With the radar unit, they detected 968 petrel-like targets over 20 stations. With night-vision, we observed 8 Black-capped Petrels flying. The song-meter units did not detect any petrel calls (Brown, 2015). A follow-up effort was completed in 2016 by a joint Grupo Jaragua/American Bird Conservancy team, with the intent to find nesting petrels. The team accomplished eight days of nest searching on Morne Trois Piton, Morne Micotrin, and the ridge connecting the two peaks. No petrel nests were located, although several areas were deemed appropriate for nesting petrels (Rupp *et al*, 2016).

In September 2017, Hurricane Maria (Category 5) struck Dominica. The storm brought with it severe winds and torrential rains, leaving a path of devastation to potential petrel nesting habitat in the high mountain peaks island wide. Large areas of forest were blown down by strong winds and the heavy rains caused enormous landslides in many areas. Several the hardest affected areas were where the 2015 EPIC-led expedition had high numbers of petrel-like targets. The Dominica Division of Forestry, along with EPIC, were interested in a follow-up expedition with the radar unit, to detect trends in in the number of petrel-like targets on Dominica.

The report that follows details the methods and results of an expedition to Dominica in January and February 2020, where the team (1) completed radar surveys, (2) used night-vision optics to look for flying petrels, and (3) deployed remote listening devices near potential petrel nesting areas.

METHODS

At all survey sites, our staff simultaneously identified petrels using radar and audio/visual methods. Data collected during previous surveys for petrels on the island of Hispaniola, Dominica, and Jamaica, allowed us to better understand the timing of movements of petrels in and around nesting areas. Based on this data, surveys began at sunset, when petrels become active at the nesting area and flight corridors and ended 3 hours later, when petrel activity slowed (Brown, 2017).

For surveys, we set up our radar within 1.5km of the potential nesting sites or flight corridors. Although radar can detect targets at much greater distances, resolution suffers greatly. Setting the range at 1.5 km is standard practice when surveying for seabirds as it allows the surveyor to detect targets at a substantial range while recording a clear and powerful target on the radar (Brown, 2017). A laptop computer was attached to the radar unit and we recorded all radar images, for subsequent review and analysis.

The radar operator monitored all targets that appeared on the radar's monitor, and recorded time, direction of flight (to the nearest degree), flight behavior (e.g. straight, erratic), velocity (to the nearest 5 km/hr), and if known, noted species and number of individuals detected.

A second surveyor was stationed at the base of the potential nesting areas or along flight corridors with 10x binoculars for observations during dusk observations and a night-vision scope when daylight is insufficient. This observer, the audio/visual (A/V) crew, constantly visually scanned the airspace above potential nesting habitat and flight corridors as focused on all visible sky for flying petrels and listened for calling petrels.

The radar and A/V crew communicated during the survey. When the radar crew detected a target that was potentially a petrel it alerted the A/V crew, allowing the A/V crew to locate and identify the target. Similarly, the A/V crew communicated to the radar crew any flying species that it detected, including birds, bats, and large insects. This enabled us to more accurately define the radar image of a Black-capped Petrel and to distinguish it from other nocturnal flying species.

Following each survey, we downloaded data and reviewed the recorded images of the radar survey. During this review, we re-analyzed all targets measuring flight speed, flight direction, and target size. This second evaluation of the survey assured researchers that no targets were missed or incorrectly measured.

Radar survey sites were chosen based on available access and proximity to historical nesting areas, likely historical flight corridors, and/or recent potential observations. We prioritized stations that had the highest numbers of petrel-like target detections during our 2015 expedition.

RESULTS

While on Dominica, we surveyed eight stations, one time at each, between 27 January and 4 February 2020. Four stations were adjacent to potential flight corridors and four stations were adjacent to potential nest areas (FIGURE ONE)

Over the eight surveys, we detected 240 Black-capped Petrel-like targets with radar. Petrel-like targets were detected at each of the eight stations (TABLE ONE).

Compared to 2015 data on petrel-like targets, overall target numbers in 2020 were down at each station, except for the DOM-04 station at Upper Trafalgar (TABLE ONE). Total petrel-like targets, at sites surveyed in both 2015 (n=691) and 2020 (n=240), was down 65%.

We visually observed six flying Black-capped Petrels, all with the thermal imaging camera. At DOM-01 on the western flanks of Morne Diablotin, we observed a Black-capped Petrel flying towards the sea at 1948. At DOM-15, we observed three Black-capped Petrels flying towards the sea, between the times of 1858 and 2022. At DOM-21 near Sylvania, we observed a single Black-capped Petrel at 1859, flying towards the sea. Finally, at DOM-02, we observed a single Black-capped Petrel flying towards the sea at 1900 (TABLE ONE).

The mean peak period of petrel activity, with all sites pooled (n=240 targets) was 93 minutes after sunset. The earliest detection was 34 minutes after sunset (station DOM-05). The latest detection was 175 minutes after sunset (station DOM-04).

Between 27 January and 6 February 2020, we deployed four song meters at locations adjacent to potential Black-capped Petrel nesting areas (TABLE TWO AND FIGURE TWO). These song meters will be downloaded every 60 days.

Herein below, we detail the petrel activity at each radar station in the order we surveyed in 2020

DOM-12

Location: Laudat
Dates Surveyed: 27 January 2020
Elevation: 600m
Distance from Sea: 6.05 km

Black-capped Petrel-like Targets: 21 (2020) and 127 (2015)
Black-capped Petrels Observed Visually: 0 (2020) and 2 (2015)

This station is located below the west slopes of Morne Micotrin and adjacent to the village of Laudat. The station has an unimpeded view of the valley that runs west from Morne Micotrin as well as the southwest slopes of Trois Piton. This flyway had many petrel-like targets in 2015 as well as petrels observed flying down valley after sunset. Further, there has been a song-meter deployed by the Forestry Division at the head of this valley, which has moved a few times since original deployment in 2015. This song meter was thought to be lost during Hurricane Maria, but was located during this expedition, by the Forestry Division staff.

Overall, petrel-like target numbers at this station were down considerably, since 2015. During recognizance of the upper slopes, in the area of potential petrel nest habitat, we observed considerable numbers of wind-downed trees but no noticeable landslides. The wind-downed trees were blown down following the passing of Hurricane Maria. It is unclear what effect the wind-downed trees had on petrels if they do nest in this area.

DOM-05
Location: Cold Soufriere
Dates Surveyed: 29 January 2020
Elevation: 550m
Distance from Sea: 1.84 km
Black-capped Petrel-like Targets: 13 (2020) and 29 (2015)
Black-capped Petrels Observed Visually: 0 (2020) and 0 (2015)

This station, located below the north flanks of Morne aux Diables, allows us to survey petrels that fly to/from both to the Atlantic Ocean and the Caribbean Sea. This peak historically had nesting petrels and is named for the species. In 2015, we surveyed this location along with another location on the peak and this station had a substantially higher number of petrel-like targets. We, therefore, chose to survey this station again as it is likely the main flyway for petrels that might nest on this peak.

Overall, petrel-like target numbers were down from 2015. However, we had several interesting targets including one traveling at 65 km/hr as well as a pair or targets travelling inland together at 55 km/hr. We had eight petrel-like targets travelling inland while five were traveling towards the sea. All detected petrel-like targets were using valleys as flyways.

DOM-01
Location: Syndicate
Dates Surveyed: 30 January 2020
Elevation: 555m
Distance from Sea: 5.46 km
Black-capped Petrel-like Targets: 1 (2020) and 43 (2015)
Black-capped Petrels Observed Visually: 1 (2020) and 0 (2015)

This station is located just south of the visitor's center in Syndicate, on the large plateau location of Syndicate on the western slopes of Morne Diablotin. The station surveys the large valley that comes off the western side of Morne Diablotin and funnels towards Portsmouth. During 2015, we had a fair number of targets pass through this valley, however, we had only 1 in 2020, a severe decline.

The same petrel-like target we observed on radar in 2020, we observed visually as well with the thermal scope. The petrel was flying down valley, towards the sea.

Morne Diablotin was ravaged by the passing of Hurricane Maria, with scores of downed trees and large mudslides throughout the mountain. This change in the potential nesting habitat might have had an affect on the number of petrels using this potential nesting area.

DOM-15
Location: Bellevue Chopin
Dates Surveyed: 31 January 2020
Elevation: 450m
Distance from Sea: 3.02 km
Black-capped Petrel-like Targets: 90 (2020) and 168 (2015)
Black-capped Petrels Observed Visually: 3 (2020) and 0 (2015)

This station was moved slightly from the 2015 location, slightly further up the west-facing valley due to development of the 2015 survey site. The scope of visibility with the radar was not impacted by this move. The station, as the one in 2015, allowed for a survey of the well-defined valley that comes from the Caribbean Sea to Morne Anglais. This station was our lowest elevation station surveyed in 2020.

Of the 90 targets observed in 2020, 29 were targets moving inland, the highest number of inland-moving targets we observed on this expedition. At this station, we also visually observed (with the thermal scope) three flying petrels, two of which were observed flying towards the sea and a third petrel flying inland.

A song-meter listening device was deployed up valley from this radar survey station.

DOM-03
Location: Pont Casse
Dates Surveyed: 1 February 2020
Elevation: 543m
Distance from Sea: 5.92 km
Black-capped Petrel-like Targets: 50 (2020) and 106 (2015)
Black-capped Petrels Observed Visually: 0 (2020) and 0 (2015)

This station is located along the northwest facing flanks of Morne Trois Piton with the radar being placed at the edge of the large traffic round-a-bout. There are a few areas along this aspect of Morne Trois Piton that look like they have good potential for Black-capped Petrel nesting habitat. In 2015, we had a fair number of petrel-like targets coming from both of these areas and we followed up by placing a song-meter in one of the areas. This recording unit did not pick up any calling petrels. Further, in 2016, nest searching by the Grupo Jaragua/ABC/Forestry Division team located no petrel nests.

In 2020, overall petrel-like target numbers were down from the 2015 numbers, however, we had consistent petrel-like flight activity at the site, including targets moving both towards the sea and towards the mountains. We followed up our radar surveys this year by placing a song-meter unit as close as possible to the potential nesting area, however large numbers of wind-downed trees (due to Hurricane Maria) blocked most access on the mountain.

DOM-21
Location: Sylvania
Dates Surveyed: 2 February 2020

Elevation: 560m
Distance from Sea: 3.86 km
Black-capped Petrel-like Targets: 18 (2020) and N/A (2015)
Black-capped Petrels Observed Visually: 1 (2020) and N/A (2015)

This survey spot is new in 2020, as it was not surveyed in 2015. This spot was chosen as it allows for a survey of the flyway that connects the Caribbean Sea to the saddle area between Morne Trois Piton and Morne Micotrin. There is some very promising looking petrel nesting habitat in this area between the two mountains. The survey site itself allows for an unobstructed view both up valley and down valley, allowing for good detectability of petrel-like targets.

The majority of petrel-like targets at this site were flying out, towards the sea. A single petrel was observed with the thermal scope, flying down canyon towards the sea. This site is one of three main valleys that connect the Caribbean Sea to the western flanks of Morne Trois Piton/Morne Micotrin.

DOM-04
Location: Upper Trafalgar
Dates Surveyed: 3 February 2020
Elevation: 503m
Distance from Sea: 4.67 km
Black-capped Petrel-like Targets: 21 (2020) and 14 (2015)
Black-capped Petrels Observed Visually: 0 (2020) and 0 (2015)

This survey site is located up-valley of the location where three petrels were observed on the ground between 2007 and 2015. This large valley connects the Caribbean Sea and Morne Micotrin. The capital city of Roseau is located along the coast on one end of the valley. This site was surveyed in 2015, although our survey was cut short by heavy rain near the end of that survey. The station allows for unobstructed views both down and up the valley.

The majority of petrel-like targets at this site were flying inland. With the thermal scope, we observed two petrels flying, one flying inland, one flying seaward.

We talked to a Forestry employee who is also a resident of Laudat (village adjacent to this site), who mentioned that he and a friend had sat at this site at dusk and observed petrels flying past the site, on numerous occasions.

DOM-2
Location: Morne Rachette
Dates Surveyed: 4 February 2020
Elevation: 724m
Distance from Sea: 4.99 km
Black-capped Petrel-like Targets: 26 (2020) and 204 (2015)
Black-capped Petrels Observed Visually: 1 (2020) and 0 (2015)

This radar station is located below the southwest facing flanks of Morne Diablotin, at the head of the well-defined Salisbury River valley that connects the Caribbean Sea to Morne Diablotin. The southwest facing flanks of Morne Diablotin were heavily affected by Hurricane Maria as hundreds of trees were blown down and large landslides swept away substantial forested areas. This radar station, when surveyed in 2015, had the highest number of petrel-like targets on Dominica.

When surveyed in 2020, our overall petrel-like target numbers were substantially lower than in 2015, with only a total of 26 petrel-like targets. However, with the thermal scope, we observed a single petrel flying down valley and had several very well-defined large and fast-moving petrel-like targets on radar.

DISCUSSION

Black-capped Petrel activity persists on Dominica. Continuing observations of petrel-like targets on radar as well as visual observations using a thermal camera support this finding. Notably less targets on radar at the survey sites we used in both 2015 and 2020 suggest there has been decline in overall petrel numbers on Dominica.

The landscape of areas where Black-capped Petrels historically nested on Dominica, were substantially altered during the passing of Hurricane Maria. Large areas of forest were knocked down by high winds and landslides including areas on Morn Micotrin, Morne Trois Piton, and Morne Diablotin. In addition, immense areas of mountain hillsides slid, removing large areas of vegetation and rock outcropping. Perhaps this massive alteration of Black-capped Petrel habitat on Dominica has led to the reduced observations of petrel-like targets during 2020.

The other island that we use radar to monitor long-term trends in petrel-like targets, is Hispaniola. Like Dominica, we survey index sites every five years with radar to track petrel-like target trends. On Hispaniola, initial surveys at index sites in 2013 were followed up with surveys five years later, in 2017. The totals of those index sites in 2013 was 1,758 while in 2017 was 855. This represented a decrease of 51% in petrel-like targets over those pooled index sites on Hispaniola. As noted above, at our index sites in Dominica, we had a pooled number of 691 petrel-like targets in 2015 and 240 petrel-like targets in 2020. This represented a decrease of 65% in petrel-like targets over the pooled index sites. This data, from both islands, is notable as it shows substantial declines in petrel-like targets from both islands.

Overall human use of potential Black-capped Petrel nesting areas on Dominica, is low. All the potential petrel nesting areas are within National Parks or Forest Reserves. There is wide-spread agricultural use of land on the slopes below potential nesting areas, that petrel would need to pass over during their over-land migration. However, encroachment into protected areas appeared very low.

Regarding song meter deployment, due to the immense number of downed trees, access to areas of worthwhile deployment, was difficult. However, staff from the Division of Forestry cleared trails to deployment areas, and all areas of deployment were within 100m of either likely petrel flyways or potential nesting areas.

Our partnership with the Forestry Division on Dominica has been instrumental in acquiring research permits, in providing access to radar and song meter survey areas, and on-island logistics. However, key staff members within Forestry have either retired or are moving off-island soon. This reduction in on-island petrel conservationists will potentially make on-island research by international petrel conservationists more difficult in the future.

Overall, potential petrel nesting activity appears to be focused in the protected land areas on Dominica. These areas have been severely affected by the passing of large hurricanes in recent years, but largely unaffected by human encroachment and land alteration in protected areas. The network of protected areas, while not created solely for the purpose of protecting Black-capped Petrels, does provide a safety net for potential nesting petrels in Dominica.

RECOMMENDATIONS FOR FUTURE CONSERVATION WORK

The priority next step for Black-capped Petrel research and conservation on Dominica is to locate nesting petrels. We believe the deployment of a full research team for the entire breeding season, would be beneficial to locating nesting petrels. The team, when deployed, would carry out a suite of conservation and research activities including but not limited to:

- Monthly radar surveys at all eight index survey sites.
- Song meter deployment, maintenance, and data processing at 20-25 potential nesting locations.
- 10-15 nights per month of nocturnal surveys along flyways and at potential nest sites, using thermal cameras as well as recording surveys for remote surveys. Critical to this would be clearing of access trails to survey sites.
- 15-25 days per month of nest searching at potential nesting areas. Critical to this would be the clearing of access trails to potential areas. Use of dogs to sniff nesting burrows as well as drone-based ground penetrating thermal cameras should be considered.
- Surveys of human communities below potential nesting areas and along high traffic flyways, to understand any human petrel interactions that occur.
- Provide Black-capped Petrel outreach lesson plans to primary school, high school, and college aged youth. Approximately 2 per week, island-wide, for 5-month period (January – May)
- Once-monthly at-sea surveys and potential satellite tagging of petrels at sea-mount fishing area/whale watching area between Dominica and Martinique.

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FIGURES AND TABLES

TABLE ONE. Locations and results of radar surveys at index sites on Dominica from both 2015 and 2020.

Station	Date	Location	Lat	Lon	Altitude (m)	Heading	Distance from Sea (km)	Petrel-like targets in 2020	Petrel-like targets in 2015	Petrels Observed in 2020	Petrels Observed in 2015
DOM-12	1/27/2020	Laudat	15 20 12.9	-61 20 11.9	600	336	6.05	21	127	0	2
DOM-05	1/29/2020	Cold Soufriere	15.62191	-61.43591	550	270	1.84	13	29	0	0
DOM-01	1/30/2020	Syndicate	15.52245	-61.41867	555	128	5.46	1	43	1	0
DOM-15	1/31/2020	Bellevue Chopin	15.27379	-61.34887	450	340	3.02	90	168	3	0
DOM-03	2/1/2020	Pont Casse	15.37778	-61.34454	543	150	5.92	50	106	0	0
DOM-21	2/2/2020	Sylvania	15.35493	-61.35769	560	140	3.86	18	N/A	1	0
DOM-04	2/3/2020	Upper Trafalgar	15.32976	-61.34801	503	200	4.67	21	14	0	0
DOM-02	2/4/2020	Morne Rachette	15.48458	-61.40962	724	340	4.99	26	204	1	0
TOTAL								240	691	6	2

TABLE TWO. Locations of song meters deployed to detect Black-capped Petrels on Dominica in 2020.

Station	Deploy Date	ARU Location	North	West	ELEV (m)
DOM-6	1/28/2020	Morne Micotrine	15.34783	-61.327	945
DOM-8	2/3/2020	Morne Anglaise	15.27794	-61.33871	754
DOM-7	2/4/2020	Morne Trois Piton	15.37666	-61.33743	724
DOM-5	2/6/2020	Morne Rachette	15.49232	-61.40787	859

FIGURE ONE. Map of radar survey locations for Black-capped Petrels on Dominica in 2020.

FIGURE TWO. Map of song meter deployment locations to survey for Black-capped Petrels on Dominica in 2020