Species Status Assessment Report for the Black-capped Petrel (*Pterodroma hasitata*)

Version 1.3

Black-capped Petrel (photo credit: Kate Sutherland)

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Summary of Version Changes:

Differences between Version 1.0 (April 2018) and Version 1.1 (June 2018) of the Black-capped Petrel (BCPE) SSA are minor and do not change the SSA analysis. The changes include the following:

1) Addition of Gulf of Mexico BCPE sightings map to the Appendix A.
2) Additional wording in Section 2.9.6 acknowledging recent inland wind farms established near BCPE nesting areas on Hispaniola.
3) Additional wording in Section 2.9.7 acknowledging potential exposure of Black-capped Petrel in Gulf of Mexico to chemical contaminants.

Differences between Version 1.1 (June 2018) and Version 1.2 (April 2019) of the Black-capped Petrel SSA are minor and do not change the SSA analysis. The changes include the following:

1) Addition and incorporation of new nesting data from the 2018 season, into descriptions of current threats and determinations of current and future conditions (Sections 2.6, 3.1.6, 3.2.1, 4.2).
2) Inclusion of new information regarding harvesting of tree ferns in petrel nesting areas (Section 2.9.1).
3) Inclusion of new information regarding effects of invasive mammalian predators (Section 2.9.4).
4) Description and justification for calculation of generation time used in the SSA (Section 3.2).
5) Addition of new information and discussion of effects of wind farms (Section 2.9.6).
6) Consideration of foraging petrels in southern Caribbean as being vulnerable to risks from oil and gas developments (Section 2.9.7).
7) Additional wording to acknowledge potential effects of climate change on nest burrow microclimates (Section 2.9.11).
8) Incorporation of new published information regarding accelerated loss of primary forests in Haiti, and discussion of how this may affect the Black-capped Petrel (Sections 3.1, 4.1.2, 4.2, Chapter 5).

Differences between Version 1.2 (April 2019) and Version 1.3 (June 2023) of the SSA:

1) Updated maps:
    a. Marine range to include northern Gulf of Mexico (Section 2.3.1).
    b. Known and suspected nesting areas (Sections 2.3.1, 4.1).
2) Additional information added:
    a. Recent taxonomic treatments and species nomenclature (Section 2.1).
    b. Population estimates and recent observations (Sections 2.4, 4.1.3).
    c. Nesting success (Sections 2.6, 4.1.6.2 – 4.1.6.6).
    d. Black-capped Petrel diet (Section 2.7).

   e. Threats to species viability: deforestation (Section 3.1.1), forest fires (Section 3.1.3), invasive mammal predation (Section 3.1.4), wind energy production (Section 3.1.6), offshore oil and gas (Section 3.1.9), marine fisheries (Section 3.1.11), and climate change (Section 3.1.12).
   f. New sections characterizing threats of terrestrial mining activities (Section 3.1.7) and development near nesting areas (Section 3.1.8) on species viability.
   g. Map depicting active federal oil and gas leases in the Gulf of Mexico within the species' range (Section 3.1.9).
   h. Maps for the species' nesting range in the Caribbean (Section 4.1) and for individual nesting sites (Sections 4.1.6.1 – 4.1.6.6).
   i. Nest counts and size of breeding areas (Section 4.1.6.1 – 4.1.6.6).
   j. Tables summarizing factors impacting species nesting areas (see current conditions summary) as well as current and future resiliency scores (Sections 4.2.1, 5.3).
   k. Maps showing predicted species habitat and forest loss within suitable habitat (Section 4.2.3).
   l. Additional citations added to literature cited.
   m. Addition of Appendix C – Fishing and lighting maps within the Black-capped Petrel range.
   n. Addition of Appendix D – Location, survey effort, habitat characteristics, and management status at confirmed, probable and suspected Black-capped Petrel nesting sites (Wheeler et al. 2021).

3) The current conditions have been synthesized and summarized.

Executive Summary

The Black-capped Petrel (*Pterodroma hasitata*; Kuhl 1820) is a pelagic seabird that is currently known to breed on one Caribbean Island and travels long distances to foraging areas in the western Atlantic and southern Caribbean basins, and the northern Gulf of Mexico. We used the best available information to assess the current and predicted future condition of the Black-capped Petrel relative to its continued viability as a species. In doing so, we considered all recognized threats to the species and how and why they may impinge upon species viability. We observed that the numerous distinct threats shared common underlying drivers, and of these, the two which encompassed virtually all threats were 1) regional climate change, and 2) human population growth – particularly on the island of Hispaniola (Haiti; Dominican Republic) where all currently known nesting by the petrel occurs.

For this assessment, we define viability as the ability of the Black-capped Petrel to sustain populations on breeding and foraging grounds beyond a biologically meaningful timeframe, in this case, 50 years. Fifty years is within the range of available climate change model forecasts and human population growth models, and it corresponds roughly to the length of time since the species was rediscovered in Haiti, thereby providing a temporally equivalent and empirically based frame of reference for predicting future conditions.

We also predicted factors affecting Black-capped Petrel status at two intermediate time frames, 10 and 25 years, with 50 years being the end of our predictive time horizon. To assess the influence of human population growth on petrel nesting habitat on Hispaniola, we considered three (3) different scenarios. The three scenarios correspond to baseline, plus 20%, and minus 20%, of current United Nations population growth projections for Haiti and the Dominican Republic. By "bracketing" our projections, we attempted to account for inherent uncertainties that can arise from long-term projections. Accounting for potential variation increased our confidence that the "true" population growth, and its subsequent effects on Black-capped Petrel nesting habitat, was captured within the range of our scenarios.

The results of the SSA reflect that the Black-capped Petrel has experienced a progressive reduction in two key demographic parameters over (at least) the past five centuries: 1) population size and, 2) number of breeding populations. Historical information also suggests that reductions were – and continue to be – primarily a result of human activities on Caribbean islands which historically hosted Black-capped Petrel breeding populations. The cumulative actions of human populations on Caribbean islands have progressively reduced the overall extent of known Black-capped Petrel breeding populations from that of at least eight (8) populations on four different islands, to four (4) current populations, all located on one island (i.e., Hispaniola). Geographic isolation has the associated effect of increasing the vulnerability of the species to catastrophic events, such as major hurricanes. Our estimates of little to no redundancy and representation are reflective of the species vulnerability to such events.

Once breeding populations of the Black-capped Petrel became geographically limited to southwestern Hispaniola, a suite of additional factors began to work synergistically to further reduce the overall population of the species. Among these, habitat loss and degradation are considered to have been, and continue to be, the most detrimental. Anthropogenic habitat loss and associated factors threaten the remaining breeding populations on Hispaniola and have contributed to the substantial decline in overall numbers of the Black-capped Petrel over the past 50 years. There has also been an apparent naturally associated decrease in petrel numbers within most individual breeding populations. Our estimate of low resiliency for the Black-capped Petrel reflects extensive nesting habitat loss and degradation and subsequent declines in petrel population size.

As the human population on Hispaniola increases, the attendant anthropogenic factors which currently influence species viability are certain to increase. In particular, the overwhelming dependence of the human population of Haiti on wood-based cooking fuels (e.g., charcoal and firewood) has resulted in substantial deforestation and forest conversion in both Haiti and adjacent regions of the Dominican Republic. Future increases in the human population of Haiti will likely result in increased deforestation rates throughout Black-capped Petrel nesting areas, both for production of charcoal and necessary agricultural products and building materials.

In the case of regional climate regimes, the best available information suggests a hotter and drier future climate within the specific area where Black-capped Petrels currently nest along with a steady increase in the number of intense (Category 3-5) hurricanes across the region over the next century. Although major hurricanes were not likely a threat to the Black-capped Petrel under their historic (i.e., pre-Columbian) population conditions, the combination of fewer and smaller breeding populations, ongoing nesting habitat loss and degradation, and more frequent and intense tropical storms will likely result in adverse effects to the petrel from these stochastic events. Based on past trends and evidence, these adverse effects will likely include increased mortalities of adults on the western Atlantic foraging grounds due to increased frequency of hurricane-induced inland strandings.

Finally, given the best available science at the time of this analysis, it is certain that the viability of the Black-capped Petrel is inextricably linked to the complex and challenging socioeconomic and environmental landscape of Haiti. Up to 60% of all known Black-capped Petrel nest sites occur in what is internationally recognized as the poorest, least developed, and most environmentally degraded country in the western hemisphere. While there are, and will continue to be, numerous successful initiatives by both local and international conservation and humanitarian organizations to provide needed financial and technical support for environmental conservation in Haiti, these efforts are nonetheless subject to the availability of donor funding in an ever-unpredictable global financial setting. The future of the Black-capped Petrel largely depends on the long-term effectiveness of ongoing and future conservation efforts in Haiti.

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Chapter 1. Introduction and Analytical Framework

The Species Status Assessment (SSA) is an in-depth review of the species' biology and threats, an evaluation of its biological status, and an assessment of the resources and conditions needed to maintain long-term viability. The intent is for the SSA to be easily updated as new information becomes available and to support all functions of the Endangered Species Program from Candidate Assessment to Listing to Consultations to Recovery. As such, the SSA will be a living document upon which other documents, such as listing rules, recovery plans, and 5-year reviews, would be based if the species warrants listing under the ESA. This SSA for the Black-capped Petrel provides the best available scientific and commercial information related to the biological status of the species.

For this assessment, we define viability as the ability of the Black-capped Petrel to sustain populations on breeding and foraging grounds beyond a biologically meaningful timeframe, in this case, 50 years. Fifty years is within the range of available climate change model forecasts (see Bender et al. 2010, entire) and it corresponds roughly to the length of time since the species was rediscovered in Haiti (Wingate 1964, pp. 158-159), thereby providing a temporally equivalent and empirically based frame of reference for predicting future conditions. Additionally, 50 years encompasses approximately 10 generations, which we believe is an appropriate time horizon to realize predicted effects of factors acting on species viability. This is because the estimated generation time (i.e., approximate age at first breeding) of the Black-capped Petrel is 5 years (Hamer et al. 2002, p. 247; Goetz et al. 2012, p. 5; Simons et al. 2013, p. S22). Also, we predicted factors affecting species viability at shorter time intervals (10 and 25 years), corresponding to approximately two and five Black-capped Petrel generations, so we could understand dynamics affecting the species from current condition to the end of the predictive time horizon. Using the SSA framework (Figure 1.1), current and future species viability was assessed by characterizing the status of the species using the conservation biology concepts of resiliency, redundancy, and representation (Wolf et al. 2015, entire).

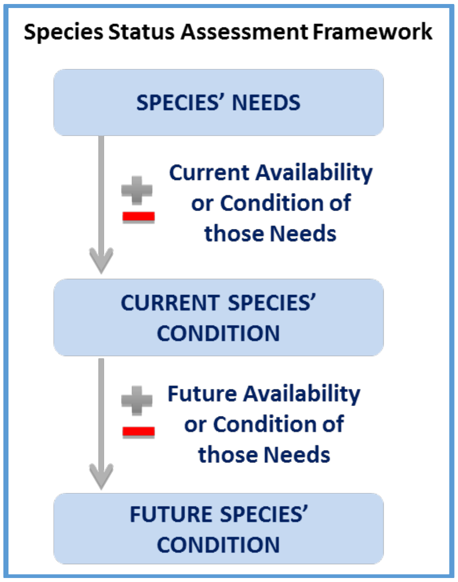


Figure 1.1 Species Status Assessment Framework.

· **Resiliency** reflects a species' ability to withstand stochastic events (arising from random factors). Resiliency is measured at the population-level using metrics that characterize population health such as demographic rates and population size. Resilient populations are better able to withstand perturbations associated with demographic stochasticity (e.g., fluctuations in birth or mortality rates), environmental stochasticity (e.g., variations in precipitation or temperatures), and anthropogenic activities.

· **Redundancy** is having a sufficient number of resilient populations, which are distributed in such a way, for the species to withstand catastrophic events (such as a rare destructive natural event or episode involving many populations). Redundancy is about spreading the risk and is measured by the number and distribution of populations across the species' range. The greater the number of populations a species has distributed over a larger landscape, the better it can withstand catastrophic events.

· **Representation** reflects a species' adaptive capacity and its ability to respond to long-term environmental changes. Representation can be measured through the genetic diversity within and among populations and the ecological diversity (also called environmental variation or diversity) of populations across the species' range. The more representation, or diversity, a species has, the more it can adapt to changes (natural or human caused) in its environment.

To evaluate the current and future biological status of the Black-capped Petrel, we assessed a range of conditions that reflect the species' resiliency, redundancy, and representation (together, the "3Rs"). This SSA provides a thorough assessment of Black-capped Petrel biology and natural history and assesses demographic risks, threats, and limiting factors in the context of determining the viability and risks of extinction for the species.

The format for this SSA includes: (1) an assessment of the species' life history and ecology (Chapter 2); (2) a review of the likely causal mechanisms underlying estimated and predicted current and future status (Chapter 3); (3) a review of the likely causal mechanisms underlying estimated and predicted current and future status (Chapter 4); (4) future conditions (Chapter 5); and (5) a summary of overall species' viability. This document is a compilation of the best available scientific and commercial information and a description of past, present, and likely future risk factors to the Black-capped Petrel.

Chapter 2. Species' Life History and Ecology

The Black-capped Petrel (*Pterodroma hasitata*; Kuhl 1820) is a pelagic seabird that is currently known to breed on one Caribbean Island and travels long distances to foraging areas in the western Atlantic and southern Caribbean basins, and the northern Gulf of Mexico. In this chapter, we provide a summary of the species' taxonomy, life history characteristics, and basic ecology. While not an exhaustive review of all extant literature, it provides a fundamental understanding of the species ecology to facilitate analyses of resiliency, representation, and redundancy.

2.1 Species taxonomy and nomenclature

Officially known as the "Black-capped Petrel" in current ornithological literature, it is also known by several distinct common names throughout its range. The name "*diablotin*" (i.e., "little devil") is most common among French and Spanish-speaking range states, which comes from the species' eerie vocalizations in the night sky (Wheeler 2020, p. 1). The petrel is also known as "*chathuant*" (in Haiti, meaning "hooting cat") and "*bruja*" (i.e., witch) or "*chanwan*" (Cuba). Many authors advocate a return to the more traditional and widely recognized (among range states) common name of "*diablotin*" (Lee and Mackin 2008, p. 2; Simons et al. 2013, p. S5; Devokaitis 2018, p. 1). Formerly in the genus *Procellaria*, the Black-capped Petrel was reclassified within the genus *Pterodroma* by Bonaparte in 1856, and common usage of the updated nomenclature occurred in 1918 with reconfirmation by Loomis (Simons et al. 2013, p. S5). The type locality for the Black-capped Petrel was never stated and is presumed to be Dominica (Simons et al. 2013, p. S5). The genus *Pterodroma* (order Procellariiformes; family Procellariidae) consists of about 30 widely distributed species, known as gadfly petrels (Simons et al. 2013, p.S4). The Black-capped Petrel (*P. hasitata*) is the only such species currently known to breed in the Caribbean region; records exist of an additional native gadfly petrel in the Caribbean (*P. caribbaea*), but that species is now considered extinct (Goetz et al. 2012, p. 3; Simons et al. 2013, p. S19). Although sympatric at sea with the Cahow (*P. cahow*), helicoidal twist counts of intestines indicate that the Black-capped Petrel is distinct from the Cahow (Simons et al. 2013, p. S6).

2.2 Morphological and genetic variability

The "light" and "dark" color forms of Black-capped Petrel have been recognized for centuries (Simons et al. 2013, pp. S4-S5). Relatively little work has been done examining the degree of genetic variability or differentiation within *P. hasitata*, and additional data on genetic structure of known nesting colonies, timing, and location of breeding, as well as at-sea distributional differences between forms are needed to better understand the taxonomic relationships of the two forms (Manly et al. 2013, entire; Simons et al. 2013, entire). However, a recent effort (n = 24) reported a 1.2% fixed genetic difference between light and dark color forms, and that individuals with an intermediate appearance genetically aligned with light forms (Manly et al. 2013, p. 230).

Field observations and examination of museum skins have revealed wide variations in both size and coloration of the Black-capped petrel (Simons et al. 2013, pp. S7-S10). Birds captured off the southeastern coast of the United States (n = 68) have ranged in weight from more than 500 grams (g) to slightly over 300g, with males averaging approximately 439 ±8.8 g, and females 419 ±12 g (Simons et al. 2013, pp. S8-S9). While weight differences were not related to sex, age, or molt stag, coloration differences were seen in smaller birds, which displayed fewer areas of white plumage (Simons et al. 2013, p. S10).

Multiple mechanisms contribute to the observed differentiation between forms (Howell and Zufelt 2019, pp. 110-112; Satgé et al. 2022, p.17). Research suggests potential seasonal or breeding isolation of each color form (Manly et al. 2013, p. 228). Moreover, satellite tracking data from ten Black-capped petrels (six dark forms and four light forms) suggest some degree of spatiotemporal partitioning of resources on breeding and foraging grounds as well as distinct distributions at sea (Satgé et al. 2022, pp. 17-22). While these findings could suggest potential existence of two distinct species or subspecies, this remains inconclusive (Howell and Patteson 2008, entire; Goetz et al. 2012, p. 3; Howell and Zufelt 2019, pp. 110-112; Satgé et al. 2022, p. 18). Thus, for purposes of this status assessment, both color forms are considered *P. hasitata.*

2.3 Geographic range and habitat affinities

2.3.1. Marine habitat

As a pelagic seabird, the Black-capped Petrel spends most of its life over open seas (Haney 1987, p. 153; Goetz et al. 2012, p. 4; Simons et al. 2013, p. S22). Use of marine habitats is largely confined to tropical and subtropical waters from 10º - 45ºN latitude and roughly 65º - 80º W in the Atlantic (Haney 1987, p. 153; Simons et al. 2013, p. S22; Jodice et al. 2015, pp. 27-28; Fig 2.1). The species has an extent of occurrence (EOO) of 9,060,000 square kilometers (km^2) (3,498,085.6 square miles [mi^2]), meaning that this area consists of the shortest continuous boundary encompassing all known, inferred, or projected sites of species occurrence, excluding vagrancy (BirdLife International 2022a, 2022b, unpaginated)). Comparatively, the Hawaiian Petrel and Bermuda Petrel have an EOO of 22,000,000 km^2 (8,494,247.5 mi^2) and 17,500,000 km^2 (6,756,787.8 mi^2), respectively (Birdlife International 2022c, 2022d, unpaginated).

Most offshore occurrences of the species have been near the Caribbean islands or areas bathed by the Gulf Stream, from southern Florida to the mid-Atlantic region of the United States (Haney 1987, p. 155). Petrels track the western edge of the Gulf Stream in this region, with abundances peaking during the spring (April-June) and fall (October-November) (Hass 2012, p. 227; Haney 1987, p. 157; Fig. 2.1). Off Florida, petrels have been found in shallower waters and nearer to shore than in the mid-Atlantic region. The offshore region from southern Florida to North Carolina is the only marine area where regular and sizable concentrations of the species occur (Fig 2.2), making this area important for their survival (Simons et al. 2013, p. S22-S23). Isolated accounts and sightings of the species in the Gulf of Mexico have usually been presumed to be of individual vagrants or strays driven by storms (Simons et al. 2013, p. S23); however, recent additional sightings of individual petrels in the central and northeastern Gulf of Mexico indicate greater use of this marine region by the species than previously believed (Jodice et al. 2021, entire).

Primary at-sea habitat of the Black-capped Petrel is generally, but not exclusively, deep waters (e.g., 200-2000 meters (m) [90-6562 feet (ft)] depths); depth is a relatively important predictor for spatial distribution of the species in winter (December-February) and spring (March-May) (Winship et al. 2018, pp. 58-61). Black-capped Petrels are most common near seamounts, submarine ridges, and other benthic landscapes that promoted vigorous current mixing and deep upwelling, which typically bring food items to the surface (Haney 1987, p. 158). Areas of the strongest and most persistent upwelling are where greatest numbers of petrels are found, especially in the deeper offshore zone near southern South Carolina and northern Georgia, and the Cape Hatteras, North Carolina region (Fig 2.3; Jodice et al. 2015, p. 61). More specifically, Black-capped Petrels are most abundant in the immediate frontal region at eddies, and relatively scarce in shallower continental shelf areas (Simons et al. 2013, p. S25). Internationally, recent satellite tracking of individual petrels and direct observations suggests that use of near-shore waters off the northern coast of Central and South America for foraging during the breeding season may have previously been overlooked or underestimated (Jodice et al. 2015, entire; Leopold et al. 2019, entire).

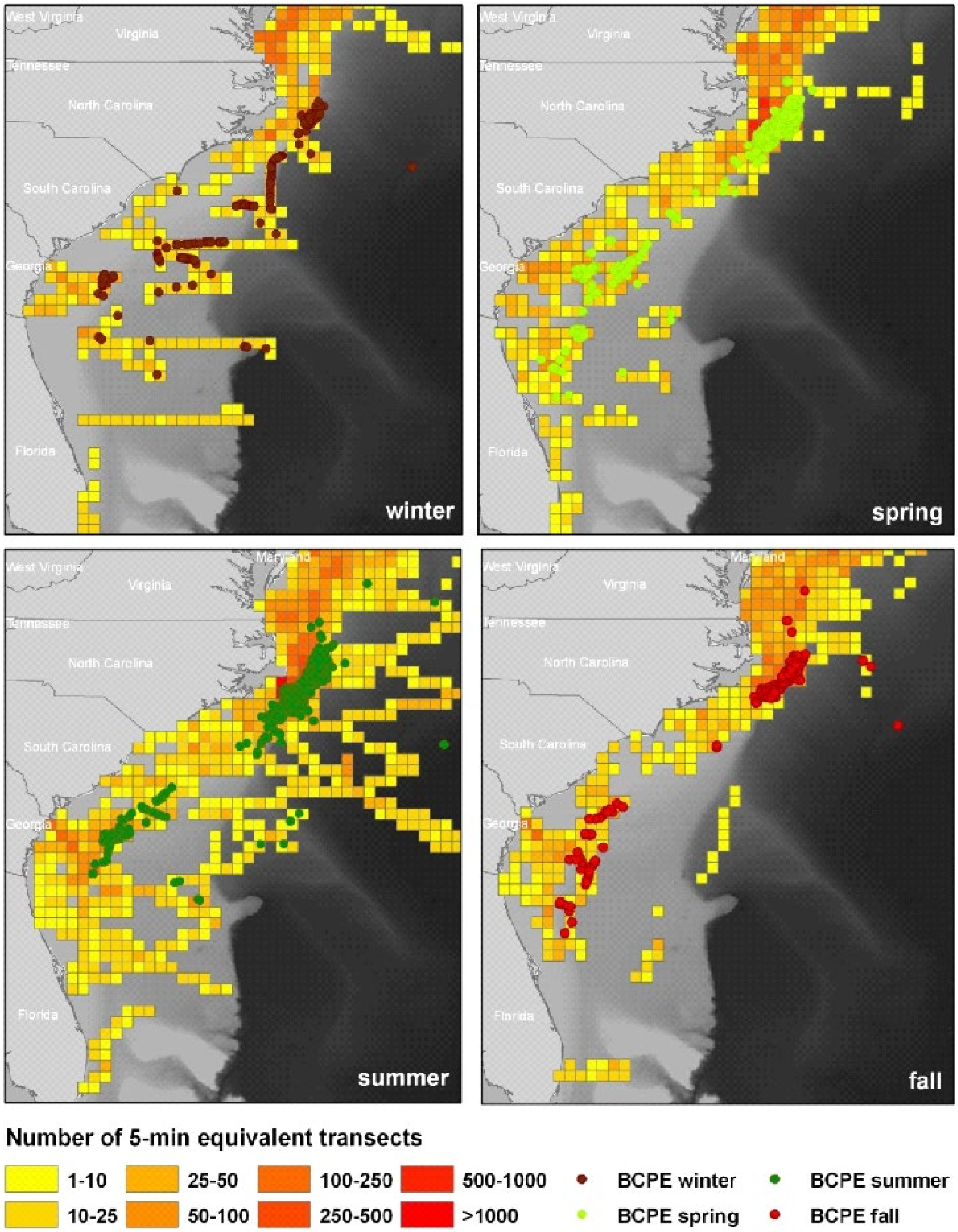


Figure 2.1. Seasonal distribution of Black-capped Petrels off the coast of the southeastern USA in relation to survey effort and coverage. Dots represent the detection of at least one Black-capped Petrel within the grid cell. Data compiled by O'Connell et al. (2009, entire) from numerous sources. Figure adapted from Simons et al. (2013, p. S27) and used with permission of lead author.

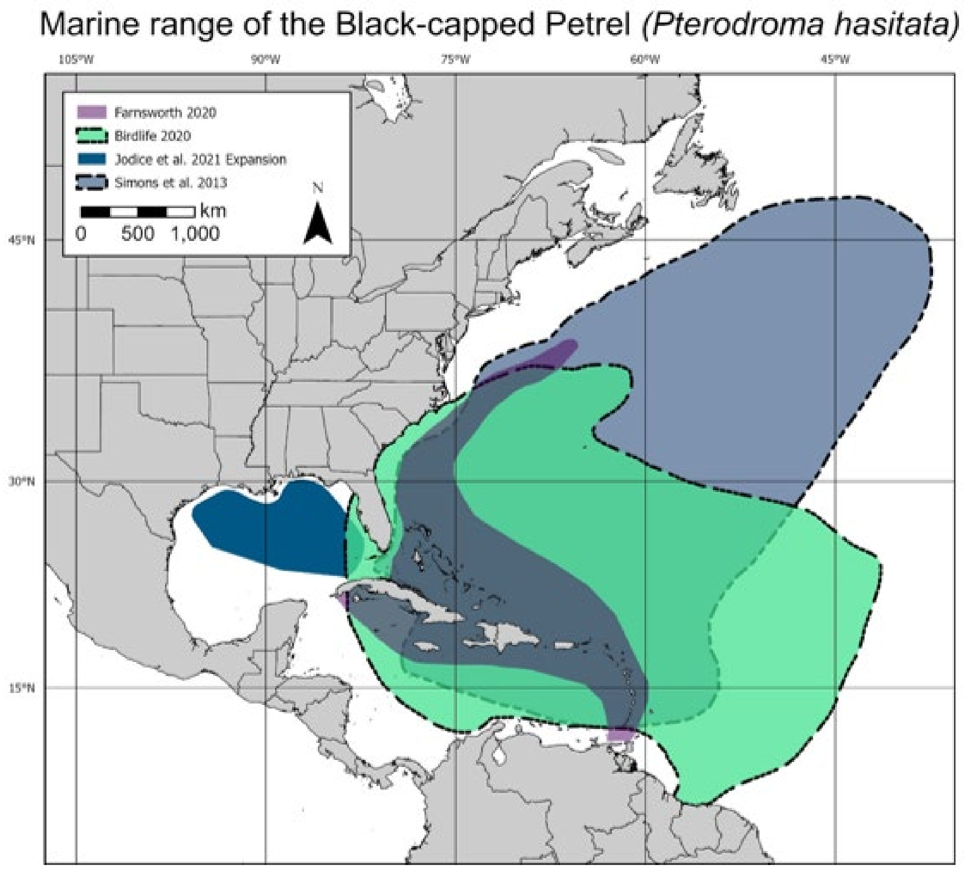


Figure 2.2. Marine range of the Black-capped Petrel (Service). Figure created using information presented in Wheeler et al. (2021, p. 6).

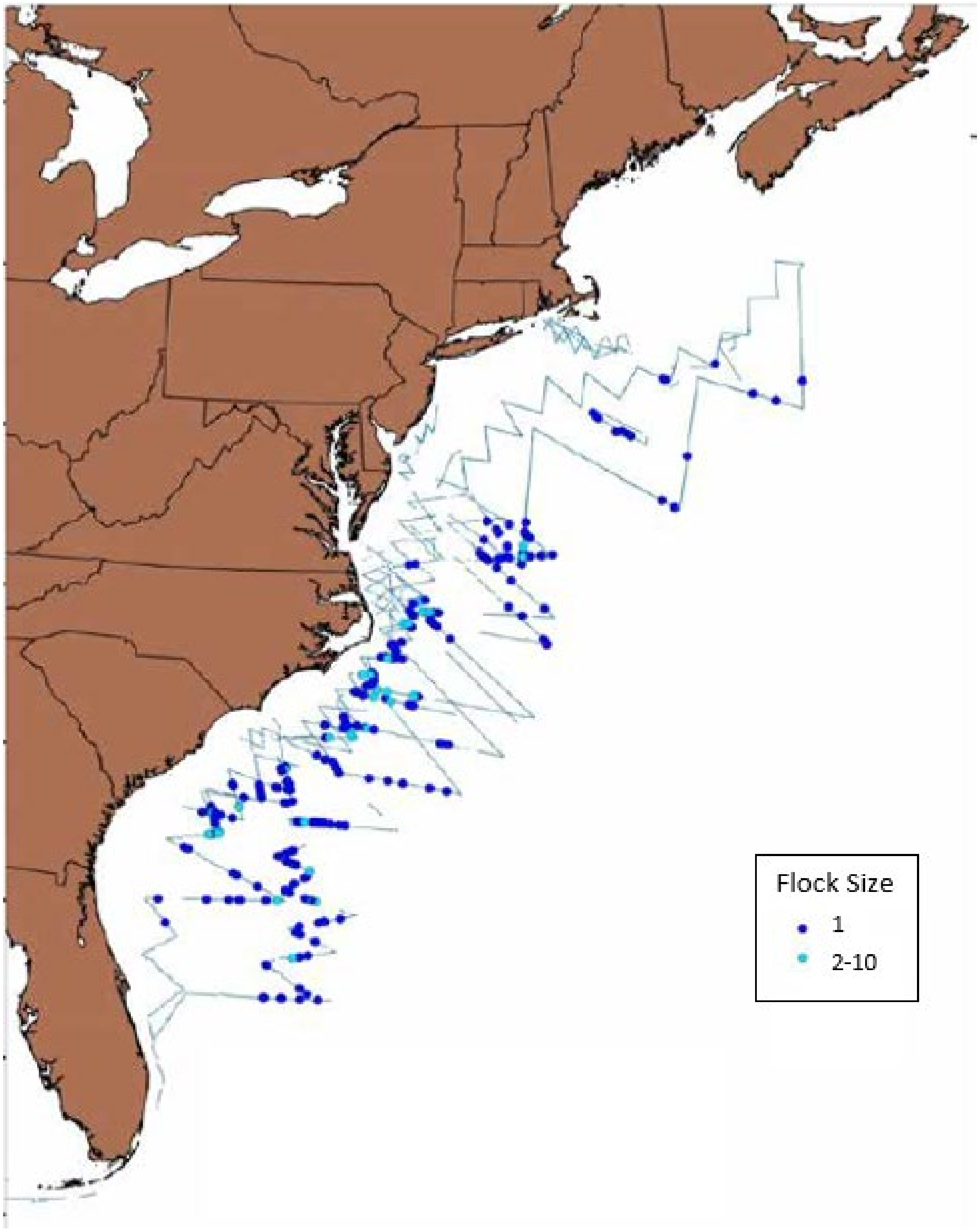


Figure 2.3. Distribution of Black-capped Petrel sightings 2010-2013 during the Atlantic Marine Assessment Program for Protected Species (AMAPPS) surveys (BOEM 2014, p. 8).

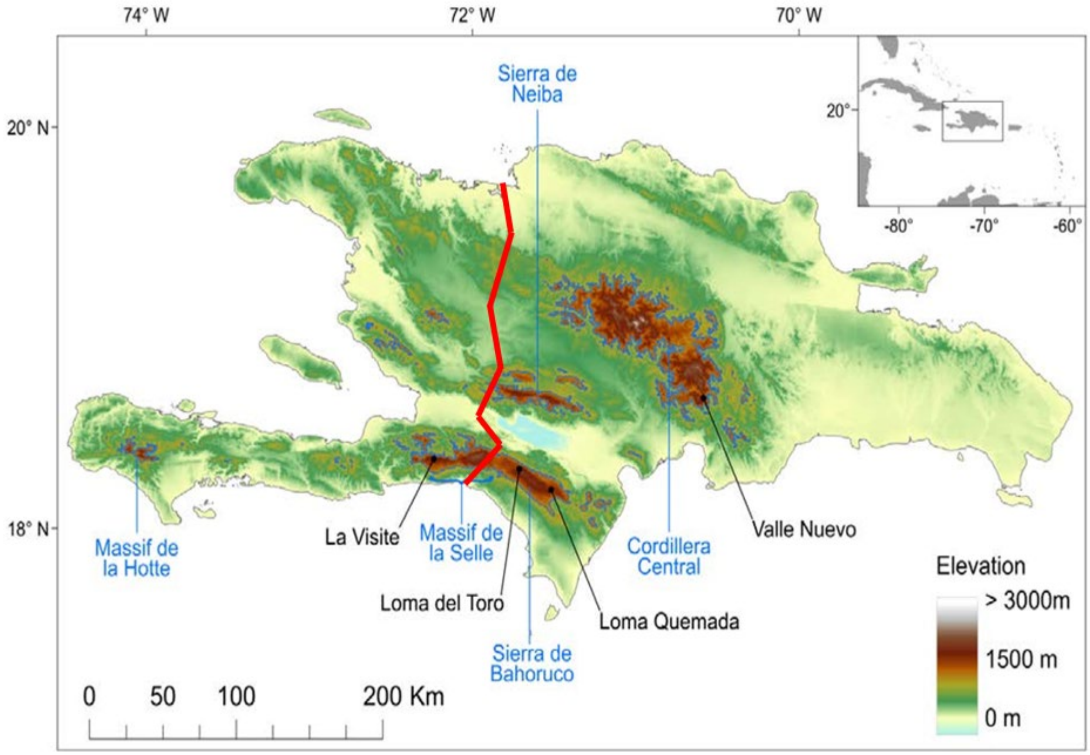


Figure 2.4. Locations of known and suspected nesting areas of the Black-capped Petrel on the island of Hispaniola. Known locations (i.e., active nests confirmed since 2000) are indicated by names in black font; mountain ranges harboring suspected or probable locations by blue font. Red line indicates the border between the Dominican Republic and Haiti. Figured adapted from Satgé et al. (2021, p. 576) and used with author permission.

2.3.2 Terrestrial habitat

Black-capped Petrels use terrestrial habitats only for nesting, though understanding of their breeding distribution is limited by the difficulties of locating nesting sites in remote and rugged mountains (Wheeler et al. 2021, p. 8). Historically, there are indications of past nesting areas having occurred in more accessible areas than those of contemporary nests, with numerous accounts of large numbers of petrels harvested for food at breeding colonies (Simons et al. 2013, p. S11). Thus, it is unclear whether current nesting areas constitute those preferred by the species or are simply those to which the species has been relegated because of additive effects from habitat loss, harvesting by humans, and invasive predators (Simons et al. 2013, p. S20; Satgé et al. 2021, pp. 15-16).

There are past anecdotal accounts and indirect indications of nesting areas in Cuba and the island of Dominica (Goetz et al. 2012, p. 13; Simons et al. 2013, p. S15; Brown 2015, entire). More recently, there were sightings of the Black-capped Petrel in La Bruja, Cuba (Plasencia-Leon et al. 2022, p. 5). Based on currently known sites, environmental variables most significantly associated with nesting activity include altitude, distance to coast, and a composite of percent tree cover and evapotranspiration index (Wheeler et al. 2021, p.8). The only confirmed active nesting areas at this time are just inland from the southern coast of the island of Hispaniola (Fig.

2.4), a landmass shared by the countries of Haiti (36%) and the Dominican Republic (64%). Confirmed nest sites have been found at elevations from 1700 to 2300 m above sea level (ASL) (Wheeler et al. 2021, Appendix 2). In most cases, nesting sites are found less than 30 kilometers (km) from the coast (see Goetz et al. 2012, pp. 4-5; Satgé et al. 2021, p. 585). Nesting areas are dominated by *Pinus occidentalis*, sparse understory vegetation, and loose soils or decaying vegetation conducive to burrow excavation (Wingate 1964, p, 151; Simons et al 2013, p. S20). A steep, mountainous terrain composed of dolomitic limestone, or other karst materials, also provides abundant holes, caves, and crevices (Wingate 1964, p. 151; Rupp et al. 2011, p. 94; Simons et al. 2013, p. S20). The known nesting areas on Hispaniola are described in detail in Chapter 4, Current Condition.

2.4 Population estimates

Population estimates and trends of the Black-capped Petrel are unknown because of the inherent difficulty of conducting accurate counts, particularly in breeding areas where all current counts have been conducted, and an uncertain relationship between numbers of calling birds, breeding chronology and breeding population size (Simons et al. 2013, p. S22). Additionally, temporal variations in calling behavior used to detect birds are based on the sex, age, and breeding status of individual birds (Simons 1985, p. 238). Discrimination of individual birds is made challenging by the high mobility of petrels, as well as their cryptic, nocturnal breeding and nesting behavior. Population models for the closely related Dark-rumped petrel (*P. phaeopygia sandwichensis*) projected that pre-breeding birds comprised approximately 50% of the total population for that species (Simons 1984, p. 1069). This suggests 50 percent of the Black-capped Petrel population could be breeding adults.

A historical range-wide population estimate at the time of the species rediscovery suggested a total population of perhaps 8,000 birds (2,000 breeding pairs; Wingate 1964, p. 154), assuming a 50 percent proportion of breeding adults in the total population. More recent published range-wide estimates encompass 2,000 to 4,000 birds, among which are 500-1,000 breeding pairs (Simons et al. 2013, p. S22; BirdLife International 2022b, unpaginated). Historic estimates should be considered conservative (i.e., as minimum estimates) because older survey techniques did not account for factors such as detection probability.

Within Hispaniola, estimates for breeding pairs is available for both the Dominican Republic and Haiti. The number of breeding pairs in the Dominican Republic are in the 10s to 100s (Simons et al. 2013, p. S22). Using radar surveys, 64-320 “petrel-like targets” (i.e., consistent with size and speed of petrels) were detected across eight sites, including three potential new nesting areas (Brown 2013, p. 7). Using digital acoustic monitoring, approximately 60 active nest sites were found in the southwestern nesting areas (McKown 2014, p. 7). This recent estimate is consistent with estimates of Simons et al. (2013, p.S6). In Haiti, estimated number of breeding pairs may range from approximately 500-1,500, and radar surveys detected 6-1,570 individuals across eight sites (Goetz et al. 2012, pp. 4-5). Nesting areas in Haiti contain up to 80% of currently known nest sites for this species (Simons et al. 2013, p. S23; Goetz et al. 2012, pp. 4-5). Overall, recent radar surveys detected a general downward trend across Hispaniola, where 51% less "petrel-like targets" were detected in 2020 compared to 2015 (Brown 2020b, p. 8).

Radar surveys in the country of Dominica detected a total of 968 "petrel-like targets" across 17 locations while also visually confirming at least eight individuals (Brown 2015, p.11). Recent radar detections have declined approximately 65% following the passage of hurricane Maria in 2017, with only 240 "petrel-like targets" detected island-wide in 2020 (Brown 2020b, p. 8). Because it is unknown whether the Black-capped Petrels detected on and near Dominica pertain to the same population as estimated by Simons et al. (2013, entire), it is therefore unknown whether these individuals represent an addition to prior abundance estimates (i.e., those of Goetz et al. 2012, Simons et al. 2013). Regardless, this information suggests a substantial decline in total numbers from 2015 to 2020, and there are no currently known nesting areas of the Black-capped Petrel in other countries in its range to increase redundancy (Goetz et al. 2012, pp. 12-14, Wheeler et al. 2021, p. 5).

2.5 Biology of nesting populations

Recent findings suggest "light form" individuals may arrive at nesting areas up to one month prior to "dark forms" (Satgé et al. 2022, p. 2). Prior to laying eggs, Black-capped Petrels may spend up to two months preparing nest burrows and crevices. It is believed nesting typically takes place January-July; with egg-laying occurring from mid-late January, chicks hatching mid-late March, and chicks leaving nests from mid-June to mid-July (Simons et al. 2013, pp. S19-S20). For example, among 35 nests with nestlings, 25 (71%) had fledged by July 11 (ABC 2014, p. 1). The actual "nesting season" may encompass up to nine months in its entirety (Simons et al. 2013, pp. S19-S20; Fig. 2.5).

Nest burrows are typically lined with material such as pine needles and small twigs brought into the burrow by the nesting pair (Simons et al. 2013, p. S20). Although females usually spend lengthy periods of time away from the nest site before egg-laying, likely to forage and acquire sufficient nutritional reserves for egg production, males frequently enter nests during this time in anticipation of the female's return. Once eggs are laid, both sexes exhibit parental care through incubation and feeding of nestlings. It is suspected that active nest burrows may remain in use by the same pair year after year, although burrows are sometimes abandoned after death of one member of the pair.

Fecundity is low, with only a single egg laid by the Black-capped Petrel; this is also the case with the sympatric Cahow (*P. cahow*) of Bermuda (Simons et al. 2013, pp. S19-S21). Assuming similar breeding and nesting biology to the Cahow, breeding begins at five to eight years of age, with established pairs persisting for 10-20 years (Simons et al. 2013, p. S22). The incubation period is 50-53 days, with chicks undergoing a lengthy nestling period of 80-85 days (Simons et al. 2013, pp. S19-S21). Following their initial exit from the nest burrow, fledglings spend an additional 4-15 days both inside the burrow and just outside the burrow entrance, engaging in nightly bouts of wing and flight musculature exercise, before finally taking flight and abandoning the nest site. Thereafter, nest sites remain vacant until approximately mid-October, when the next nesting cycle begins for the light forms.

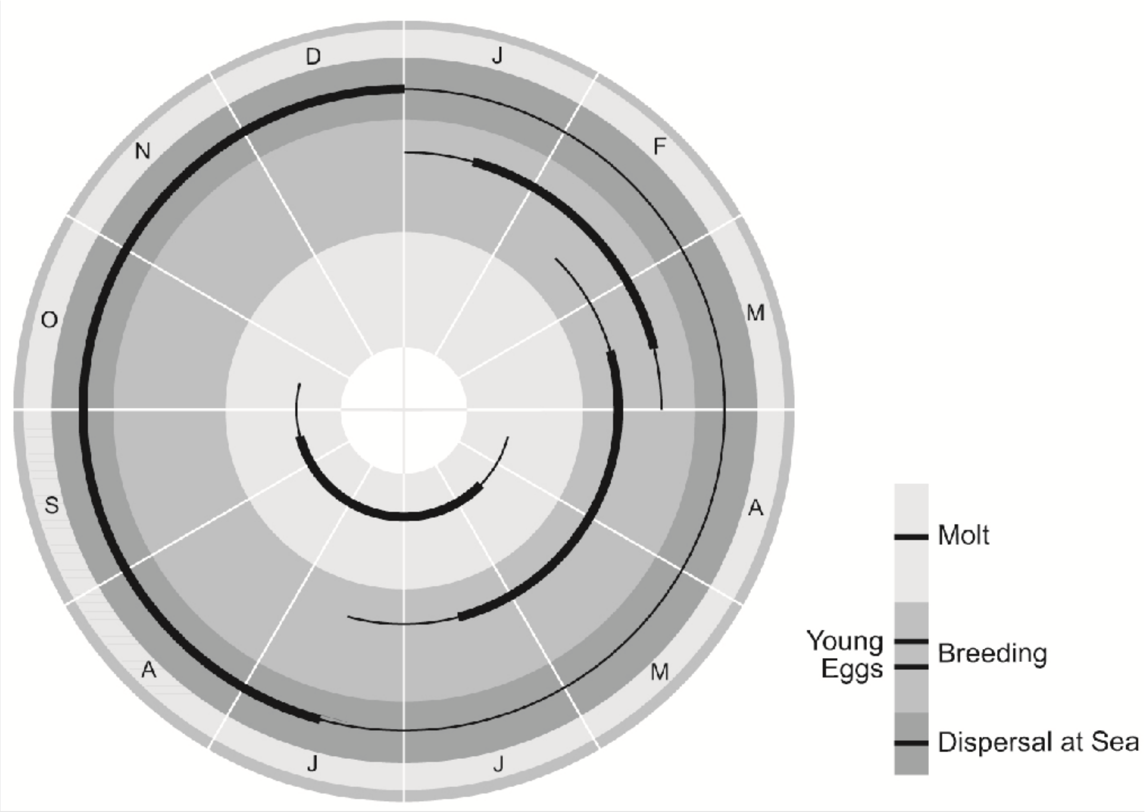


Figure 2.5. Annual activity cycle of the Black-capped Petrel. Figure adapted from Simons et al. (2013, p. S21) and used with permission of lead author.

2.6 Survival and longevity

For many long-lived seabirds, high adult survival rates and longevity tend to compensate for inherently low reproductive rates. However, this ecological attribute means that several years of poor reproduction can be masked by high adult survival, resulting in an apparently “stable” breeding population size (e.g., active nests) until senescence and loss of older age-classes results in a precipitous population decline. Black-capped Petrel adults may live 20-40 years (Goetz et al. 2012, p. 5). Long-term observations estimate an annual adult mortality of 5% for the Cahow (cited as personal communication from D. Wingate in Simons et al. 2013, p. S21).

Regarding the ecologically similar Dark-rumped Petrel (now called the Hawaiian Petrel), Simons (1984, p. 1074) stated: *“in species such as the Dark-rumped Petrel the initial rate of decline of the breeding population is considerably less than the rate of decline of the population overall”*, and furthermore: *“If the health of the petrel population were assessed solely on the basis of the number of active burrows in the colony, as it has for most of the past 15 years, there is a good* *chance that a steadily declining population would not be detected until the decline was well established".*

To increase our understanding of age-specific survival and individual longevity of the Black-capped Petrel, 30 Black-capped Petrel nests – half in Haiti and half in the Dominican Republic – were monitored (Rupp et al. 2012, entire). Reported overall nesting success was 76.7%, with 23 of 30 nests fledging chicks (Simons et al. 2013, p. S21). More recently, Grupo Jaragua and ABC reported outcomes of 456 cumulative nesting efforts comprising 128 individual nests monitored since 2010 and reported overall nesting success of 68% and 45% for nests in Haiti (n = 325) and Dominican Republic (n = 131), respectively (Brown and Jean 2020, pp. 3-6; 2021, pp. 4-5; IBPCG 2018; 2019; 2020; 2021, entire). Similar nest success has been reported for the closely related Cahow (Madeiros 2012, entire).

Because the petrel produces only one chick/nest, overall nesting success thus equals nestling survival rate. This approximates the maximum fecundity reported for other similar species and is likely sufficient to maintain an equilibrium population (based on Simons 1984, entire; Madeiros et al. 2012, entire). However, there are significant temporal (interannual) and spatial variations in nesting success and productivity (Simons et al. 2013, p. S21). For example, recent nesting seasons (2019, 2020) recorded substantially lower success of some nesting colonies in both Haiti and the Dominican Republic - including a total failure of one population in 2020 - with most losses due to predation (IBPCG 2020, p. 4; 2021, pp. 1-6).

2.7 Diet, feeding and foraging

Foraging by Black-capped Petrels occurs mainly (96%) in flocks, with 88% of observed feeding flocks comprised also of other avian species (Simons et al. 2013, p. S28). Such flocks may contain up to 65 Black-capped Petrels (Haney 1987, p. 159). Schools or congregations of baitfish or marine invertebrates have reportedly attracted petrels in feeding assemblages of up to 12 other seabird species, with individual feeding bouts typically ranging from 2-8 accompanying species (Simons et al. 2013, p. S28). These mixed species foraging flocks are most comprised of Cory's Shearwaters (*Calonectris diomedea*), Audubon's Shearwaters (*Puffinus iherminieri*), Greater Shearwaters (*P. gravis*), and Pomarine Jaegers (*Stercorarius pomarinus*) during summer, and Black-legged Kittiwakes (*Risa tridactyla*) and Herring Gulls (*Larus argeniatus*) during the winter (Simons et al. 2013, p. S28). Black-capped Petrels are not usually known to be attracted to feeding activities or assemblages of marine mammals; however, they have shown to be attracted to chum, and may be attracted to other waste discarded from ships and fishing vessels. This may mostly occur during times of low or unpredictable natural food abundance (Simons et al. 2013, p. S28).

The petrels possess apparent behavioral and physical adaptations that allow efficient exploitation of ocean niches with deep water and scarce prey. For example, their low wing loadings allow efficient gliding, making long distance foraging flights more energetically efficient (Simons et al.

2013, pp. S28-S29). Additionally, petrels have been observed arriving from upwind to investigate active feeding sites of other seabirds. Black-capped Petrels may be able to visually detect food items and feeding sites from distances of 0.7-6.2 km or more (Haney et al. 1992, p. 52). Their high, arching flight pattern likely facilitates visual detection of potential feeding sites (Simons et al. 2013, p. S28).

The petrel's exploitation of diel, vertically migrating, mesopelagic nekton suggests adaptation for nocturnal or crepuscular feeding (Imber 1985, p. 225; Simons et al. 2013, p. S30). Based on time of collection and degree of digestion of stomach contents, Black-capped Petrels feed mainly during nighttime or early morning hours, although there are also observations of diurnal feeding activity (Simons et al. 2013, p. S28). Diurnal activity peaks occur from 0700-0900 hours (h) and 1700-1900 h, with all observed diurnal feeding activity either prior to 0900 h or after 1500 h (Haney 1987, p. 153).

Squid and fish appear to make up the bulk of the petrels' diet. Off the coast of North Carolina, the contents of 57 Black-capped Petrel stomachs contained (in order of occurrence) squid (93.0%), fish (49.1%), unidentified items (17.5%), *Sargassum* fragments (14.0%), crustaceans (3.6%), and fragments of plastic in 1.8% of all stomachs (Moser and Lee 1992, p. 85). However, squid can be overestimated from stomach contents, due to the persistence and accumulation of beak fragments in crops (Simons et al. 2013, p. 30). Additionally, the presence of *Sargassum* and plastic fragments in crops is believed to be a result of incidental ingestion while feeding on items at the sea surface (Simons et al. 2013, p. S30). The file fish (*Monocanthus hispidus*) found in one stomach is a species closely associated with floating *Sargassum* mats. Assessment of diet via fecal DNA (n = 6) revealed a low proportion of occurrence of Cephalopoda in two samples (Satgé et al. *in litt.*); fish that perform diel migrations (i.e., Myctophids and Stomiiforms) accounted for 28.2% of all sequence reads, and unidentified Scombriformes (bony fish) and Anguilliformes accounted for 44.8% and 21.7% of all sequence reads, respectively (Satgé et al. *in litt.*). Further, there was found to be lower fish diversity in non-breeding petrels captured at sea (n = 2) compared to breeding birds at Loma del Toro (Satgé et al. *in litt.*). Off the coast of Georgia, three petrel stomachs contained fish (a single *Monocanthus hispidus*), squid, and *Sargassum* algal blades, in addition to small pieces of petroleum residue and paper in one stomach (Haney 1987, entire).

2.8 Parasites and diseases

Based on 20 samples taken from petrels off the coast of North Carolina were presence of several ectoparisitic lice (Phthiraptera) species (Simons et al. 2013, p. S29). These lice were classified in the families of Philopteridae (3 species) and Menoponidae (1 species), with the latter species (i.e., *Austromenepon popellus*) being widespread and common among the petrel genera *Pterodroma*, *Procellaria*, *Lugensa*, and *Pseudobulweria* (Simons et al. 2013, p. S29). Potential internal parasites or pathogens (fungal, bacterial, viral) which may also affect the Black-capped Petrel are currently unknown.

Chapter 3. Factors that Influence the Species' Viability

In this chapter, we provide an overview of the main stressors impacting the viability of the Black-capped Petrel, both in its terrestrial breeding habitat and marine range. Most stressors are the result of anthropogenic activities, and the species' apparently finite availability of suitable breeding areas present a major limiting factor in its ability to maintain viability. This overview is followed by a synopsis of conservation efforts aiming to address those stressors.

3.1 Stressors

3.1.1 Deforestation

Many Caribbean islands where petrels were historically reported have experienced extremely high rates of forest conversion and loss since European colonization (Goetz et al. 2012, entire; Simons et al. 2013, p. S31), although the petrel was likely extirpated from Martinique in pre-Columbian times (Simons et al. 2013, p. S11). Loss and degradation of nesting habitat because of deforestation continues to be one of the most significant threats to the Black-capped Petrel (Goetz et al. 2012, entire; Wheeler et al. 2021, pp. 12-16). Primary mechanisms of deforestation in the region include urbanization, clearing of land for pastures or agriculture, felling of trees for building materials, and charcoal production.

Recently, the harvesting of tree ferns (Fig. 3.1) to sell as substrate for ornamental plants has been increasingly occurring in petrel nesting areas of Haiti (Wheeler et al. 2021, p. 14). The harvesting of these ferns disrupts and destabilizes soil in the vicinity of the nest burrow. At least 14 active nests destroyed due to this activity during the 2020-21 nesting season (Brown and Jean 2021, p. 4). On Hispaniola, where all known currently active petrel nesting sites occur, estimates of current deforestation range from slightly less than 90% for the Dominican Republic portion to over 90% for the Haitian portion (Castro et al. 2005, p. 7; Simons et al. 2013, p. S31; Churches et al. 2014, entire). Deforestation in the Haitian nesting areas is particularly significant for the petrel (Figs. 3.2, 3.3), given that up to 70% of all active nest sites of the species may occur there (Goetz et al. 2012, p. 5; Wheeler et al. 2021, p. 10).

Although deforestation in petrel nesting areas of the Dominican Republic has been comparatively lower than in those of neighboring Haiti, recent increases in forest clearing for subsistence agriculture and charcoal production in the Sierra de Bahoruco and other areas adjacent to the Haitian border have resulted in naturally associated increases in nesting habitat loss and degradation there (Checo 2009, entire; Grupo Jaragua 2011, entire; Goetz et al. 2012, p. 7; Simons et al. 2013, p. S31; Lloyd and Leon 2019, entire; see Figs. 3.2, 3.3, 3.4). Recent quantitative assessments also indicate that the rate of deforestation in and around petrel nesting colonies and areas of suitable nesting habitat has accelerated in recent years, ranging from 3.8% to 56% from 2000-2018 in areas known or likely to contain petrel nests (Lloyd and Leon 2019, p. 5; Satgé et al. 2021, p. 583).

Figure 3.1. Tree Ferns harvested and cut into planting substrate in the La Visite National Park in Haiti (May 2018). Photo taken by Environmental Protection in the Caribbean (EPIC).

Figure 3.2. The border region between Haiti (left of red line) and the Dominican Republic (right of red line) adjacent to the Sierra de Bahoruco of the Dominican Republic. Note heavy deforestation on Haitian side and dispersed areas of deforestation on the Dominican Republic side.

Figure 3.3. Deforested landscapes below the Morne Vincent petrel nesting colony (upper image) and near the Pic La Visite nesting colong (lower image) in Haiti. Photos by J. Goetz.

Figure 3.4. Charcoal production on the island of Hispaniola. Left image depicts forested area cleared both for agriculture and to obtain wood for charcoal, with active charcoal pit-oven visible center-image. Right image depicts an actual charcoal pit-oven in use. Photos by T. White.

3.1.2 Human predation

The harvesting of petrels – both adults and nestlings – from nest burrows for human consumption has occurred for centuries (Simons et al. 2013, pp. S10-S19). In conjunction with habitat loss, historical accounts of large numbers of petrels taken for food on the islands of Jamaica, Guadeloupe, and Dominica likely contributed to the eventual extirpation of the species from those areas (Simons et al. 2013, pp. S11-S12). The petrel is thought to have been eliminated from the island of Martinique by harvesting for food by the pre-Columbian Carib Indian population (Simons et al. 2013, p. S11). Today, however, due both to the scarcity of the petrel and its use of remote and largely inaccessible areas to nest, human predation is considered incidental and opportunistic (Goetz et al. 2012, p. 8; Simons et al. 2013, p. S30; Wheeler et al. 2021, pp. 12-16).

3.1.3 Forest fires

As the Black-capped Petrel only comes on land for breeding, forest fires directly affect the species during the nesting season (Fig. 3.5). The frequency and intensity of fires in and around petrel nesting areas has increased in recent years, further exacerbating, and contributing to deforestation and habitat degradation in the region (Batlle and Ramon 2021, p. 36; IBPCG 2021, p. 1). Effects may be significant and long-term, as fires set to clear land for agriculture can result in substantial loss and conversion of forested nesting habitat. Although natural fires resulting from lightning strikes also occur (Robbins et al. 2008, p. 8), these tend to occur mainly during the wetter summer months. Naturally occurring fires have been attributed to helping maintain open, park-like pine savannas at higher elevations which may be more accessible to petrels (Simons et al. 2013, p. S31). In contrast, most anthropogenic fires constitute a direct threat as they occur during the winter dry season, when petrels are actively nesting (Simons et al. 2013, p. S31; Fig. 3.6).

Fires can also have indirect effects on petrel nesting habitat by increasing erosion and mudslides following elimination of previously existing vegetation and ground cover. Increased erosion of cliffs used for nesting by petrels in the Massif de la Selle in Haiti may have been caused by fires deliberately set to facilitate clearing of land and for fuel wood harvesting (Woods et al. 1992, pp. 196-205; Simons et al. 2013, p. S33). For years, such fires have removed large areas of forest cover in the former petrel nesting areas of Pic Macaya in the Massif de la Hotte of Haiti (Sergile et al. 1992, pp. 5-12). In the petrel nesting areas of the Dominican Republic, fires have been deliberately set in retaliation for actions taken by government officials to evict or otherwise deter Haitian migrants engaged in illegal land-clearing activities (Rupp and Garrido 2013, p. 5).

The incidence of anthropogenic fires has been positively associated with increases in human populations (Wingate 1964, p. 154; Simons et al. 2013, p. S31). Dry season fires also tend to be more intense, delaying or inhibiting forest recovery due to destruction of seed banks and organic humus layers (Myers et al. 2004, p. 11; Rupp and Garrido 2013, p. 5). This creates ideal conditions for establishment of invasive plants such as the terrestrial fern (*Dicranopterus pectinata*), which quickly colonize burned or deforested areas (Slocum et al. 2006, p. 526; Davis 2019, p. 58), and can completely block petrel access to nesting substrate (Wheeler et al. 2021, p. 14; Fig. 3.7).

Figure 3.5. Burned area at the Morne Vincent petrel nesting colony in Haiti. Photo by J. Goetz.

Figure 3.6. Black-capped petrels killed by fires near nesting areas on Hispaniola. Photo by J. Goetz.

Figure 3.7. Example of dense growth of the invasive terrestrial fern (*Dicranopterus pectinate*) covering an open hillside in the El Yunque National Forest of Puerto Rico. Hillside was denuded by hurricane Maria in 2017, and subsequently colonized by ferns. Photo taken by A. Jhonson-Camacho, May 2022.

3.1.4 Introduced mammals

Like most native Antillean species, the Black-capped Petrel evolved in the absence of mammalian ground predators. Following European colonization, many Caribbean islands quickly (in an evolutionary context) became host to populations of domestic dogs (*Canis familiaris*), feral pigs (*Sus scrofa*) and domestic cats (*Felis domesticus*). Introduced black rats (*Rattus rattus*) and Norway rats (*Rattus norvegicus*) are known avian nest predators and have been observed at entrances to petrel nest burrows (Goetz et al. 2012, p. 7; Satgé 2021, p. 2). While most of these introduced species occur at low to moderate densities near known Black-capped Petrel nest locations, low numbers of these avian nest predators could have a disproportionate and significant impact on the few active nests that currently exist, particularly those in more accessible sites (Simons et al. 2013, pp. S31-32).

The deliberate introduction of the small Indian mongoose (*Herpestes javanicus*) began in Jamaica in 1872; except for Dominica, this introduction has resulted in uncontrollable populations on all islands where the petrel is known or suspected to nest, or have once nested (Barun et al. 2011, pp. 19-20; Simons et al. 2013, p. S31). Following initial introduction to Jamaica, the mongoose was promptly introduced to Cuba (1882), Hispaniola (1895), Martinique (1889), and Guadeloupe (1880-1885 (Simons et al. 2013, p. S31). Although introduced also in Dominica during the 1880s, that introduction was apparently unsuccessful (Henderson 1992, p. 4). Abandonment of an active petrel nest due to repeated incursions by a mongoose was recently documented in the Dominican Republic (IBPCG 2019, p. 4). Mongoose predation was observed between early March and late May, resulting in the killing of at least seven petrel chicks in Valle Nuevo during the 2020-2021 breeding season (Grupo Jaragua 2021, pp. 3-4; Fig. 3.8). There have been no known successful nests in Valle Nuevo over the past two seasons (2020 and 2021), largely due to mongoose predation (IBPCG 2021, p 1; IBCPCG 2022, p. 6).

Dogs are commonly kept by security personnel and allowed to roam free at night at communication towers near petrel nest sites in the Dominican Republic (Rupp et al. 2011, entire); they may excavate petrel nest burrows, or prey on fledgling or adult petrels at or near nest entrances (Woods 1987, pp. 196-205; Goetz et al. 2012, p. 7). Historically, local inhabitants in Guadeloupe use trained dogs to assist in harvesting petrels for food (Simons et al. 2013, p. S12). On a Bahamian island, a pack of three free-ranging dogs reduced a breeding colony of White-tailed Tropicbirds by 80% in four years (Simons et al. 2013, p. S32). Recent evidence from camera trapping in the La Visite colony showed that, out of 35 known active nests (active meaning an egg or chick was observed in the nest), 18 were depredated by a single dog in 2021 (Brown and Jean 2021, pp. 4-5; Fig. 3.8). A minimum of nine dogs also killed at least 11 adult Black-capped Petrels during the 2020-21 breeding season (Brown and Jean 2021, p. 5; Satgé 2021, p. 2; Grupo Jaragua 2021, p. 2).

These introduced mammals have negatively affected other native Caribbean species (Henderson 1992, pp. 2-3; White et al. 2014, pp. 35-38). This includes those closely related to the Black-capped Petrel. Rats, mongoose, and dogs likely played a major role in the extirpation of the Jamaican Petrel (*P. caribbaea*) (Lewis et al. 2010, p. 2; Goetz et al. 2012, pp. 13-14; Simons et al. 2013, pp. S16-S17). Feral cats, which have been documented at elevations up to 2100 m in the Sierra de Bahoruco of the Dominican Republic near petrel nesting sites, are known to be significant predators of Dark-rumped petrels (*P. sandwichensis*) in the Hawaiian Islands (Simons et al. 2013, p. S31; Simons and Bailey 2020, unpaginated), of Great-winged petrels (*P. macroptera*) on Kerguelen Island (Simons et al. 2013, p. S31), as well as of Barau's petrels (*P. baraui*) on Reunion Island (Faulquier et al. 2009, entire). The recent loss of at least nine active petrel nests in the Dominican Republic was attributed to a single feral cat (IBPCG 2019, p. 4). Feral cats within Black-capped Petrel nesting areas should be considered a serious threat.

Figure 3.8. (Top) A dog carrying off an adult petrel killed at its burrow in the La Visite nesting colony in Haiti (Photo by EPIC). (Bottom) A mongoose taking a petrel chick from a nest in Valle Nuevo in the Dominican Republic during the 2020-21 nesting season (Photo by Grupo Jaragua). Photos adapted from IBPCG 2021 (pp. 1-4) and used with permission.

Uncontrolled nest predation by invasive mammals could cause species extinction in as little as 20-30 years given a breeding population of 450 pairs, based on population modeling of the endangered Dark-rumped Petrel (*P. phaeopygia sandwichensis*), a species with similar nesting ecology as the Black-capped Petrel (Simons 1984, entire). The recent breeding population estimate for the Black-capped petrel was 500-1000 pairs (Simons et al. 2013, p. S23). However, no such estimates have been made following the recent 51% decrease in petrel radar detections near nesting colonies on Hispaniola and naturally associated 65% decrease in detections near Dominica (Brown 2020, p. 4). If the observed declines in radar detections accurately reflect a corresponding decline in total petrel numbers near breeding areas, then the current number of breeding pairs may be as low as 250-500. Moreover, losses of breeding adults can have up to a five-times larger effect on population growth than that of reduced nesting success (Simons 1984, pp. 1072-1073). As with most *k*-selected seabird species, adult breeder mortality is additive rather than compensatory, especially for those with small populations (Faulquier et al. 2009, pp. 334-335). Even under optimal conditions, they are unable to respond quickly by increasing fecundity (Simons 1984, p. 1704). Events such as the loss of at least 11 breeding adults to feral dogs during the 2020-21 nesting season (Brown and Jean 2021, p. 5), combined with numerous other losses of eggs and nestlings to predation annually since at least 2018, likely constitutes an unsustainable level of nest predation for this species (Simons 1984, pp. 1070-1071).

3.1.5 Communication towers and artificial lighting

Anthropogenic lighting-induced mortality of Black-capped Petrels is likely an underestimated, yet important, cause of mortality both for breeding adults and juvenile fledglings. Petrels – particularly inexperienced fledglings and juveniles – are especially sensitive to artificial lights, likely due to a dependence on visual cues such as moonlight and starlight for nocturnal navigation (see Imber 1975, p. 304; Le Corre et al. 2002, p. 390; Rodriguez and Rodriguez 2009, p. 303; Rodriguez et al. 2017a, p. 989; Rodriguez et al. 2017b, p. 68). Petrels that nest in burrows or cavities are affected by artificial lighting greater than ground-nesting species due to their inherent nature to associate light with food (Imber 1975, p. 305). While other large structures that have artificial light, including wind turbines, constitute as a threat to the species, recent years have seen the proliferation of telecommunication towers throughout the Caribbean islands. These structures affect the Black-capped Petrel though collisions and disorientation by lighting for the towers. These towers are typically located on high mountain ridges, hills, and other prominent topographic features and the structures extend several meters above canopy level. Communication towers are equipped with bright lights to provide security which may disrupt aerial courtship activities of petrels (Goetz et al. 2012, p. 8), as well as fatally attract and disorient flying petrels (Le Corre et al. 2002, p. 390; Longcore et al. 2008, p. 489). Eight cases of light-induced groundings of Black-capped Petrels have been reported, with light-induced mortality primarily impacting fledglings (Rodriguez et al. 2017a, p. 989).

In addition to artificial lighting from communication towers, there are other, additional types of anthropogenic lighting that may result in mortality for individual petrels. At many tower sites security personnel maintain fires during the night, both for light and warmth, and these fires may further disorient breeding petrels, like the historic use of “sen-sel” fires (i.e., large nighttime bonfires) to attract and harvest petrels by inhabitants of Haiti in years past (Wingate 1964, p. 154; Goetz et al. 2012, p. 8; Simons et al. 2013, p. S30). Petrels will often fly directly into such fires with fatal results.

Other threats posted by communication towers include guy wires, which secure many of the tallest towers (Fig. 3.9; Longcore et al. 2008, p. 487; Simons et al. 2013, p. S32). Because of the nocturnal habits of the Black-capped Petrel, combined with the high speed at which they fly, they are highly vulnerable to aerial collisions with these unseen structures, especially on foggy nights typical of the petrel nesting season (Goetz et al. 2012, p. 8; Longcore et al. 2013, p. 411; Simons et al. 2013, p. S32; Wheeler et al. 2021, p. 15). There have been numerous documented cases of Black-capped Petrels being killed or injured by aerial collisions with these structures in or near their breeding areas (see Fig. 3.10; Goetz et al. 2012, p. 8; Simons et al. 2013, p. S32; Wheeler et al. 2021, p. 15). Such losses are particularly significant in terms of petrel population dynamics as they likely represent loss of breeding adults (Simons 1984, p. 1073; Saether and Bakke 2000, p. 648; Simons et al. 2013, p. S19).

Figure 3.9. Communication towers near Black-capped Petrel nesting areas on Hispaniola. Height of structures and associated guy wires depicted in left image; nighttime security lights depicted in right image. A disoriented and grounded Black-capped Petrel also being recovered from the ground in right image. Photos by J. Goetz.

Figure 3.10. Black-capped Petrels injured from nocturnal aerial collisions with communication towers near nesting areas on Hispaniola. Photos by J. Goetz.

3.1.6 Offshore, coastal, and upland wind energy projects

Wind is becoming more popular as a renewable energy resource across the globe. Collisions with wind turbines are a concern for many species of seabirds and displacements from offshore wind farm areas have been documented (Garthe et al. 2017, p. 347). Wind turbines are installed in areas of high wind offshore and nearshore coastal areas, and as with communication towers, land-based wind farms tend to be located on higher ground, where winds are higher and more constant. A single wind turbine could also greatly impact the species depending on its location; this is because reports of stranded Black-capped Petrels on land after large storms indicate individuals are blown away from pelagic waters and towards land, depending on wind direction. This misdirection could leave them susceptible to entering offshore and coastal areas where wind turbines are operating and other wind energy activity is occurring. Wind turbines are typically turned off during storms when wind speeds exceed 55mph (88.5 kilometers per hour [kph]) to reduce the stress on the turbine components (DOE 2022, unpaginated), however, static turbine blades still pose a risk for collision.

For offshore wind energy sites, wind farms can change the local hydrodynamics and species distribution. For example, turbidity is affected and influences predator and prey interactions, where predators may be attracted and prey may avoid the area affected (Van Berkel et al. 2020, pp. 113-114). In the U.S., as of 2022, the only offshore areas that have operating wind farms are off the coast of New Jersey and Virginia; these existing offshore wind energy areas are outside of the Black-capped Petrel's range, but some of the proposed areas off the Atlantic coast of the U.S. are within the species' core areas and home ranges (Satgé et al. 2022, p. 14).

Off the coast of South America, there are plans to develop wind farms off the coast of Colombia that may affect the Black-capped Petrel. The increasing use of wind farms on and near Caribbean islands constitutes a potential threat to flying petrels (Simons et al. 2013, p. S32). Recent construction of inland wind farms near petrel nesting areas on Hispaniola (Fig. 3.11) constitute an additional and unquantified threat, given there is no data on the flying height of Black-capped Petrels when approaching nesting areas or known incidents of this species colliding with wind turbines.

An example of wind energy impacts to a similar species is described for the Hawaiian Petrel. There are seven wind farms on three different islands in Hawaii; it has been anticipated that up to 209 Hawaiian Petrels will be incidentally taken between six of the seven permitted wind farms over the life of their permit term (USFWS 2022, unpaginated). So far, there have been 11 Hawaiian Petrels that have been incidentally taken (mortality) at four of the permitted wind farms. Mortalities of nesting petrels caused by wind farms (or any other factors) would be effectively doubled via a "multiplier effect", as the single chicks are completely dependent on biparental care (Simons 2013, pp. S21-S22), and would likely die within the nest burrow from subsequent starvation.

Figure 3.11. Inland wind farm in the southwestern Dominican Republic and located between the coastline and a Black-capped petrel nesting area of Loma Quemada, Sierra de Bahoruco. Note presence of wind turbines also on a ridge in the background. Photo by A. Jhonson-Camacho, January 2018.

3.1.7 Terrestrial mining activities

The island of Hispaniola is rich in mineral resources, and terrestrial mining activities have occurred on Hispaniola since early Spanish colonial times (Nelson et al. 2011, entire; Redwood 2015, entire). In the Sierra del Bahoruco of the Dominican Republic, active mining for bauxite occurred from 1959-1985, and former bauxite pits and strip-mined sites are currently present within 5 km (3 mi) of known Black-capped Petrel nesting areas (Fig. 3.12). Although large-scale mining activities in the area mostly ceased in 1985, active bauxite mining still occurs at the "Las Mercedes" mine in the southern part of the Sierra del Bahoruco (Redwood 2015, p. 14).

There was a recent discovery of "economically significant" amounts of "Rare Earth Elements" (REE) in the Sierra del Bahoruco in association with former bauxite mines and adjacent areas (Proenza et al. 2017, p. 1321; Proenza et al. 2021, p. 21). REE are in high demand globally, as they are essential for production of numerous modern technologies including cell phones, solar cells, and electric vehicles (Dutta et al. 2016, p. 183; Proenza et al. 2017, p. 1321). Global demand of REE is increasing at the rate of 5%/year, requiring a steady and dependable supply of these minerals in the future (Dutta et al. 2016, p. 184). Following this discovery of REE, the Government of the Dominican Republic established under Decree #430-18 an area of 14,876 hectares (ha) (36,744 acres (ac)) as the "Reserva Fiscal Ávila", designated for the exploration, evaluation, and development of REE reserves in the Sierra del Bahoruco (Proenza et al. 2021, p. 22). The rapidly increasing global demand for REE, and the substantial economic importance of the mining sector to the Dominican Republic foretells a likely resurgence and expansion of large-scale mineral exploration and extraction in the region (Dutta et al. 2016, p. 185; Redwood 2015, p. 12). The presence of large-scale industrial mining, and associated habitat alterations, infrastructures, and artificial lighting in areas near active petrel nesting sites may adversely affect adjacent or nearby nesting petrels through direct or indirect mortality (Fig. 3.12).

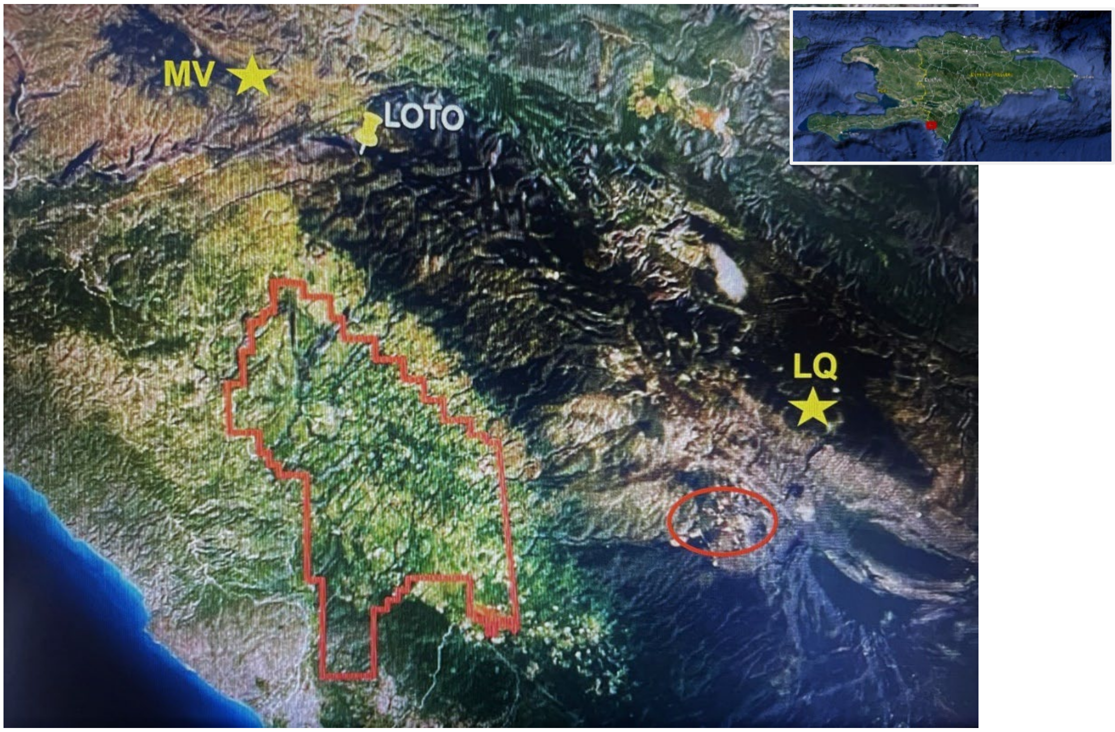


Figure 3.12. Area set aside for future REE mineral exploration and mining (red polygon) and nearby area of additional REE sources at the former Aceitillar bauxite mine (red oval) in relation to the locations of petrel nesting sites at Morne Vincent (MV), Loma del Toro (LOTO) and Loma Quemada (LQ). Distances from REE mining concession to Loma del Toro is about 7 km, and from Aceitillar to Loma Quemada about 5 km. Location data provided by Grupo Jaragua.

3.1.8 Development

Although the region harboring Black-capped Petrel nesting colonies is currently among the most remote and sparsely populated areas of Hispaniola, the government of the Dominican Republic has initiated long-term plans to promote major tourism development in the region (Ministerio de Turismo 2012, entire; DGAPP 2021, entire). These plans are focused immediately south of the petrel nesting areas in the Sierra del Bahoruco, on coastal area of Pedernales/Cabo Rojo, and include several major resort hotels, apartment complexes, golf courses, a major international airport, and large marina (DGAPP 2021, entire). The airport is expected to become the second largest in the Dominican Republic in terms of passenger traffic, with an estimated 1.6 million passengers/year at project completion (DGAPP 2021, pp. 89-107).

Concomitant with this development will be an increase in human presence and electric power needs. Wind turbines, as well as a new 138 kilovolt electrical transmission grid parallel to the coast, will be installed to supply power to the region (DGAPP 2021, pp. 57-64). Thousands of collisions have occurred at 3% of the total length of powerlines (Travers et al. 2021, p.13). The significant increase in local human population, and associated increases in artificial lighting, will be located between petrel nesting areas in the Sierra del Bahoruco and Caribbean Sea, which also align with petrel flight paths to and from such areas. This could result in direct or indirect mortality to petrels.

3.1.9 Offshore oil and gas

Within the Black-capped Petrel's range, there are offshore oil and gas activities occurring off the coasts of South America, Mexico, in the Caribbean, and southeastern United States. In the U.S., this industry is active in the northern Gulf of Mexico in the outer continental shelf (OCS). The OCS is a legal area that extends beyond the Exclusive Economic Zone (EEZ) (typically from 3 mi) out to 200 nautical miles (230.2 mi) from the U.S. coast, in which the U.S. has sovereign rights for resource exploitation and exploration; however, less than five percent of prime marine habitat for Black-capped Petrel overlaps with oil and gas platforms in the Gulf of Mexico (Michael et al. 2022, p. 10).

Black-capped Petrels have been frequently sighted in the central and northeastern Gulf of Mexico where oil and gas activities are ongoing (Jodice et al. 2021, p. 60; see Fig. 3.13), although it is not known whether they are using this area for foraging, nor the age class of individuals sighted. Seabirds that are using the northern Gulf of Mexico, as well as the southern Caribbean waters near Colombia and Venezuela, are at a greater risk of being affected by offshore oil and gas compared to the eastern coast of the U.S. Black-capped Petrels observed foraging in the southern Caribbean Sea occurred in Colombian lease areas under evaluation or exploration, or open for concession; minimum distances to an active lease area and a well in production were 7 km and 24 km, respectively (Satgé et al. 2019, pp. 40-41). In addition, petrels occurred 34 km from an active lease area, and 50 km from a well in production, near Venezuela (Satgé et al. 2019, p. 12). All petrel life stages may be affected by petroleum exposure or food contamination, resulting in lethal and sublethal effects (BOEM 2022c, p. 272; Satgé et al. 2022, p. 21); Black-capped Petrels utilizing these areas for foraging or resting could be exposed to hydrocarbon releases during accidental oil spills as well as to increased concentrations of contaminants from uncontrolled seepage. This could result in direct mortality (i.e., external oiling), indirect mortality (ingestion of crude oil through prey or preening), or sub-lethal effects on reproduction, such as hormone suppression, impaired egg formation, or increases in malformations (Helm et al. 2015, pp. 431-453). There are currently no active oil and gas leases in the Atlantic area (Presidential Memorandum 2020, unpaginated; BOEM 2022a, unpaginated). While offshore oil and gas activity in the northwest Atlantic could occur in the future, there is currently more petroleum activity in southern Caribbean waters, resulting in a greater risk associated with oil spills, interactions with platform lighting, flaring and other potential impacts in this area (see Wiese et al. 2001, pp. 1286-1287). Gas flaring, whose bright light may attract the petrels, could cause disorientation or mortality if a petrel flew close enough to the flames.

There are four phases of activity associated with offshore oil and gas that include the exploration, development, production, and decommissioning of structures. Oil and gas exploration activities include geological and geophysical (G&G) surveys that use a variety of techniques, including seismic imaging, to detect reservoirs under the sea floor for extraction. Some of the G&G surveys are conducted using ship-based seismic surveys that may use various types of sonar to map the ocean floor and search for potential areas of oil seeps. Seismic ships may deploy instruments including lines that could create collision or entanglement hazards to seabirds. Development, or construction, processes include pile driving and installation of infrastructure, such as pipelines. Ships and aircraft used during this stage present potential for collisions. During the production stage, platforms and oil rigs are operated for maximum efficiency and processing of petroleum products; this includes drilling and pumping- air and water quality components.

Some of the infrastructure may include oil platforms, rigs, pipelines with ships, and helicopters that service the structures. The offshore environment is not only affected by the oil and gas infrastructure and operations, but artificial lighting from the structures, ships, and helicopters may affect the Black-capped Petrels as well. Oil and gas structures are well-lit for worker safety and lights are known to disorient flying petrels, especially on foggy nights. Moreover, helicopters are frequently used to transport crew and equipment to offshore production facilities, and the effects of these low altitude overflights on foraging petrels is unknown. As most petrels that forage in this area are adults, any increase in losses from threats on the foraging grounds would disproportionally affect the adult segment of the population (Simons et al. 2013, pp. S23-S28). Loss of adults has greater implications for long-lived *k*-selected species, as time for recovery for the adult age class is inherently longer (Simons 1984, p. 1072; Saether and Bakke 2000, p. 648).

Additionally, oil spills, which have previously impacted areas where the species occurs, are accidental occurrences resulting from offshore oil and gas production activities. Oil spills vary in magnitude and their effects depend on the geographical location, season, and area affected by the oil and clean-up efforts. While it is difficult to determine exactly when and where a spill may occur, the probability increases in areas where there is more activity. The Deepwater Horizon oil spill in the northern Gulf of Mexico occurred in 2010, discharging about 210 million gallons (780,000 m^3) of crude oil within the range of the Black-capped Petrel. Between 51,600 and 84,500 birds of at least 93 species died with many others affected; some marine birds affected the most included Brown Pelicans, Laughing Gulls, Terns, Skimmers, and Northern Gannets. While no Petrels were reportedly recovered from this incident, the oceanographic currents, as well as tidal and wind regimes, would have made shoreline deposition and carcass detection problematic (Haney et al. 2014, p. 247; Haney et al. 2015, p. 280; DHNRDAT 2016, pp. 4-462). In the Gulf of Mexico, the number of accidental spills that could occur between 2023–2028 has been estimated (ABS Consulting 2016, entire; BOEM 2022c, pp. G-1–G-3). The results indicate there may be between 0–3 large accidental oil spills (>1,000 barrels [bbl]) from platforms, 0–8 large accidental oil spills (>1,000 bbl) from pipelines, 4–628 spills between ≥ 1 to < 50 bbl, and 0–117 spills between ≥ 50 to < 1,000 bbl may occur within the northern Gulf of Mexico OCS (BOEM 2022c, p. G-2).

Direct effects to Black-capped Petrel from oil spills may be through ingestion or external exposure. Direct, as well as indirect, contact with some petroleum products or byproducts can cause irritation to the skin, mouth, lungs, and air sacs, in addition to organ damage, anemia, and weight loss (DHNRDAT 2016, p. 4-461). Indirect impacts to the Black-capped Petrel occur if prey species are affected in the pelagic environment, as prey abundance may decline or become contaminated, causing adverse effects to petrels. Petroleum residues and other contaminants may increase the probability of incidental ingestion of petroleum fragments by surface-feeding birds and fouling of plumage from floating residues (Simons et al. 2013, p. S32). Fouling of feathers affects the petrel's ability to float, fly, and thermoregulate. A Black-capped Petrel was once found heavily oiled with "fuel oil" on a beach in Connecticut in 1938 (Clapp et al. 1982, pp. 174), but such incidents are relatively few, and the genus *Pterodroma* is less vulnerable to such exposure (Clapp et al. 1982, p. 178); however, there are few data regarding the validity of this assertion (Simons et al. 2013, p. S32).

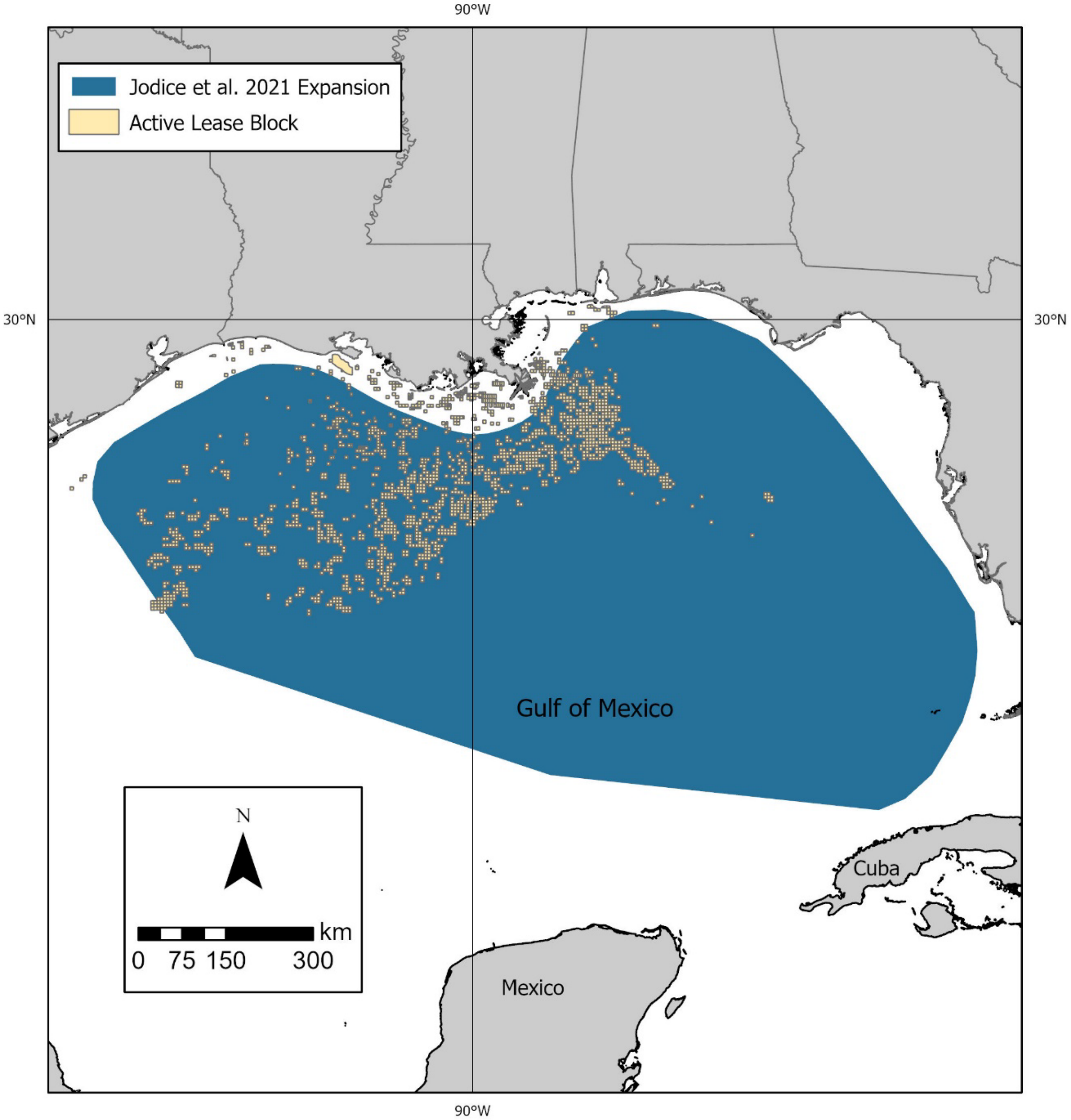


Figure 3.13. Active federal oil and gas lease blocks in the Gulf of Mexico outer continental shelf region that occur in or near the Black-capped Petrels' range (Jodice et al. 2021, p. 60; BOEM 2022b, unpaginated). Active lease block information included is from 1 March 2022, and data are updated by the Bureau of Ocean Energy Management (BOEM) monthly. Leases in state waters are not included.

3.1.10 Mercury and plastic pollution

Black-capped Petrels appear far less likely to incidentally ingest plastic fragments than many other seabirds (Simons et al. 2013, p. S33). In a long-term study off the coast of North Carolina, plastic was present in the stomach contents of over 55% of 38 species of seabirds sampled (Moser and Lee 1992, entire). In this same study, 1.8% (n = 57) of sampled Black-capped Petrels contained plastic. Black-capped Petrels do not forage heavily in areas along current edges where such residue and flotsam tend to collect, but rather in areas of current upwelling where nutrient-rich waters promote increased abundance of primary producers and prey species. This aspect of

Black-capped Petrel foraging behavior may make them less vulnerable to incidental ingestion of such material (Simons et al. 2013, p. S33).

Procellariforms are known to be particularly susceptible to heavy metal bioaccumulation compared to other seabirds (Kim et al. 1996, pp. 262-265; Kojadinovic 2007a, p. 424; Kojadinovic 2007b, p. 10). While impacts of high concentrations of mercury specific to the Black-capped Petrel are unknown, the species has been reported with relatively high concentrations of mercury, with amounts seven to nine times higher than that of most other pelagic species (Simons et al. 2013, p. S33). It is likely that any increase in mercury would impact the Black-capped Petrel, as such high levels are associated with reduced reproductive output and neurological damage in other avian species (Simons et al. 2013, p. S33) and because it is already exposed to higher-than-normal levels of this contaminant.

3.1.11 Marine fisheries

The range of the Black-capped Petrel has some overlap with international industrial fishing fleets and squid fisheries, with squid fishing occurring in the Caribbean Sea. The vessels targeting squid use very bright lights to attract their catch, which could cause disorientation, and increase the number of collisions, by Black-capped Petrels; however, there is little information from foreign fishing fleets regarding the impacts from fisheries (Simons et al. 2013, p. S33). There are no known reports of *Pterodroma* bycatch in any marine fisheries of the northern Gulf of Mexico, Atlantic, or Caribbean fisheries.

There are several methods of commercial fishing practiced in the species' range, including pelagic long line fishing, gillnet use, and trawling. Because of the surface-feeding habits of the Black-capped Petrel, the species is not considered particularly vulnerable to effects of either long-line or pelagic gill net commercial marine fisheries (Simons et al. 2013, p. S33). Marine fisheries may entangle seabirds in clear monofilament fishing lines or hooks and increase opportunity for collisions with vessels (Furness 2003, p. 34). It is difficult to conclusively determine the direct and indirect impacts to Black-capped Petrels from marine fisheries based on the amount of applicable information available. One study based on ecological traits of seabirds provided species-specific risk analysis for fisheries bycatch and estimated 24 Black-capped Petrels were affected by pelagic longline fishing in the U.S. Atlantic waters between 1992 to 2016; this analysis was based on the relationships between seabird bycatch likelihood, and the surface scavenging behavior of species, such as petrels, resulting in a higher chance of interaction with longline fisheries (Zhou et al. 2019, p. 1332).

Lighting on fishing vessels may cause disorientation for Black-capped Petrels and is concentrated in areas of increased fishing effort (Appendix C). There has been at least one incident of Black-capped Petrel collision with a fisheries research vessel in the northern Gulf of Mexico in U.S. waters (Jon Moore, pers. comm., as related to J. Chris Haney). The collision occurred at night and the vessel was lighted which likely contributed to attraction and disorientation of the petrel.

3.1.12 Climate change

The Black-capped Petrel faces potential climate change effects on both foraging and breeding areas through differing mechanisms (Simons et al. 2013, p. S33). Because of the species' highly specific nesting habitat requirements, found only in areas highly sensitive to climatic change, it is among the most vulnerable to adverse effects of climate change (Williams et al. 2007, pp. 5739-5740; Sekercioglu et al. 2008, p. 145; Thurman et al. 2020, p. 520). Combined climate-induced and anthropogenic habitat changes potentially result in the total loss of nesting habitat for the Black-capped Petrel on Hispaniola, with catastrophic implications for the species (Travis 2003, p. 472). This is typically the case for species like the Black-capped Petrel inhabiting high-elevation habitats; tropical high-elevation climates are among those most likely to disappear by the end of this century (Williams et al. 2007, p. 5739). Such species have little option for relocating or migrating to alternative areas (i.e., "niche tracking"), and may go extinct should bioclimatic conditions render habitat locally unsuitable (Williams et al. 2007, p. 5738; White et al. 2014, pp 26-30; Thurman et al. 2020, p. 520). The Black-capped Petrel is restricted to the highest elevations on Hispaniola, and should such areas be rendered unsuitable, the species would simply have no place to go to seek climate refugia.

In foraging areas (i.e., marine habitat), the strong association of the Black-capped Petrel with Gulf Stream waters, and associated current upwelling off the southeastern U.S. coast, makes the species vulnerable to climate-induced changes from existing marine hydrology in this zone. It affects the intensity and track of the Gulf Stream with associated changes in marine primary productivity and the abundance and diversity of marine nekton (i.e., actively swimming aquatic organisms) which are essential food sources for the Black-capped Petrel (Chávez et al. 2011, p. 230; Bakun et al. 2015, pp. 85-86; Saba et al. 2016, p. 131; Siqueira and Kirtman 2016, pp. 3965-3966; Kimball et al. 2020, p. 936; Zhang et al. 2020, pp. 707-710). For example, in coastal South Carolina, a 30-year transition was detected for the subtidal nekton population to a state of lower total abundance and different species assemblage coincident with both increased water temperature and storm events (Kimball et al. 2020, pp. 927-928). Similarly, in the southern Caribbean, higher amounts of chlorophyll, phytoplankton, and pelagic biomass were reported in upwellings with lower SSTs, used for foraging by nesting petrels (Rueda-Roa and Muller-Karger 2013, entire; Jodice et al. 2015, pp. 29-30).

A decadal decline was also reported in plankton productivity associated with diminished upwellings and increasing SSTs (Taylor et al. 2012b, p. 19319). Changes in marine upwellings could result in seabirds having difficulties in obtaining prey resources (Bakun et al. 2015, p. 85). However, an overall increase in marine primary productivity with increasing water temperatures suggests that primary productivity may not be the most sensitive indicator of climate change for open ocean habitats (Chávez et al. 2011, p. 253). An observed weakening and meridional shift of the Gulf Stream was observed, based on over two decades of remote sensing data, which was attributed to a climate-related weakening of the NAO and AMOC (Zhang et al. 2020, entire); however, temporal length of remote sensing data was insufficient to determine whether observed changes were due to multi-decadal variations or a long-term trend (Zhang et al. 2020, p. 710). Changes in either the direction(s) or temperature of these marine currents could alter the foraging ecology of the species (Siquiera and Kirtman 2016, entire; Zhang et al. 2020, entire). While there are currently no specific projections for reversal of the Florida Current or Gulf Stream proper to quantify this threat (Zhang et al. 2020, entire), marine current changes appear to be a low threat to the petrel over the timeframe of this assessment is believed to be low, albeit unquantified (Weaver et al. 2012, entire; Simons et al. 2013, p. S33; Bakun et al. 2015, entire).

More consequential to the Black-capped Petrel in its foraging areas are projected climate-related increases in the frequency and intensity of Atlantic hurricanes over the next century. Because Black-capped Petrels tend to congregate at high densities on marine foraging grounds off the eastern USA during the peak of the Atlantic hurricane season, they are especially vulnerable to such atmospheric events (Hass et al. 2012, p. 258-260). This could substantially increase the number of Black-capped Petrels driven inland and stranded by these storms, thereby increasing mortality (Hass et al. 2012, p. 257). For example, three stranded petrels were found in Alabama after Hurricane Irma; all were injured, one survived, and a fourth petrel was reportedly found dead (WSFA 12 News 2017, unpaginated).

Over 100 years of data were modeled on the relationship between Black-capped Petrel inland strandings (i.e., birds found far inland from normal marine habitat) and resultant mortalities in the continental USA in relation to Atlantic hurricane intensities and trajectories taking place during hurricane seasons (June-September) (Hass et al. 2012, entire). It was found that on at least eight occasions over the past century, major hurricanes (Categories 3 to 5) likely resulted in mortalities of 10s to 100s of Black-capped Petrels. Increased intensity and frequency of major (Category 3-5) Atlantic hurricanes (Bender et al. 2010, p. 456), combined with reduced translation speeds (i.e., the speeds at which hurricanes move), may further accelerate erosion and degradation of nesting areas (Hass et al. 2012, p. 259; Simons et al. 2013, p. S33; Kossin 2018, p. 104). Recent long-term studies on the neighboring island of Jamaica have shown that such hurricanes accelerate structural and compositional changes in Caribbean montane forests through the process of thermophilization (i.e., adapting to a warmer climate), by shifting tree species composition towards an abundance of warmer habitat species (Tanner et al. 2022, p. 2). A potential effect of these changes would be alterations in nest burrow microclimates. Although the optimal range of temperature and humidity for successful nesting by the Black-capped Petrel is currently unknown, studies of seabird nesting strategies have shown considerable species-specific variation in optimal nest microclimates and basal metabolic rates during incubation (Shaffer et al. 2001, p. 829; Whittow 2002, pp. 409-439; Shoji et al. 2015, pp. 44-45). Any reductions in the current Black-capped Petrel breeding population from other unrelated factors (e.g., predation, tower collisions, and forest fires) could thereby amplify and exacerbate hurricane-related losses.

Predicted temperature increases may affect the petrel in numerous ways, including through increased rainfall (Campbell et al. 2011a, pp. 1873-1875Karmalkar et al. 2013, p. 291). Warmer oceans, resultant of climate change, increase the amount of water that evaporates into the air, and this moisture-laden air converges into a storm system that can produce heavy rain (EPA 2022a, unpaginated). Associated changes in precipitation may result in increased episodes of heavy rainfall, which would likely result in increased erosion, flooding, and loss of nesting burrows or sites under current landscape conditions (Simons et al. 2013, p. S33). A massive landslide is believed to have eliminated the only known Black-capped Petrel nesting area on the island of Guadeloupe, resulting in its extirpation from that island (Simons et al. 2013, pp. S11-S12).

On the other hand, decreases in precipitation combined with higher temperatures may increase frequency of drought and attendant susceptibility of breeding areas to forest fires (Karmalkar et al. 2013, p. 284). Currently, anthropogenic forest fires cause substantial habitat degradation and loss within and adjacent to petrel nesting areas (Sergile et al. 1992, p. 6; Goetz et al. 2012, p. 7; Rupp and Garrido 2013, p. 5; Simons et al. 2013, p. S31; see Figure 3.3). Also, increased temperatures may increase incidents of new invasive or vector-borne diseases. For example, warmer temperatures associated with climate change can accelerate mosquito development, biting rates, and incubation of West Nile virus in mosquitos (EPA 2022b, unpaginated). Small population size and distribution of the Black-capped Petrel increase vulnerability of this species to overcoming stochastic events such as pathogens, which may pose an additional climate-induced risk for the species (Simons et al. 2013, pp. S33-S34).

3.2. Conservation efforts

Several non-government organizations (NGOs) are currently working in Haiti and the Dominican Republic to reduce or mitigate the severity of these threats. These NGOs include international organizations (e.g., BirdsCaribbean, Environmental Protection in the Caribbean, Plant with Purpose, American Bird Conservancy, International Black-capped Petrel Conservation Group) as well as local organizations (e.g., Grupo Jaragua, Société Audubon Haiti). Because most of the threats to the Black-capped Petrel are directly the result of anthropogenic activities (see section 3.1), these NGOs have been providing technical assistance and education on sustainable agricultural practices, watershed management, and reforestation of previously deforested and degraded areas in the regions where petrels nest.

Conservation efforts including environmental education regarding the Black-capped Petrel occurs at the local level. For example, in Boukan Chat, Haiti (adjacent the Morne Vincent petrel nesting area), NGOs have developed Black-capped Petrel educational programs for local schoolchildren, provided financial and technical assistance with construction of freshwater cisterns, as well as provided tree seeds and technical assistance for local reforestation projects.

Some residents of Boukan Chat have been hired specifically to improve community awareness of the Black-capped Petrel and its plight, and of how sustainable land management can be mutually beneficial to both the community and the petrel.

Building on past and current efforts, the International Black-capped Petrel Conservation Group (IBPCG) recently compiled and published a comprehensive and strategic Conservation Action Plan (heareafter, “Plan”) for the long-term conservation of the Black-capped Petrel (Wheeler et al. 2021, entire). The Plan summarizes recent information relative to species conservation, including nesting habitat modeling and population viability analyses; additionally, the Plan identifies priorities such as promoting petrel conservation through local community involvement, as well as habitat and species conservation measures. The Plan is an invaluable guide for current and future Black-capped Petrel conservation efforts and the main source of the updated information presented in this revised SSA.

Other NGO efforts include recent production of the documentary “Save the Devil” detailing local efforts to save the species, in addition to active monitoring for forest fires near petrel nesting areas, continued monitoring of petrel nest success in the Morne Vincent/Sierra del Bahoruco nesting area, continued radar and bioacoustical monitoring for petrel detections, and working with owners of a local communication tower to reduce nocturnal lighting intensity (Brown 2016, entire; IBPCG 2016, entire; 2017, entire; Wheeler et al. 2021, entire). Additionally, there have been some efforts to trap introduced predators at or near petrel nest sites, but results have been hindered by remoteness of field sites and theft of traps. While some efforts are locally successful, they are relatively limited in both geographic scope and funding. There are other areas of Hispaniola which harbor – or may harbor – Black-capped Petrel nesting colonies (e.g., Pic Macaya, Pic La Visite, Massif de La Selle) that could benefit from similar efforts. Unfortunately, these NGO efforts are currently paused indefinitely due to the extreme instability in Haiti (see https://www.bbc.com/news/world-latin-america-63042307). Figure 3.14 depicts the interactions and relationships between the threats (section 3.1) and their influence on Black-capped Petrel viability.

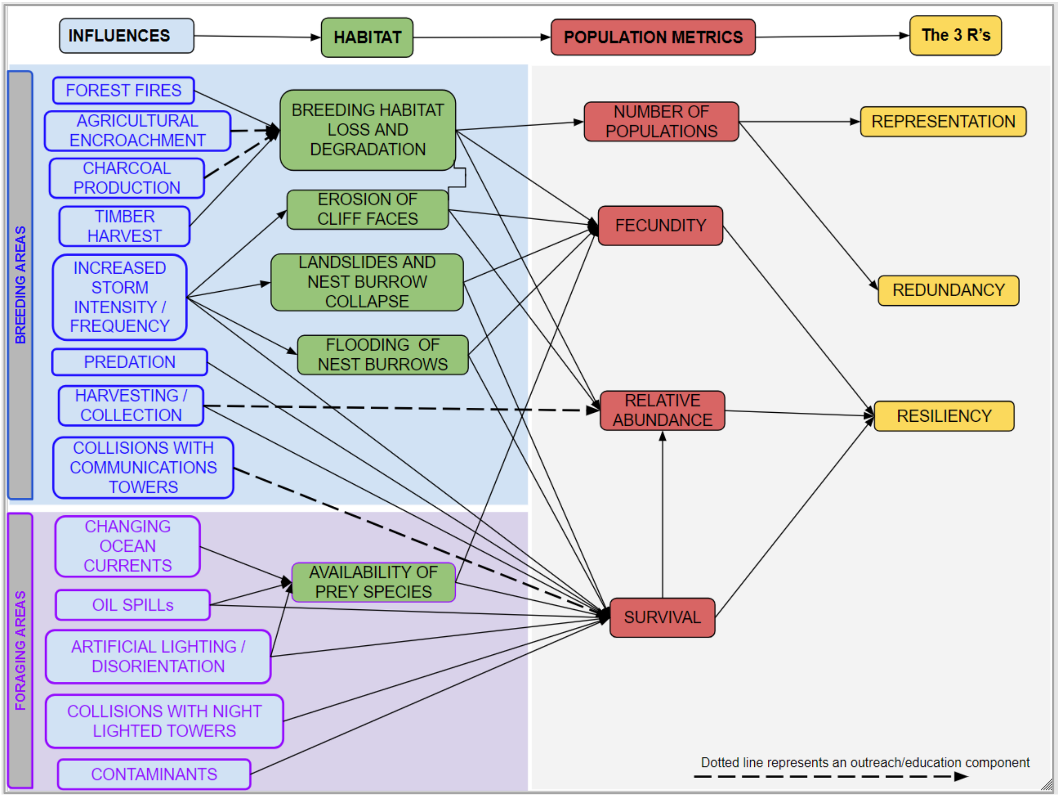


Figure 3.14. Influence diagram depicting interactions and relationships between factors influencing Black-capped Petrel viability.

Chapter 4. Current Condition (Resiliency, Redundancy, and Representation)

In this chapter we characterize the Black-capped Petrel's current condition by examining distribution of resilient analysis units (i.e., breeding populations) across its range. After reviewing information on current range and distribution, we consider the needs of the species at population- (for resiliency) and species-level (for redundancy and representation). Finally, we combine the results of assessing the 3Rs into a characterization of current, species-level viability.

4.1. Range and Distribution

The range of the Black-capped Petrel (Fig. 4.1) is likely related to the geological history of the Caribbean Region (Simons et al. 2013, pp. S10-S11). Colonization of at least one of the larger islands (e.g., Cuba, Hispaniola) by non-migrating and winter-breeding *Pterodroma* most likely occurred during the Pleistocene, perhaps even earlier. Other Caribbean islands (e.g., the Lesser Antilles) were subsequently colonized and re-colonized over time. Current evidence suggests that the original colonizing stock of the birds that would become Black-capped Petrel originated from South Atlantic petrel populations following the closure of the Panama isthmus (Simons et al. 2013, pp. S10-S11; Imber 1985, p. 215-222). Once established, the geographic distribution of breeding populations has remained stable due to the inherently strong philopatry (i.e., remaining or returning to the same breeding sites) exhibited by *Pterodroma* spp. (Simons et al. 2013, pp. S19-S22).

Currently, breeding populations of Black-capped Petrels are found mainly along the geologic suture zone between the ancient islands of North and South Hispaniola, which later fused to form the current island of Hispaniola. Simons et al. (2013, p. S10-S11) believed that the Black-capped Petrel or its ancestors also colonized some geologically older islands (e.g., Puerto Rico) but were extirpated, likely due to either human harvesting or competitive interactions and incompatibility with maturing island biotas. Because the Lesser Antilles (e.g., Guadeloupe, Dominica) are younger than the Greater Antilles, the petrel most likely colonized and re-colonized those islands from stocks originating in the Greater Antilles (Simons et al. 2013, pp. S10-S11).

Stochastic disturbances, such as volcanic activity, hurricanes, and earthquake-induced landslides, may have resulted in periodic localized extirpations of Black-capped Petrels from some of the smaller islands it may have inhabited. For example, the 1847 earthquake in Guadeloupe is believed to have caused the disappearance of the petrel from that island (Simons et al. 2013, p. S11-S12). Such events may also have facilitated colonization by enhancing habitat used for nesting (Simons et al. 2013, p. S11). Mudslides resulting from hurricanes and tropical storms create natural openings within disturbed soils which is a characteristic favorable for excavation of petrel nest burrows. This shifting availability of suitable nesting sites may have caused nesting colonies to move or become relict. Simons et al. (2013, p. S7) hypothesized that the cycle of ancient colonization and extirpation may have promoted the observed polymorphism exhibited by the species. While a definitive assessment of the extent to which historic populations depended on forested habitats is not possible, stable forest systems appear important for contemporary populations of the Black-capped Petrel (Simons et al. 2013, pp. S10-S13).

Historical occurrences of breeding *Pterodroma* have been documented on only five of the Caribbean islands: Martinique, Guadeloupe, Dominica, Jamaica, Cuba, and Hispaniola. Below we summarize the historic and current condition of those occurrences (Simons et al. 2013, pp. S10-S13). Although breeding by petrels is suspected to occur in Cuba and Dominica, there are no empirical data to confirm this suspicion. For a summary of habitat status and survey effort of confirmed, probable, and suspected breeding locations of the Black-capped Petrel, see table 4.1.

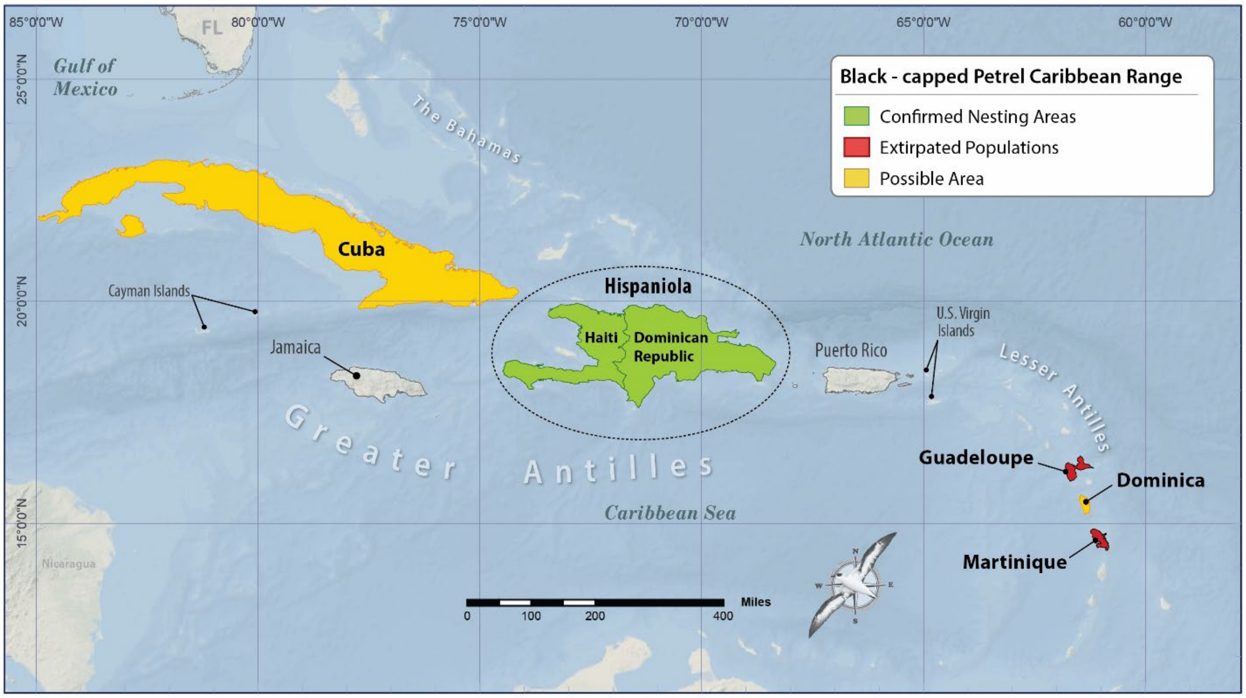


Figure 4.1. Caribbean range for Black-capped Petrel nesting.

4.1.1. Martinique

Black-capped Petrel were likely eradicated from the island of Martinique by the resident Carib Indians who harvested the bird for food during pre-Columbian times (Simons et al. 2013, p. S11). There are reports of the species on Martinique up to and during the 19th century (Simons et al. 2013, p. S11; Wetmore 1952, entire). However, today Martinique is mostly deforested, and there have not been reports of nesting petrels there since before the 1902 eruption of Mount Pelée (Simons et al. 2013, p. S11).

4.1.2. Guadeloupe

Former nesting by the Black-capped Petrel on Guadeloupe is well-documented during the 18th and first half of the 19th centuries (Simons et al. 2013, pp. S11-S12). Detailed accounts exist of local hunting parties harvesting large numbers of Black-capped Petrel adults and nestlings for food during those times. Massive landslides caused by a large earthquake in 1847 destroyed the only known nesting area on the island, and nesting birds are believed to have disappeared from the island by approximately 1850 (Simons et al. 2013, p. S12). Subsequent island-wide deforestation and habitat conversion (e.g., forest to agriculture) may have played a role in inhibiting re-colonization of the island by the petrel during the late 19th and 20th centuries (Simons et al. 2013, p. S31). No petrels have been documented in Guadeloupe since their extirpation in the 1850s.

4.1.3. Dominica

Allegedly the site of the first type specimen of the Black-capped Petrel, Dominica is believed to have once harbored most of the breeding population of the species (Simons et al. 2013, pp. S12-S13). French colonists in Dominica once exported large numbers of the birds as food for colonists on other islands. Although still numerous on the island during the early 19th century, the last confirmed nesting of the petrel in Dominica was in 1862 (Simons et al. 2013, pp. S12-S13). Subsequent sightings and collections of the petrel in Dominica (e.g., in 1932, 1977, 2007) suggest the possibility that nesting by the Black-capped Petrel yet occurs (Goetz et al. 2012, pp. 12-13; Simons et al. 2013, pp. S12-S13).

Nocturnal radar surveys for the petrel in Dominica identified numerous “petrel-like” targets that further suggest potential presence (Brown 2015, entire). The number of detections declined by over 60% by 2020 (Brown 2020, p. 4). Although recent ground-based searches for petrel nests, as well as nocturnal acoustic surveys for vocalizing birds have yet to yield conclusive evidence of nesting, there remains an uninhabited and largely inaccessible area of approximately 388 km^2 in the interior of the island that has not been adequately surveyed (Brown and Collier 2001, pp. 2-3; Simons et al. 2013, pp. S12-S13). Recent nocturnal searches using thermal scanning devices detected one flying petrel (Satgé and Millischer 2022, p. 14). Thus, current nesting by the Black-capped Petrel on Dominica remains speculative and unknown.

4.1.4. Jamaica

Jamaica once hosted an endemic species (or subspecies) of *Pterodroma* – the allegedly now extinct Jamaican petrel (*Pterodroma caribbaea*) – but there are no substantiated records or documentation of the Black-capped Petrel nesting in Jamaica (Simons et al. 2013, pp. S17-S19). Although the Jamaican petrel was well-known on the island up until the 19th century, the introduction of the mongoose in 1872 is believed to have caused the complete eradication of the species. No signs have been found of the current existence of either the Jamaican or Black-capped Petrel on Jamaica, despite extensive survey efforts over the last century and suitable areas of nesting habitat, specifically in the Blue Mountains and John Crow Mountains in the northeastern portion of the island (Simons et al. 2013, pp. S17-S19).

4.1.5. Cuba

According to Simons et al. (2013, pp. S15-S17.), the first reports of the Black-capped Petrel on Cuba date from the 1970's (see also Goetz et al. 2012, p. 13). These initial reports were of birds (n = 6) collected in Cuba. It was later revealed that the petrels had been collected at night from boats located several kilometers from the coast indicating they were most likely foraging birds originating from breeding colonies on nearby Hispaniola (Simons et al. 2013, pp. S15-S17). The birds were collected in an area of strong upwelling currents, like that of the deep-water areas off the southeastern coast of the United States where petrels are known to congregate and feed. There have been recent sightings of Black-capped Petrels flying inland near La Bayamesa National Park in southeastern Cuba (Placencia Leon et al. 2022, unpaginated). However, definitive evidence of nesting by the Black-capped Petrel on Cuba has yet to be acquired (Simons et al. 2013, pp. S15-S17; Wheeler et al. 2021, p. 10).

4.1.6. Hispaniola (Haiti, Dominican Republic)

The island of Hispaniola, comprised of the nations of Haiti (western third) and the Dominican Republic (eastern two thirds), is the only confirmed area where the Black-capped Petrel is currently known to breed (Goetz et al. 2012, pp. 9-10; Simons et al. 2013, pp. S13-S15, Wheeler et al. 2021, p.10). Current estimates of the total breeding population are 500-1,000 pairs (Simons et al. 2013, p. S22) distributed among four distinct, albeit ecologically similar areas (Simons et al. 2013, p. S22). One of the breeding areas is entirely in Haiti (Pic La Visite), the second spans the Haiti-Dominican Republic border (Morne Vincent-Sierra del Bahoruco), while the third and fourth are located entirely in the Dominican Republic (Loma Quemada, Valle Nuevo). Despite the relative proximity and ecological similarities of the known nesting areas (Goetz et al. 2012, pp. 9-11; Simons et al. 2013, pp. S13-S15), these areas are considered to constitute four distinct breeding populations (Wheeler et al. 2021, p. 25). There are currently no empirical data regarding the genetic composition of Black-capped Petrel breeding colonies, so we cannot yet make definitive conclusions regarding the interchange of genetic material among colonies (Satgé et al. 2022, entire).

Common characteristics of all known breeding colonies include the following (Goetz et al. 2012, p. 5; Simons et al. 2013, pp. S19-S22; Satgé et al. 2021, p. 585):

1. Elevations exceeding 1500 m (4900 ft) ASL
2. Open canopy montane broadleaf or pine (*Pinus occidentalis*) forest
3. Loose soil, talus or decaying herbaceous vegetation on or near steep slopes, and/or
4. Rocky crevices and limestone solution cavities on cliff faces
5. Less than ca. 30 km (46 mi) from the nearest coastline

Below, we describe the current conditions and threats at each of the four known breeding colonies – as well as one former colony (Pic Macaya) - according to the most recent information (see Rimmer et al. 2010, entire; Goetz et al. 2012, entire; Simons et al. 2013, pp. S30-S34; McKown 2014, entire; Brown 2016, entire; IBPCG 2017, entire; Wheeler et al. 2021, entire). Although the Sierra de Bahoruco-Morne Vincent colony is considered a single breeding colony, its unique feature of being the only international colony requires separate descriptions of the portions in Haiti and the Dominican Republic. This is because of distinct differences in habitat quality and associated threats between the two portions of this binational colony.

4.1.6.1. Pic Macaya, Haiti

The most westerly of the previously known or probable breeding colonies on Hispaniola (Fig. 4.2), Pic Macaya, is in a national park (Sergile et al. 1992, p. 5), but there is no legal delineation of its boundaries or control of human access into the park (Goetz et al. 2012, pp. 9-10). The Pic Macaya area once hosted an estimated 5% of the total breeding population of the Black-capped Petrel. The Pic Macaya area faces substantial threats primarily from fires, invasive mammals, continued deforestation, and habitat loss (Goetz et al. 2012, p. 5; Wheeler et al. 2021, p. A2-84), with up to 56% of total forest cover lost from 2000-2018 (Satgé et al. 2021, p. 586). Most of this loss occurred due to damage associated with the Category 4 hurricane Matthew in 2016 (Satgé et al. 2021, p. 586). As a result of past and current deforestation, the forested area at Pic Macaya is currently estimated at approximately 20 km^2 (Goetz et al. 2012, p. 5; Hedges et al. 2018, p.11851), but the petrel nesting area (Fig. 4.2) was limited to just under 5 km^2 (1235.5 ac).

Little is known regarding past nest abundance or nesting success by Black-capped Petrel because of the logistical difficulties of accessing Pic Macaya. A survey of this colony approximately thirty years ago suggested a 40% decline in the local petrel population since the time of Wingate's original survey in 1964 (Woods 1987, entire; Simons et al. 2013, p. S22). Estimates from 1994 suggest continued declines in numbers of breeding petrels at this site (Simons et al. 2013, p S22). No petrels were detected during a recent single-day survey of Pic Macaya on February 10, 2005 (Simons et al. 2013, p. S22). Goetz et al. (2012, p. 10) reported that six petrels were detected flying and vocalizing on the southern slopes of Pic Macaya in December 2010. There is no information on the current number of breeding pairs, if any, in this colony. Accordingly, Pic Macaya is now considered a probable or "suspected" nesting area, rather than an active one (Wheeler et al. 2021, pp. A2-71, 83).

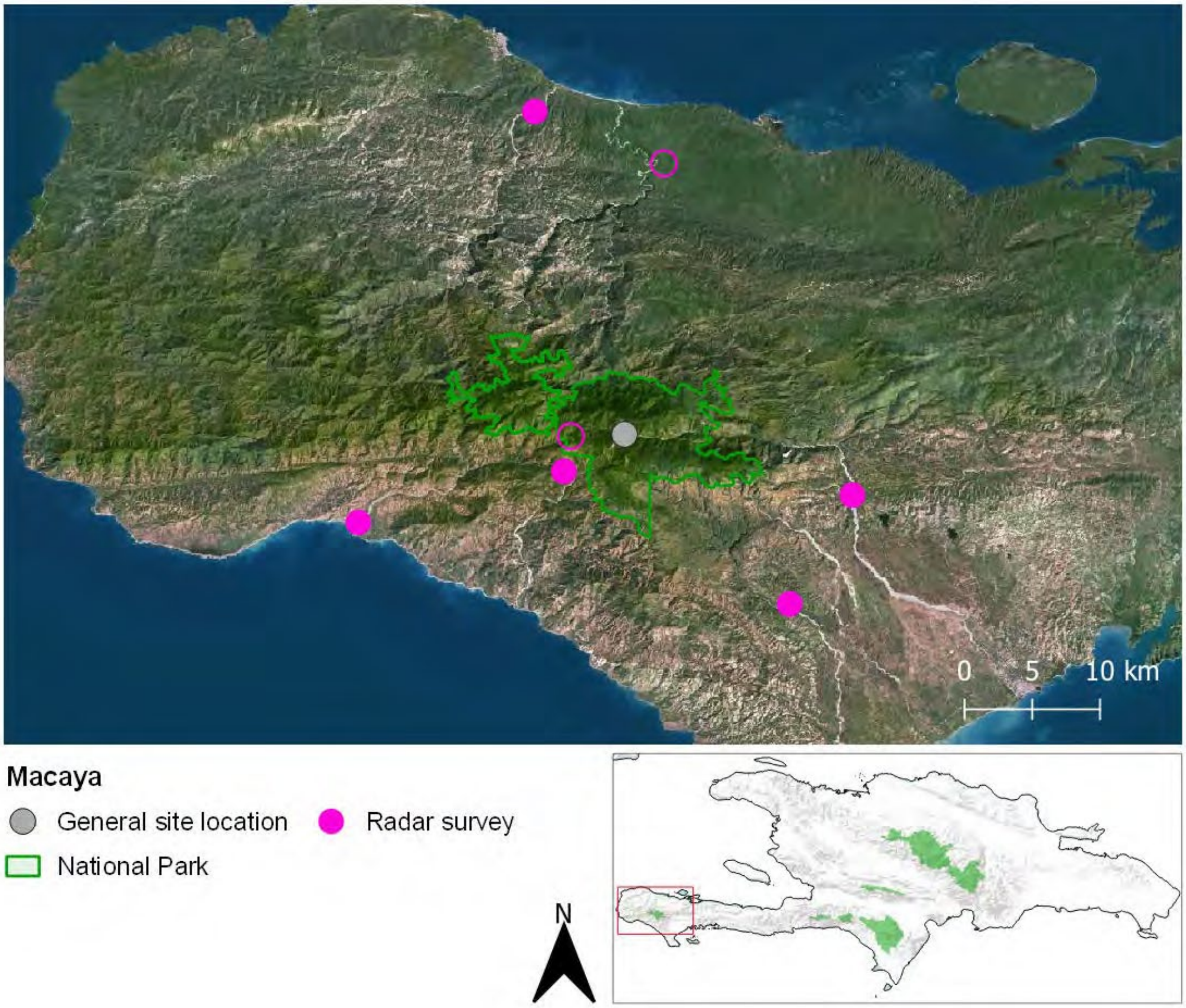


Figure 4.2. Location of the former (or suspected) Black-capped Petrel nesting area at Pic Macaya, Haiti. Inset on lower right shows location within Hispaniola. Figure adapted from Wheeler et al. (2021) and used with author permission.

4.1.6.2. Pic La Visite, Haiti

The most significant breeding colony of the Black-capped Petrel contains nearly half of the total known breeding population, but in which known nests (n = 57) are concentrated in an area of one hectare (IBPCG 2021, p. 3; Wheeler et al. 2021, pp. 10, A2-73). Unfortunately, the Pic La Visite colony is also one of the most threatened. Pic La Visite – like Pic Macaya – is technically a national park, and substantial loss of Black-capped Petrel habitat was reported in the La Visite area due to deforestation (for agriculture) of both higher elevation pine forest and steeper slopes at the foot of cliffs (Rimmer et al. 2010, p. 32; Hedges et al. 2018, p. 11854).

Based on surveys during late 2005 and early 2006, it was concluded that the breeding population of petrels at La Visite had declined greatly since earlier surveys of Wingate (1964, p. 152) who estimated the local breeding colony at that time to contain a total of 500-600 pairs (Rimmer et al.

2010, p. 36; Collar et al. 1992, p. 57). Previously, the overall population of Black-capped Petrels in Haiti had declined by 40% from the numbers reported by Wingate in 1964 (Woods 1987, pp. 196-205). Subsequent surveys at La Visite in late 2008 and early 2009 recorded several groups of up to 24 petrels vocalizing in the area (Simons et al. 2013, entire). According to observations in 2009, the remaining forested areas of the breeding colony had been degraded considerably due to charcoal production, logging, and conversion to pasture and agricultural lands resulting in the loss of much of the confirmed breeding area (Simons et al. 2013, p. S13; Fig. 3.1).

The only tract of nesting habitat remaining in the La Visite area is less than 230 ha (56,833 ac) (Figs. 4.3, 4.4; Goetz 2012, p. 5; Simons et al. 2013, p. S13). A complete loss was predicted of remaining areas of primary forests in Haiti (including that of La Visite) by 2035 (Hedges et al. 2018, p. 11854). Given the past and current threats in this area, the La Visite petrel nesting stronghold has and continues to experience precipitous declines in both habitat availability and quality, and subsequently, breeding pairs; however, there remains an approximately 20 km escarpment in the nearby Pic La Selle (the highest point in Haiti at over 2700 m elevation) that has not been surveyed for petrel nesting activity (Goetz et al. 2012, p. 10). This area is subject to the same threats and pressures as La Visite (Hedges et al. 2018, p. 11854). While the total number of active petrel nest sites and associated nest success in the greater La Visite area remains uncertain, nests were actively monitored for the first time in this colony during the 2018 nesting season. Since then, a cumulative total of 50 nesting attempts have been documented. Of those, 26 (52%) eventually fledged a chick (IBPCG 2018; 2019; 2020, entire).

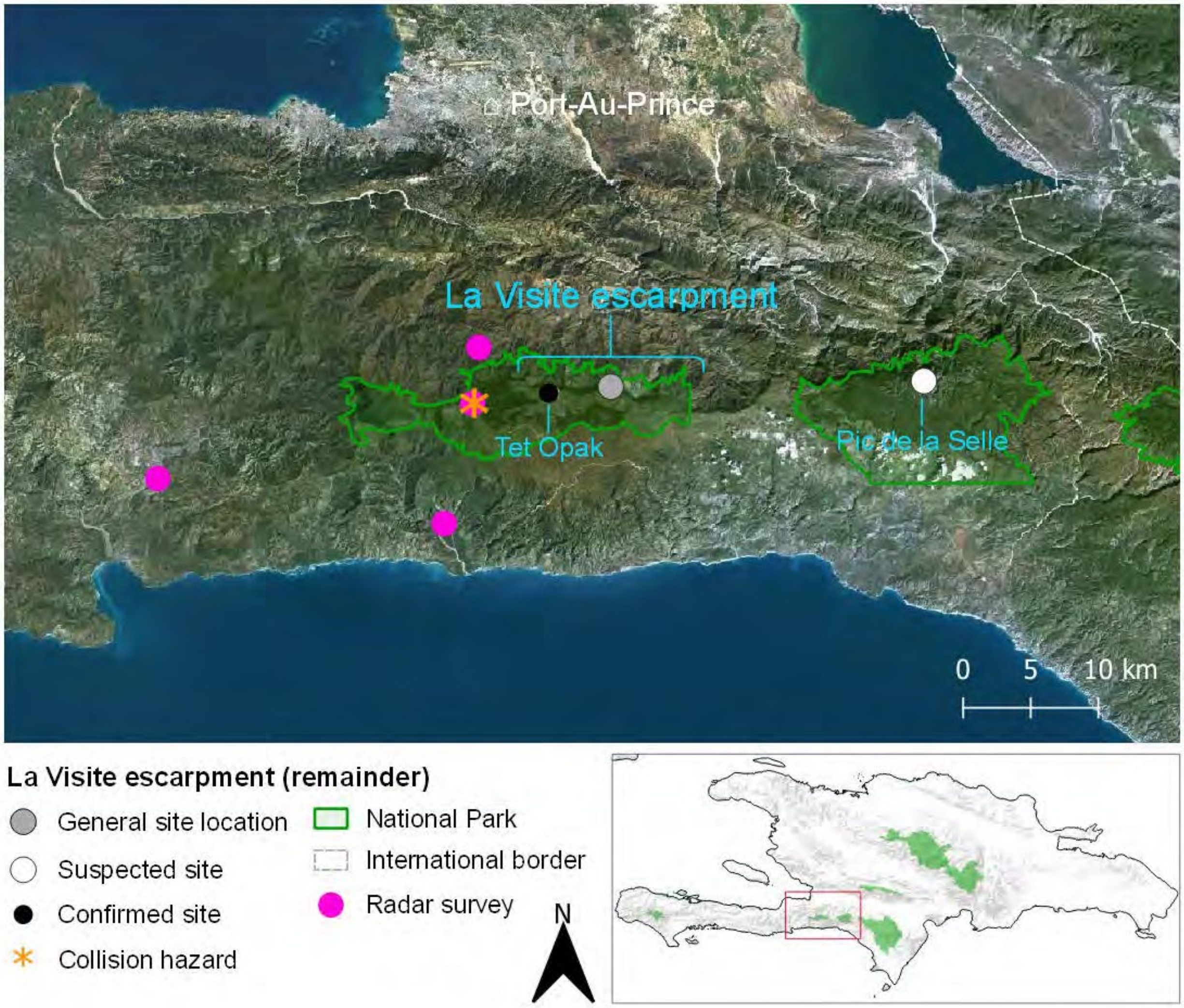


Figure 4.3. Location of the Black-capped Petrel nesting area at Pic La Visite, Haiti. Inset on lower right shows location within Hispaniola. Figure adapted from Wheeler et al. (2021, p. A2-73) and used with author permission.

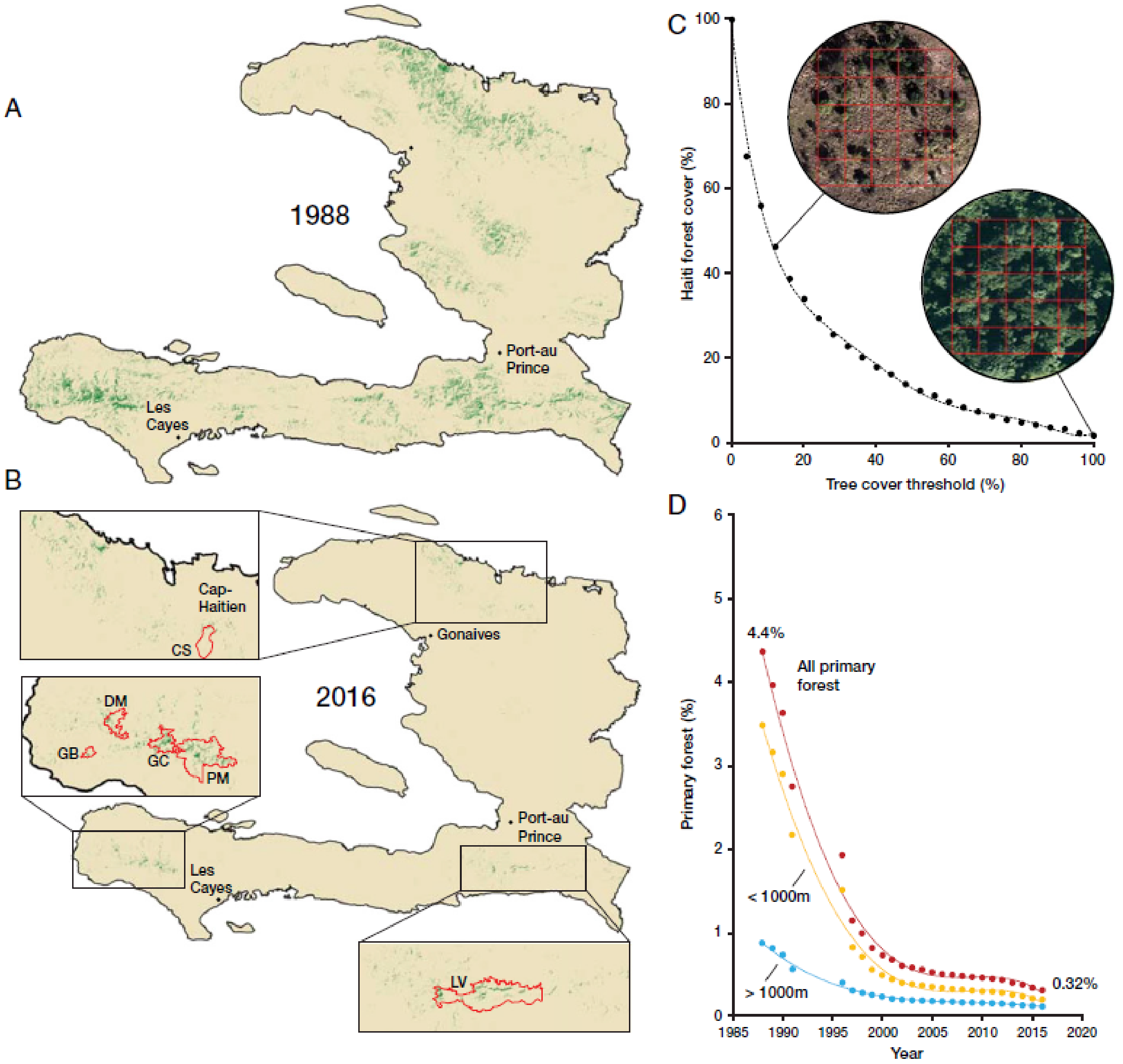


Figure 4.4. Changes in the distribution of primary forests in Haiti, 1988-2016. Within the insets of panel B (lower left), PM denotes area of Pic Macaya National Park (outlined in red), while LV denotes La Visite National Park (outlined in red). Figure adapted from Hedges et al. (2018, p. 11851) and used with permission of primary author.

4.1.6.3. Morne Vincent, Haiti

The Morne Vincent nesting area is estimated at approximately 13 ha (32.1 ac) (Wheeler et al. 2021, p. A2-75). Like other breeding colonies in Haiti, the Morne Vincent area faces significant pressure from land clearing activities and conversion of forests to cattle pastures. The Morne Vincent portion of the nesting colony is not within an officially protected zone, and woody vegetation in the area has been replaced by shrubs and bushes due to deforestation of larger trees (ABC 2014, p. 2).

Due to its proximity to the border of the Dominican Republic (<3 km), which facilitates access to the area by researchers (Fig. 4.5), Black-capped Petrel nesting activities in Morne Vincent are better documented than in other Haitian colonies. For example, 36 active nests were reported in the area, of which 20 were accessible to researchers who documented a nest success rate of 75% (ABC 2014, p. 1). Similar estimates were also reported by Rupp (2012, entire) who documented nearly 77% success based on 30 active nests monitored (i.e., 15 in Morne Vincent; 15 in the Dominican Republic). During the most recent (2020-21) nesting season, 87% success was reported of 15 nests monitored (IBPCG 2021, p. 4). The primary cause of nest failure is predation (Wheeler et al. 2021, p. 16). As with the other breeding colonies, the total number of breeding petrels in this area is highly uncertain.

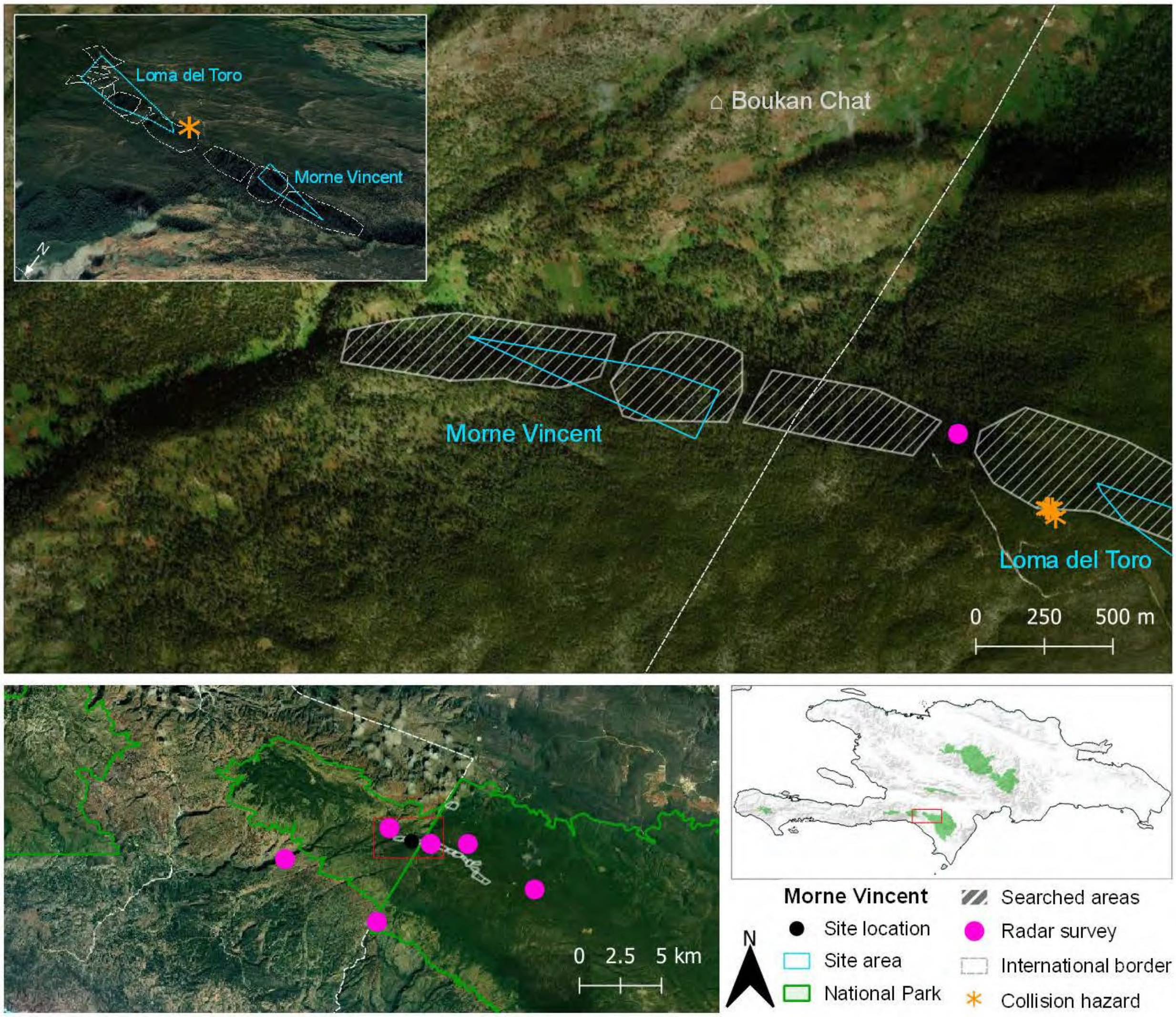


Figure 4.5. Location of the Black-capped Petrel nesting area at Morne Vincent, Haiti. Inset on lower right shows location within Hispaniola. Figure adapted from Wheeler et al. (2021, p. A2-75) and used with author permission.

4.1.6.4. Sierra de Bahoruco, Dominican Republic

Loma del Toro is one of the three known Black-capped Petrel nesting areas in the Dominican Republic. It is in the Sierra de Bahoruco, a generally east-west oriented mountain range. Sierra de Bahoruco extends into neighboring Haiti where it is physiographically contiguous with the adjacent petrel nesting area of Morne Vincent (Fig. 4.6). Like Morne Vincent, the petrel nesting activities in Loma del Toro are better known than the other two current and former colonies in Haiti. Moreover, due to differences in political and socioeconomic conditions between Haiti and the Dominican Republic, the habitat and forests in the Sierra de Bahoruco are in better overall condition than petrel nesting areas of Haiti (Goetz et al. 2012, p. 11; Simons et al. 2013, pp. S13-S14). The Sierra de Bahoruco is part of the UNESCO Jaragua-Bahoruco-Enriquillo Biosphere Reserve which was established to protect over 1000 km^2 of montane forest in southwestern Hispaniola).

The petrel nesting area is located along a steep forested slope that extends southeast approximately 8 km from Loma de Toro and at an elevation of 2200 m (Simons et al. 2013, pp. S13-S15). Two nests have been in rocky outcrops, but most nests have been found in soil, scree, and crevasses. The area occupied by the nesting colony is approximately 150 ha (Wheeler et al. 2021, p. A2-77). Thus, the total area encompassed by this nesting colony in both countries is 163 ha (402.8 ac). Habitat at this site consists mainly of large open canopy stands of Hispaniolan pine (*Pinus occidentalis*). However, there have recently been increasing amounts of deforestation and habitat degradation in the Sierra de Bahoruco and surrounding region (Grupo Jaragua 2011, entire; Goetz et al. 2012, p. 5; Simons et al. 2013, pS31). As of 2013 there was an estimated loss of nearly 80 km^2 of forest in the area, primarily due to illegal clearing of forest for agricultural activities (Gallagher 2015, unpaginated). Some deforestation occurred, and continues to occur, in the vicinity of the known Black-capped Petrel nesting area (Figs. 3.2, 3.3) where an 11% decrease in forest cover occurred from 2000-2018 (Satgé et al. 2021, p. 583). Moreover, there have been recent episodes of extensive forest fires and severe nest predation by stray dogs in this nesting area (IBCPCG 2021, p. 1).

The size of the breeding population in the Sierra de Bahoruco colony was estimated as less than 200 pairs, although current numbers are uncertain given the recent marked decline in radar detections (Simons et al. 2013, p S19). Cumulative monitoring efforts since 2018 of 95 petrel nesting attempts suggest that overall success rates (53%) are less than that of the nearby portion in Morne Vincent, Haiti (IBPCG 2018; 2019; 2020; 2021, entire). During a recent petrel nesting season (2021-22), 22 of 23 nests monitored in the Loma del Toro portion of this colony were affected by feral dogs (IBCPCG 2022, p. 6). There are no historical estimates of nest success available for comparison to times prior to the introduction of exotic mammals into Black-capped Petrel habitat.

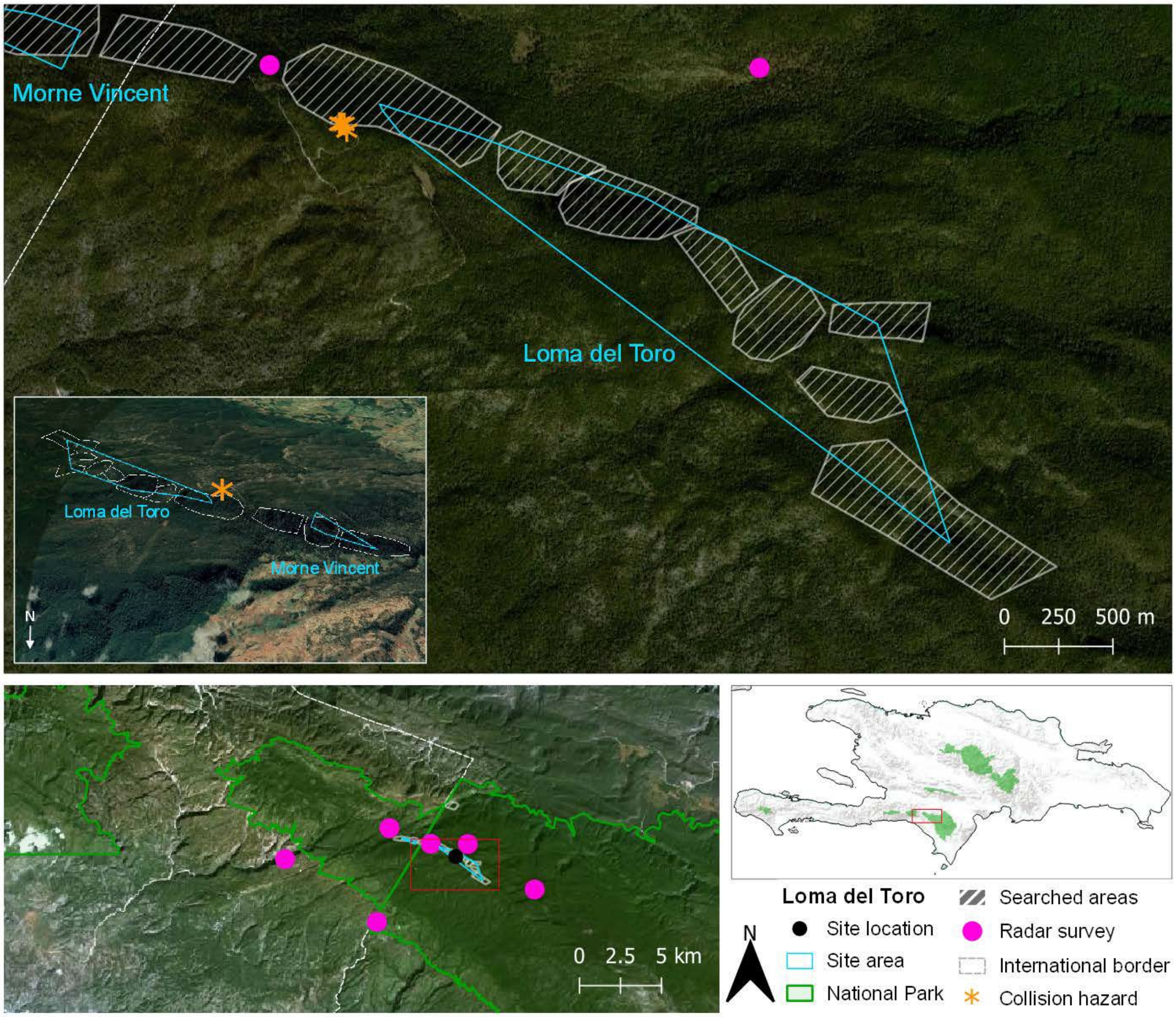


Figure 4.6. Location of the Black-capped Petrel nesting area at Loma del Toro, Dominican Republic. Inset on lower right shows location within Hispaniola. Figure adapted from Wheeler et al. (2021, p. A2-77) and used with author permission.

4.1.6.5. Valle Nuevo National Park, Dominican Republic

Though previously suspected (see Goetz et al. 2012, p. 5; Brown 2013, entire; McKown 2014, entire), nesting by the Black-capped Petrel in the Valle Nuevo National Park was first documented in May 2017 (IBCPCG 2018, p 1). To date, 13 confirmed Black-capped Petrel nests have been identified within an area of approximately 14 ha (34.6 ac) (Wheeler et al. 2021, p. A2-81; IBCPCG 2021, p. 4). The first discovered nest site was at an elevation of 2000 m ASL in an area of secondary broadleaf forest (e.g., *Brunellia comocladifolia* and ferns). The burrow was excavated from a dense mass of decomposing terrestrial herbaceous vegetation and leaf litter. Valle Nuevo National Park is part of the Cordillera Central Mountain range of Hispaniola which is a different physiographic region than the areas hosting other nesting colonies on Hispaniola (Fig. 4.7). Given the apparent similarities of the habitat at Valle Nuevo to that of other known petrel nesting colonies on Hispaniola, the tendency of petrels to form nesting colonies, and the extremely remote and difficult access to the area, it is likely that additional petrel nests exist in this area. As with all other Black-capped Petrel nesting colonies, petrels nesting in Valle Nuevo face the threats of agricultural activities, invasive mammals, habitat loss, and presence of communication towers (Goetz et al. 2012, p. 5; Wheeler et al. 2021, pp. 12-16), in addition to the increasing threat posed by encroachment of invasive ferns which block access to petrel nest sites by both petrels and researchers (Wheeler et al. 2021, p. 14; Davis 2019, p. 58). All nests at Valle Nuevo failed to fledge young during both the 2020 (n = 13) and 2021 (n = 17) nesting seasons, and mongoose predation is believed to be the cause (IBPCG 2021, p. 4).

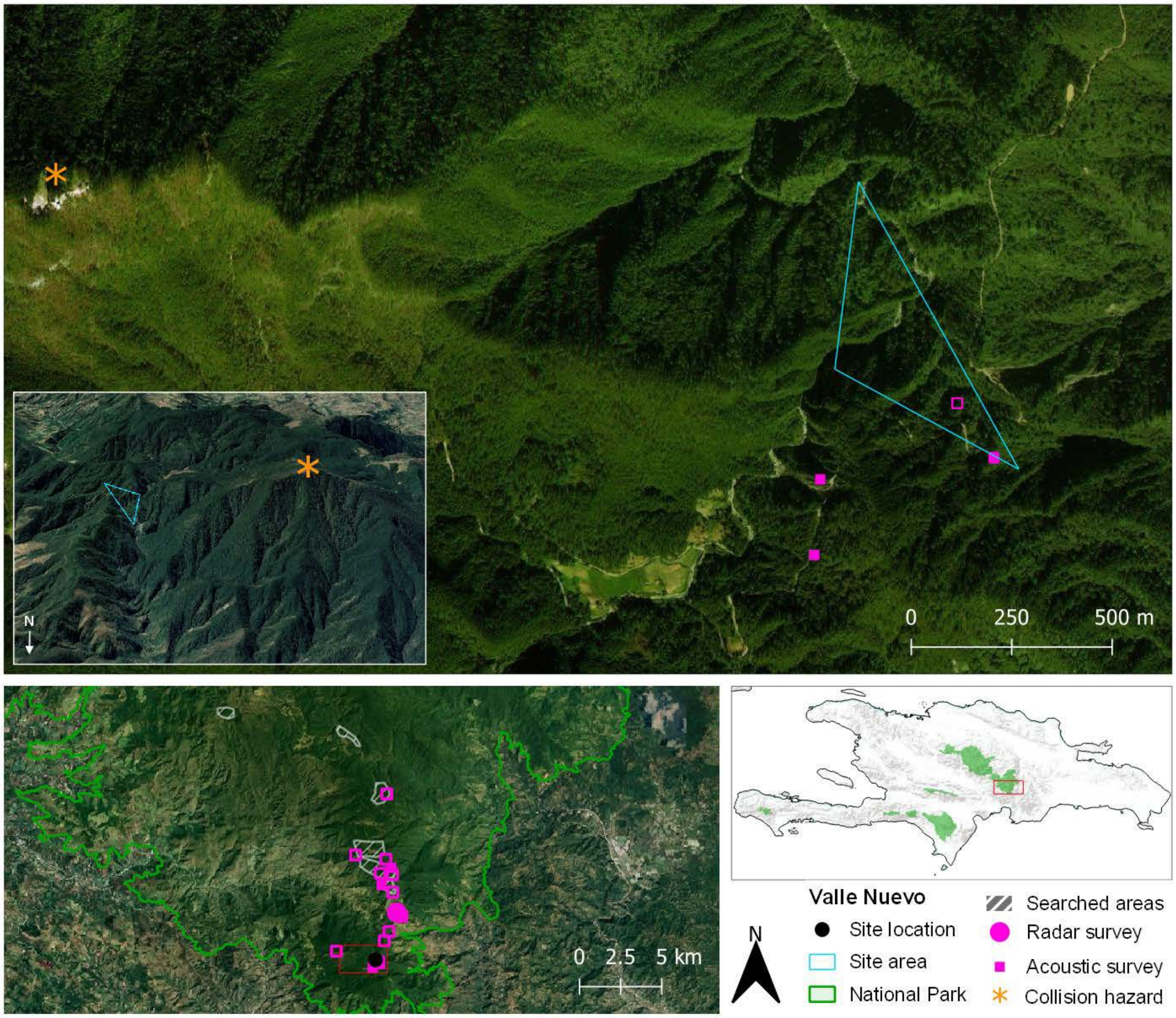


Figure 4.7. Location of the Black-capped Petrel nesting area at Valle Nuevo, Dominican Republic. Inset on lower right shows location within Hispaniola. Figure adapted from Wheeler et al. (2021, p. A2-81) and used with author permission.

4.1.6.6. Loma Quemada, Dominican Republic

Located in the southeastern portion of the Sierra del Bahoruco at an elevation of 1700 m ASL (Fig. 4.8), Loma Quemada is the petrel nesting colony at the lowest elevation (Wheeler et al.

2021, p. A2-80). The habitat at Loma Quemada is similar to Loma del Toro, located approximately 20 km to the west, and it shares many of the same threats from habitat loss and degradation, anthropogenic fires, and predation and nest destruction by invasive mammals such as feral pigs (Wheeler et al. 2021, p. A2-80). As of October 2020, a total of seven petrel nests had been discovered within an area of approximately 11 ha (27.2 ac). Two (29%) of these nests fledged young during the 2020-21 nesting season (IBPCG 2021, p. 4), a similar outcome as the previous (2019-20) season when only 33% (2/6) of nests were successful (IBPCG 2020, p. 5). Preliminary data from the 2021-22 season suggests yet a further decline in nest success (IBCPCG 2022, p. 6).

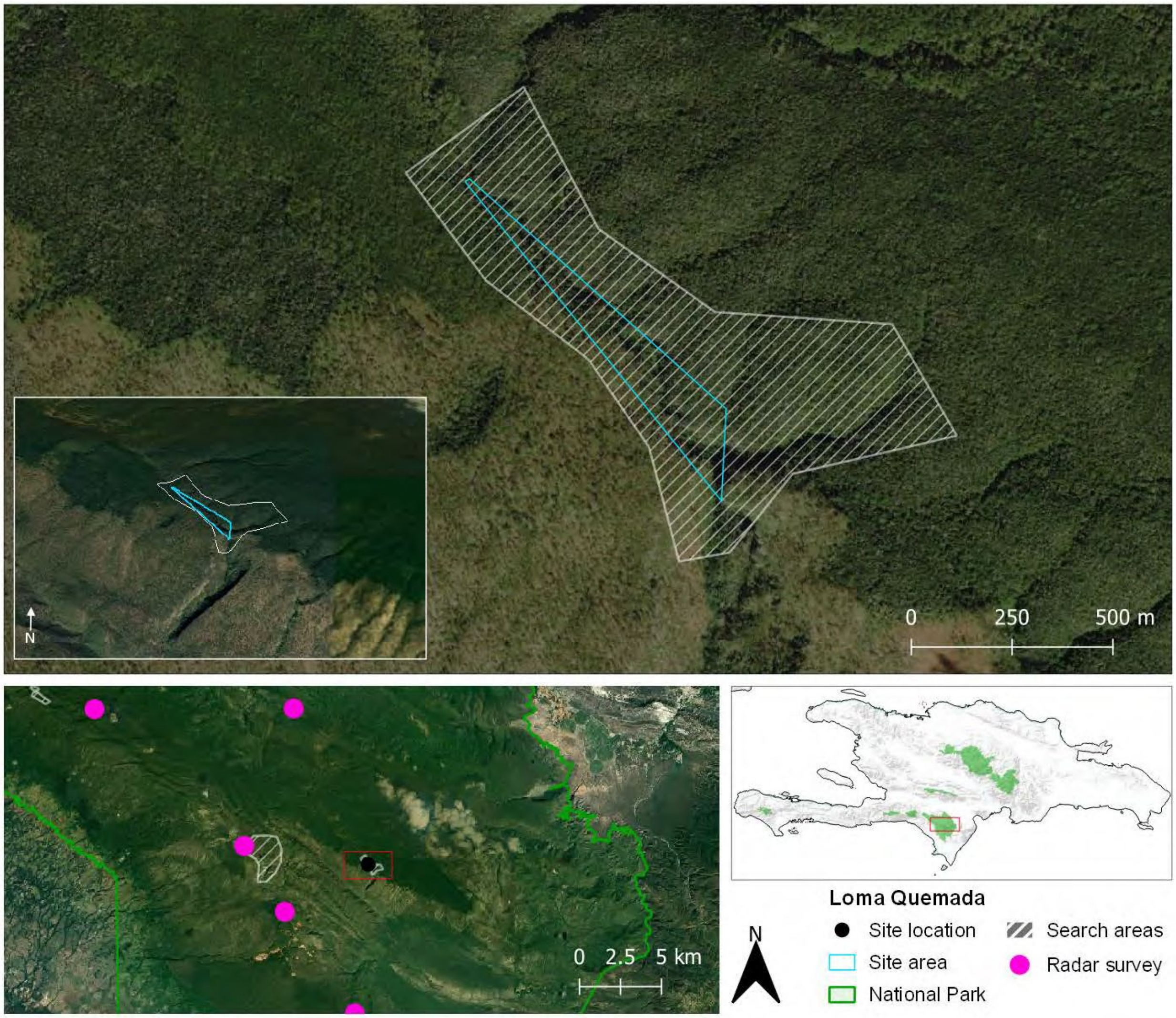


Figure 4.8. Location of the Black-capped Petrel nesting area at Loma Quemada, Dominican Republic. Inset on lower right shows location within Hispaniola. Figure adapted from Wheeler et al. (2021, p. A2-85) and used with author permission.

Table 4.1. Summary of breeding status and survey effort of confirmed breeding locations of the Black-capped Petrel, based on information presented in Wheeler et al. (2021, p. 10) and used with permission of lead author (see Appendix D for additional information from original source).

Site Name	Breeding Status	Geographic Area	Country	Audio/Visual Effort	Ground Search Effort	Radar Effort
La Visite (Tet Opak)	Confirmed (57 nests)	Massif de la Selle	Haiti	High	High	Fully covered
Morne Vincent[1] (Boukan Chat)	Confirmed (17 nests)	Massif de la Selle	Haiti	High	High	Fully covered
Loma del Toro[1]	Confirmed (34 nests)	Sierra de Bahoruco	Dominican Republic	High	Thorough	Fully covered
Loma Quemada	Confirmed (7 nests)	Sierra de Bahoruco	Dominican Republic	Medium	Medium	Fully covered
Valle Nuevo	Confirmed (17 nests)	Cordillera Central	Dominican Republic	Low	Medium	Fully covered

[1] Considered parts of same nesting colony due to proximity

4.2. Black-capped Petrel Current Condition

In the previous section, we described the historical and current range and distribution of the species. In this section, we will characterize species viability in terms of resiliency of the Black-capped Petrel at the population-level and the redundancy and representation at the species-level. As explained in Chapter 1, we define viability as the ability of the species to sustain wild populations, both across its range and among representative units beyond a biologically meaningful timeframe. For the Black-capped Petrel, a biologically meaningful timeframe of 50 years into the future was used, as it corresponds roughly to the length of time since the species was rediscovered in Haiti (i.e., Wingate 1964, entire), thereby providing a temporally equivalent and empirically based frame of reference for predicting future conditions. Additionally, the estimated age at first breeding (i.e., estimated generation time *sensu* Cooke et al. 2018, p. 2) of the Black-capped Petrel is approximately 5 years (Goetz et al. 2012, p. 5; Simons et al. 2013, p. S22), consistent with average age at first breeding (5.3 yrs.) reported for the order Procellariiformes in general (Hamer et al. 2002, p. 247). Thus, 50 years encompasses approximately 10 generations, which we believe is an appropriate timespan to realize predicted effects of factors acting on species viability. We also examined factors affecting species viability at shorter time intervals (10 and 25 years), corresponding to approximately 2 and 5 Black-capped Petrel generations, to inform dynamics affecting the species from current condition to the end of the predictive time horizon.

4.2.1. Population Resiliency

For the purposes of this assessment, resiliency is defined as the ability of the species to withstand normal environmental variation and stochastic disturbances to maintain wild populations over time. Examples of stochastic disturbances that may affect individual populations of Black-capped Petrel include climatic factors such as severe droughts (and associated fires), hurricanes, and excessive rainfall. These disturbances can reduce habitat quality and nesting success on the breeding grounds and may negatively affect population growth. The inherently low reproductive output of the strongly *k*-selected Black-capped Petrel (e.g., 1 egg/nest/year) may further exacerbate negative ramifications of species-wide reductions in nesting success due to stochastic climatic aberrations (Simons 1984, pp. 1073-1074).

Resiliency is measured at the population-level and best characterized by the number of individuals per breeding population; however, the remote locations of breeding populations make it difficult to obtain this information. Some information is available on nest success of each breeding population (see Tables 4.2 and 4.3), but is limited, and we supplement our understanding of resiliency by including the average number of Black-capped Petrels seen annually along defined transects on foraging grounds in the western Atlantic region; after correcting for search effort, average number of petrels observed was relatively low from 1979 to 2016 (Figure 4.9).

A resilient petrel population requires multiple areas of suitable nesting habitat and consistent and adequate pelagic food resources in traditional feeding areas. There are currently an estimated total of 500-1000 breeding pairs across the species' range given data and observations over the past 10-15 years (Simons et al. 2013, p. S22). The number of breeding pairs have declined precipitously from historic to contemporary times, and overall success of known existing nests is currently medium (10-year mean of 61%; n = 456 cumulative nesting efforts), and with substantial temporal and spatial variation (see IBPCG 2018; 2019, 2020; 2021, entire; Brown and Jean 2020; 2021, entire).

Table 4.2. Relative condition of factors used to determine Black-capped Petrel resiliency.

POPULATION RESILIENCY FACTOR	HIGH	MEDIUM	LOW
ACOUSTIC DETECTIONS / MINUTE IN NESTING AREA[1]	>4	1-4	<1
RADAR DETECTIONS / NIGHT[1]	>500	100-500	<100
NUMBER ACTIVE NESTS[2]	>40	21-40	1-20
NEST SUCCESS (% nests fledging young)[3]	>67%	29-67%	<29%

[1] During January-February activity peak (Simons et al. 2013, entire)

[2] Values based on known range of total active nests/area (7-57) (Wheeler et al. 2021, p. 10; IBPCG 2021, p. 3). Values for low, medium, and high categories determined by rounding this range to 0-60 and dividing into three equal intervals.

[3] Value ranges based on published estimates for the Bermuda Petrel (0.29-0.67) (Wurster and Wingate 1968, p. 980; Simons 1984, p. 1067; and Madeiros 2012, p. 40).

Table 4.3. Overall conditions of known or suspected breeding populations of Black-capped Petrels (BCPE), based on resiliency factors in Table 4.2.

Population	Calls/Minute	Radar Targets	Active Nests	Nest Success[1]	Overall Condition
Pic Macaya[2]	Low	Unknown	Unknown	Unknown	Unknown
Pic La Visite	High	High	High	Medium	High
Morne Vincent/ Loma Del Toro	Medium	Medium	High	Medium	Medium
Loma Quemada	Unknown	Low	Low	Low	Low
Valle Nuevo	Low	Low	Low	Low	Low
Dominica[2]	Low	Medium	Unknown	Unknown	Unknown

[1] Based on an average of the most recent (2018-2021) monitoring data (IBPCG 2018, 2019, 2020, 2021, entire; Brown and Jean 2021, entire).

[2] Included because of several inland detections and sightings of BCPE. No actual nesting has been documented to date (Dominica) or during past 20 years (Pic Macaya) (Wheeler et al. 2021, p. 10).

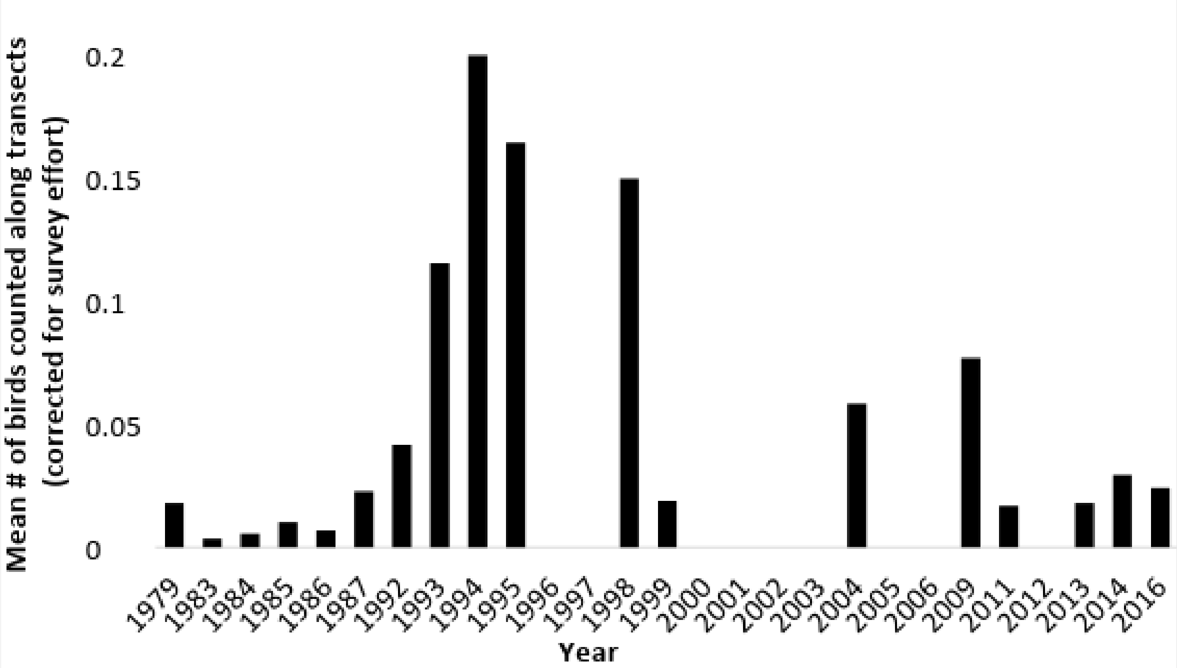


Figure 4.9. Black-capped Petrel sightings on foraging grounds in pelagic zones of the Southeastern United States (ranging from Virginia to Florida). Survey effort varied greatly by year, so the data were corrected for search effort to facilitate year-to-year comparison.

To quantify resiliency of the Black-capped Petrel, we compared current population resiliency to the historic optimal, based on known prior distribution and number of breeding populations. We used the following methodology:

- (1) Based on resiliency factor categories assigned to breeding populations (Table 4.3), the following values were assigned: High = 3, Medium = 2, Low = 1. This was done to calculate an overall average resiliency for each breeding population.

- (2) After calculating the overall average resiliency of each site, we then calculated overall resiliency for the species (i.e., redundancy). This was done by using a scale of 0-1 with equal divisions. The following levels were assigned for redundancy: Low <0.34, Medium = 0.34 - 0.66, and High = >0.66). We used this value as a comparison to the historic optimal population resiliency.

- (3) After calculating species redundancy, we determined the historic optimal population resiliency (High resiliency x eight sites = 3x8 = 24). Doing so allowed to calculate deviation of current redundancy from this "optimal" redundancy (i.e., uniformly high historical population resiliency). This was done by dividing the sum of current population resiliencies (*PRc*) (using zero to indicate now extirpated populations) by the historical optimal (*PRopt*):

$$\sum_1^n (PRc)/PRopt = (3+2+1+1+0+0+0+0)/(3*8) = 7/24 = \mathbf{0.292}$$

From these calculations, the current resiliency of the Black-capped Petrel is low, with less than a third (0.292) of its historical optimal resiliency.

Table 5.1. Resiliency scores for both current and the historic optimal by site.

Site	Historical Optimal Resiliency	Current Resiliency
Pic La Visite	High (3)	High (3)
Morne Vincent/Loma Del Toro	High (3)	Medium (2)
Loma Quemada	High (3)	Low (1)
Valle Nuevo	High (3)	Low (1)
Pic Macaya	High (3)	Extirpated (0)
Martinique	High (3)	Extirpated (0)
Guadeloupe	High (3)	Extirpated (0)
Dominica	High (3)	Extirpated (0)
SUM	**24**	**7**

4.2.2. Species' Redundancy

Redundancy reflects the capacity of a species to persist in the face of catastrophic events. This is best achieved by having multiple, widely distributed resilient populations across the geographical range of the species. Redundancy helps preserve genetic and adaptive diversity and evolutionary flexibility in the species.

Black-capped Petrel redundancy is characterized by the number and geographic dispersion of resilient populations. Currently, redundancy is characterized by four breeding populations occurring on one island. Although 2 nests were recently (May 2022) discovered in Haiti on Pic de La Selle near the current population at Pic La Visite (IBPCG 2022, p. 3), no additional data exist regarding this potentially additional population. Given the proximity and analogous life history characteristics of the known nesting colonies, the probability that these colonies would be similarly affected by an extreme climatic event is high. Although total numbers of nests per population are uncertain, most nests (80-90%) are believed to be within the Pic La Visite and Morne Vincent/Loma del Toro nesting areas (Brown and Jean 2021, p. 2). This means that most nests are within a geographically restricted area, which would hinder the species' ability to face catastrophic events. Additionally, this geographically restricted area is currently subject to significant and increasing pressure from deforestation and other anthropogenic activities (IBPCG 2019, pp. 2-3; Wheeler et al. 2021, p. A2-74).

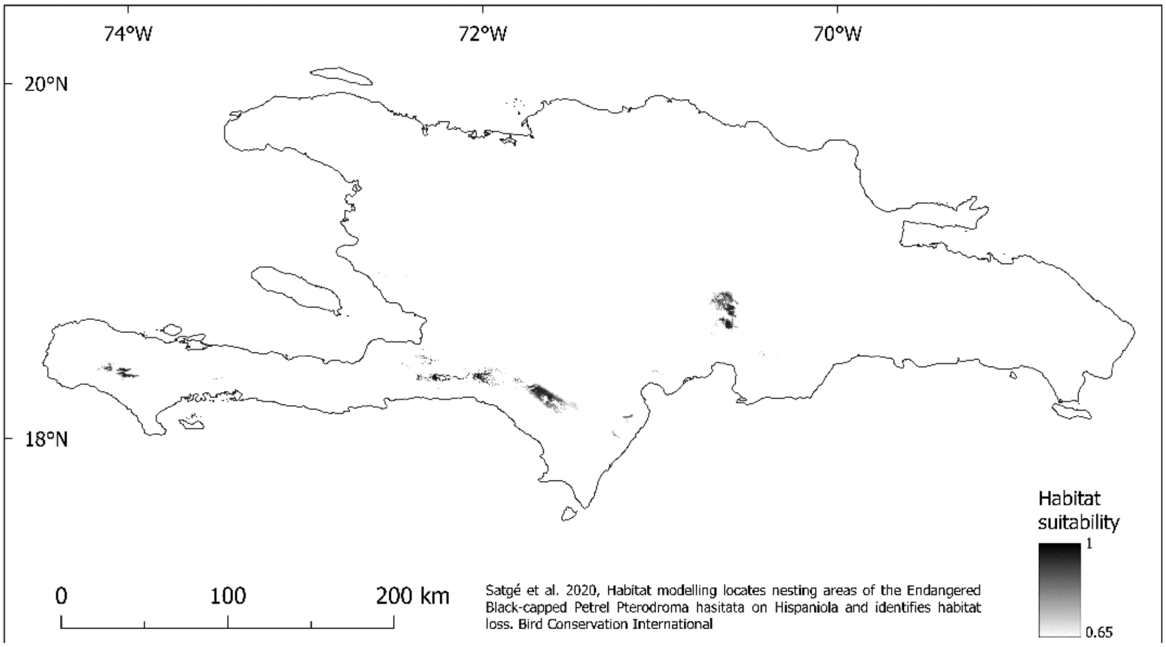
4.2.3. Species' Representation

Representation reflects the adaptive capacity of a species in the face of current and future physical (e.g., climatic variations, habitat degradation, and anthropogenic structures) and biological (e.g., novel predators, pathogens) stressors. This capacity is typically expressed by the existence of genetic and phenotypic (e.g., behavioral) diversity. For the Black-capped Petrel, genetic representation currently consists primarily of two distinct color forms (i.e., "light", "dark"). Howell and Patteson (2008, entire) reported seasonal differences in the relative abundance of color morphs on pelagic foraging grounds, with the light form being more common during May and June, while dark form individuals were more common during late summer and fall. Moreover, there is evidence that the light forms may breed up to 1.5 months prior to dark forms (Grupo Jaragua 2021, p. 2; Satgé et al. 2022, entire). There is a 1.2% fixed genetic difference between the two forms (Manly et al. 2013, p. 232), which is within the range typically observed in polytypic species or between sister species, suggesting the possibility of two distinct and genetically differentiated populations. The factors responsible for the existence and maintenance of these color forms are unclear, and this question cannot be resolved without additional behavioral and genetic research in breeding populations (Manly et al. 2013, p. 232). The lack of data on the relative abundance of each color form, or regarding their geographic origin in terms of breeding populations, are exacerbating the uncertainty associated between the forms (and their associated contribution to adaptive capacity).

The Black-capped Petrel exhibits substantial latitudinal variation in their foraging areas (Jodice et al. 2015, p. 25). The species can be found in a wide range of pelagic habitats, with representation ranging from tropical southern Caribbean waters to the northeastern Gulf of Mexico and the more temperate and cooler areas of the mid-Atlantic Gulf Stream. Over the course of the year, individual birds are known to travel over a total range of approximately 25 degrees latitude (i.e., 10°-35°) with the greatest ranges exhibited during the nonbreeding season (Jodice et al. 2015, pp. 26-27). This wide-ranging behavior is because the birds depend on accessing specific marine conditions and environments for foraging (Simons et al. 2013, pp. S23-S29), which are geographically disjunct and distant (Jodice et al. 2015, entire). Although all currently known breeding populations occur on Hispaniola, there is no data on the genetic structure or diversity within individual breeding populations, nor regarding the degree of genetic exchange, if any, between breeding populations (Simons et al. 2013, p. S6).

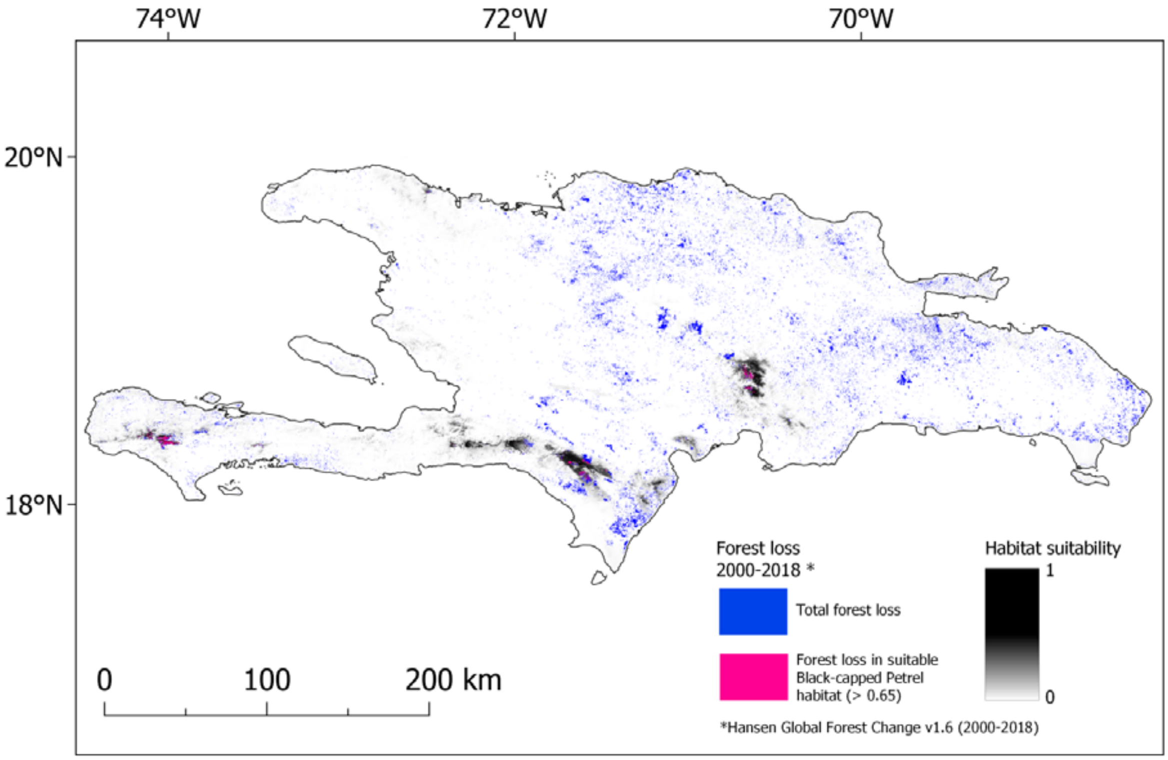
Historical records up to at least the early 19th century also documented nesting by the petrel on at least three additional islands: Dominica, Guadeloupe, and Martinique (Simons et al. 2013, pp. S10-S13), as well at Pic Macaya in western Haiti up to the end of the 20th century (Wheeler et al. 2021, pp. A2-71, 83). Of these, only Dominica currently presents credible evidence of the possible existence of a yet extant breeding population (Brown 2015, entire, Wheeler et al. 2021, p. A2-95). Based on recent habitat suitability modelling for the species , there are an estimated 563 km^2 of potentially suitable nesting habitat (suitability indices > 0.65) throughout Hispaniola, with only about 167 km^2 considered "highly suitable" with indices > 0.9 (Fig. 4.10, see also Satgé et al. 2021, p 581). Of the predicted suitable nesting areas, approximately 75% are in the Dominican Republic (Satgé et al. 2021, p. 581). Geographic representation for the species consists currently of a loose assemblage of four small breeding populations on Hispaniola, and those areas with currently known nest sites occupy, in aggregate, approximately 2 km^2 (Wheeler et al. 2021, pp 73-82).

According to Satgé et al. (2021, p. 581), because of accelerated forest loss during 2000-2018 (Lloyd and Leon 2019, p. 5) the amount of suitable nesting habitat (>0.65) declined concomitantly by 15.5% (103.5 km^2) and that of highly suitable (> 0.9) by 16.7% (33.4 km^2; see Fig. 4.11). Accordingly, current representation in terms of nesting habitat is limited to a relatively narrow range of characteristics shared by all four known breeding areas and populations. Thus, there are credible past records of up to at least eight breeding populations of the species within the Caribbean, compared to the four currently, for an approximate 50% reduction in geographic representation since the early 19th century.



Satgé et al. 2020, Habitat modelling locates nesting areas of the Endangered Black-capped Petrel Pterodroma hasitata on Hispaniola and identifies habitat loss. Bird Conservation International

Figure 4.10. Areas of predicted Black-capped Petrel nesting habitat suitability on Hispaniola. Figured adapted from Satgé et al. (2021, p. 583) and used with author permission.



*Hansen Global Forest Change v1.6 (2000-2018)

Figure 4.11. Forest loss and Black-capped Petrel nesting habitat suitability on Hispaniola. Blue represents all areas of forest loss from 2000-2018, while pink represents forest loss that occurred in areas suitable for nesting. Figure adapted from Satgé et al. (2021, p. 584) and used with author permission.

Current Conditions Summary and Synthesis

From these analyses, the Black-capped Petrel currently suffers from low resiliency, poor redundancy, and only half of its historical representation. Principal factors that have adversely affected current conditions include increases in 1) forest fires, 2) predation of nests and adults by invasive mammals, 3) loss and degradation of nesting habitat, and 4) direct effects of hurricanes and tropical storms. Resiliency of the Valle Nuevo nesting population in the Dominican Republic has experienced an apparent complete failure of all known nests over the past 2 (2020, 2021) nesting seasons (IBPCG 2021, p. 1; IBCPCG 2022, p. 6), largely because of mongoose predation.

Additionally, a major tourist development is underway in the Dominican Republic and located along petrel flight paths between the nesting areas in the Sierra del Bahoruco and the Caribbean Sea. According to official statements and published plans by the Dominican government, this development will consist of a major international airport, large marina or cruise ship terminal, luxury apartment buildings, and several major resort hotels. While likely needed for the economic welfare of the local citizens, the infrastructure associated with such developments also inevitably results in a substantial increase in artificial lighting, including that of commercial and private aircraft during nighttime arrivals and departures. Indeed, concerns have recently been raised by local residents over the potential for environmental damage and degradation resulting from this development project (DRS 2022, unpaginated).

Such threats on the nesting grounds are currently reducing the species' reproductive success in affected breeding populations through direct losses of adult breeding birds. For strongly *k*-selected species such as the Black-capped Petrel, losses of breeding adults exacerbate the ecological effects of lowered reproductive output because of the level of parental care they provide to offspring, and population modeling for similar species have shown that such combined effects – if not controlled - can quickly place the species at risk of extinction (Simons 1984, p. 1071). Even a rather "generic" population viability analysis (PVA) based on composite data from 35 other *Pterodroma* species predicts a steady decline in population viability for the Black-capped Petrel during this century, with a nearly 75% decrease in total population over the next 50 years (Wheeler et al. 2021, p. 18).

Nearly 50% of all known active nests are also concentrated in a single area of only one hectare (i.e., Pic La Visite) (Wheeler et al. 2021, pp. 10, A2-73), which lowers redundancy. From recent species-specific habitat modelling (Satgé et al. 2021, entire) we know that the amount and distribution of suitable nesting habitat for the species on Hispaniola is approximately 70% less than previously believed (i.e., USFWS 2019, p. 48), and that such habitats have been severely reduced and fragmented by ongoing forest loss for the past two decades. This limited availability and distribution of suitable high-elevation nesting habitats renders such areas highly vulnerable to slight changes in environmental conditions due to climate change. Recent (2018-2021) trends and data suggest that the factors which impinge upon species persistence (summarized in Table 4.4) are increasing in both magnitude and biological impact.

Table 4.4. Summary of location and type of factors impacting the Black-capped Petrel. Symbols indicate factors affecting the species or habitat (✓), factors that have the potential to affect the species or habitat (✸), and extirpated (X).

Nesting Areas	Deforestation	Human Predation	Forest Fires	Introduced Mammals	Communication Towers	Artificial Lighting	Invasive Ferns	Wind Energy	Mining	Development	Oil and Gas	Contaminants/Mercury	Plastics/Marine Debris	Fisheries	Climate Change	Hurricanes	Conservation Actions
Sierra de Bahoruco, Dominican Rep/Loma del Toro	✓		✓	✓	✓	✓		✸	✓	✓					✸	✸	✸
Valle Nuevo National Park, Dominican Republic	✓		✓	✓	✓	✓	✓								✸	✸	✸
Loma Quemada, Dominican Republic	✓		✓	✓	✸	✸		✸	✓						✸	✸	✸
Pic La Visite, Haiti	✓	✸	✓	✓	✓	✓									✸	✸	✸
Morne Vincent, Haiti	✓	✸	✓	✓	✓	✓									✸	✸	✓
Pic Macaya, Haiti	✓		✓	✓											✸	✓	✸
Martinique	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Guadeloupe	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Dominica	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Foraging/Marine Habitat						✓		✸			✸	✸	✸	✸	✸	✸	

Further, because of the recent and significant deterioration in political stability and socioeconomic conditions in Haiti (see https://www.bbc.com/news/world-latin-america-63042307), the environmental pressures associated with local food and fuel production have also increased, as impoverished communities and villages seek necessary resources for survival with no effective government enforcement of environmental laws or regulations. Against this backdrop is the fact that these same conditions have also severely hampered - and in some cases halted – previous species conservation efforts by local and outside non-governmental organizations (NGOs).

Finally, current global geopolitical and economic conditions have increased the urgency of acquiring and maintaining reliable and low-cost sources of energy, both renewable and petroleum based. The recent discovery of economically significant sources of Rare Earth Elements (REE) in the southern Sierra del Bahoruco prompted the Dominican government to set aside a large tract of land near current petrel nesting areas for the exploration and extraction of these resources, which are critical components in solar and cellular communication technologies. Likewise, there are plans for expansion of offshore wind turbines in the northern Gulf of Mexico and off the eastern seaboard of the USA, in areas known to be used by Black-capped Petrels. The plans for tourism development in the southwestern Dominican Republic include the expansion of existing wind turbines in the area to supply the anticipated increase in local energy needs.

Threats related to anthropogenic stress and climate change have caused reduced resiliency of breeding populations, which in-turn cause low species-level redundancy. This hinders the ability of the species to withstand climate change-induced catastrophic events (e.g., hurricanes), and inflexible breeding habitat requirements would make it difficult to move to other geographic areas, should their current terrestrial habitat become unsuitable. Therefore, current condition for the species is fairly low.

Chapter 5. Future Conditions

We have considered the known biological and ecological needs of the Black-capped Petrel (Chapters 3), including the factors driving current condition of those needs (Chapter 4). In this Chapter, we consider how those factors may affect future conditions for the species, relative to its continued viability as a species. We examine future conditions at 10, 25 and 50 years into the future from the date of this assessment. These time periods correspond to approximately two, five, and ten generations for the Black-capped Petrel (Simons et al. 2013, p. S22), and are within the predictive range of existing supporting data.

5.1 Introduction

Given the limited data available on Black-capped Petrel population dynamics (see Chapter 2), we focused efforts on determining future habitat suitability, because species viability depends upon its continued access to adequate breeding and foraging areas. This was done by assessing predicted regional climate change, as well as estimating future anthropogenic pressures to the species, using human population growth as a proxy. There exist adequate data and recent studies upon which to make reasonable predictions of future conditions within the known range of the species, relative to these drivers (Smucker et al. 2007, entire; Campbell et al. 2011a, entire; Hass et al. 2012, entire; Karmalkar et al. 2013, entire).

Future regional climate change is assessed by reviewing available literature, and predicted species response, on Hispaniola. In terms of overall importance to the species, Hispaniola (terrestrial and adjacent marine habitats) and the western North Atlantic areas containing the Gulf Stream appear to be essential for species viability. Our estimates of future conditions for the petrel are therefore focused primarily on these two geographic areas. Hence, this is the spatial level of resolution of this Chapter.

Anthropogenic pressures on the species were estimated using available data and current demographic projections from the United Nations (UN 2017) for Haiti and the Dominican Republic, using estimated total human population, as well as human population densities for both countries. Because of past, current, and projected socioeconomic conditions on Hispaniola, changes in human population and human population density result in changes in environmental pressures associated with local natural resource consumption (Smucker et al. 2007, p. 9). These changes directly and indirectly affect current breeding habitat and nesting success of the Black-capped Petrel (Smucker et al. 2007, entire; Checo 2009, entire; Goetz et al. 2012, pp. 6-8; Simons et al. 2013, pp. S30-S34).

5.1.1 Regional climate change

Climate change is expected to impact the petrel through changes in temperature and rainfall patterns, increased frequency of intense hurricanes, and possibly marine foraging habitat changes. The future effects of climate change on both terrestrial and marine habitat of the Black-capped Petrel remains uncertain, albeit likely an additional environmental stressor for a species increasingly subject to numerous other interrelated threats (see Section 3.1). The local climate of the currently known petrel nesting areas on Hispaniola is projected to become hotter and drier over the next 50-60 years, with less differentiation between wet season and dry season rainfall amounts (Taylor et al. 2012a, entire). Recent analyses of projected future climate patterns in the Caribbean region (Campbell et al. 2011a, entire; Karmalkar 2013, entire) predict a median increase in annual surface air temperature of 2.8°C (range 2.1-3.1) within current petrel nesting areas on Hispaniola by year 2080. Additionally, precipitation is projected to substantially decrease during the early (May-July) and late (August-October) wet seasons for these same areas with a generally drier precipitation pattern year-round. Percentage decreases in early wet season precipitation are projected to be greater (median -41%) than decreases in late wet season precipitation (median -22%). Decreases in wet season precipitation are particularly significant, as those months are when the greatest amount of annual rainfall occurs (Karmalkar et al. 2013, pp. 301-303). Decreases in dry season precipitation are projected to be comparatively less than decreases during the wet seasons by current models (Karmalkar et al. 2013, pp. 301-303), resulting in an overall future reduction in the degree of bimodality of current wet/dry seasons in the western Caribbean (e.g., Hispaniola).

Although the full ecological effects of a projected hotter and drier climate in the current Black-capped Petrel nesting areas on Hispaniola are complex and unknown, it is likely such a change will increase the frequency and intensity of forest fires (Schumacher et al. 2006, p. 541; Weibel et al. 2009, entire). Any increases in this disturbance are likely to have significant adverse effects on species viability. Decreased rainfall and humidity during the traditional wet seasons may also exacerbate effects of naturally occurring fires from lightning strikes (Rorig et al. 2007, p. 606; Dowdy and Mills 2012, p. 2028). Fires would likely become more intense and extensive (Weibel et al. 2009, entire), mimicking the effects of the more damaging dry season anthropogenic fires (see Section 3.1.3). Such effects include elimination of naturally occurring seed banks, increased erosion and mudslides, and loss of accumulated organic humus layers which may be used as nest sites by Black-capped Petrels. Because the early wet season (May-July) is projected to experience the greatest reduction in precipitation, increased occurrence of forest fires at such time increases risks to nesting Black-capped Petrels as well as fledglings which leave nests during this season.

Changes in temperatures and rainfall patterns are not the only projected effects of regional climate change for Hispaniola. The frequency of intense hurricanes (i.e., Categories 4 and 5) are predicted to increase for the region (Elsner et al. 2008, entire; Knutson et al. 2013, entire). In addition, the amount of precipitation associated with these atmospheric events is projected to increase by at least 11%, with up to 20-30% increases in precipitation near the center of these storms. Higher rainfall associated with such storms may be further exacerbated by a long-term trend in reduced translation times, thereby increasing storm residency times over land (Kossin

2018, p. 104). As summarized by Bender et al. (2010, p. 458): *"…results suggest that a significant anthropogenic increase in the frequency of very intense Atlantic hurricanes may emerge from the background climate variability in the latter half of the 21st century, despite a projected decrease in the overall number of hurricanes"*.

In upper elevation Caribbean forests, intense hurricanes cause widespread and severe damage to vegetation at all strata, including large accumulations of organic debris (Figure 5.1) which may block or otherwise impede access by petrels to previously existing nest burrows. The physical and ecological effects of these storms may persist for decades and include redirection of ecological succession, changes in the ecological space available to organisms, and wholesale changes in forest microhabitats (Lugo 2008, p. 383; Tanner et al. 2022, p. 2) (Figure 5.1).

Figure 5.1. Examples of damage to upper elevation rainforest in Puerto Rico caused by the category 5 hurricane Maria on 20 September 2017. Note widespread severe defoliation and major structural damage to trees in both images, and landslides in background of lower image. Photos taken by T. White, 4 October 2017.

Hurricane-induced erosion and landslides could severely affect Black-capped Petrels by degrading or eliminating currently productive nesting areas, particularly if said areas undergo prior degradation and ground cover loss due to forest fires or anthropogenic land-clearing. Hurricanes also accelerate habitat transformations of Caribbean montane forests through the process of thermophilization, whereby tree species composition shifts towards greater abundance of species associated with warmer environments (Tanner et al. 2022, p. 2). Such changes can affect the microhabitat and microclimate of petrel nest sites, potentially reducing their suitability for successful nesting. Projected climate change and associated effects on hurricane intensities may also have repercussions for Black-capped Petrels in their marine foraging areas. Recent projected increases in major hurricane activity in the region due to climate change predict hurricane-related mortalities of Black-capped Petrels could nearly double over the next 100 years (i.e., 50% increase over a 50-year period) from this factor (Figure 5.2), particularly from the powerful "Cape Verde" hurricanes (Figure 5.3) for which landfall rates along the southeastern USA coast are projected to increase 10% per decade over the next century (Bender et al. 2010, entire; Knutson et al. 2010, entire; Hass et al. 2012, pp. 256-257).

Finally, future climate-related changes in ocean-atmospheric interactions such as the North Atlantic Oscillation (NAO), Atlantic Meridional Overturning Circulation (AMOC), Intertropical Convergence Zone (ITCZ) and Sea Surface Temperatures (SST) can have substantial and interrelated effects on southern Caribbean and coastal marine upwelling ecosystems (Taylor et al. 2012b, entire; Rueda-Roa and Muller-Karger 2013, entire). Any weakening or shifts of the Gulf Stream would result in spatiotemporal changes in the upwellings and ephemeral eddies and associated food availability along the western edge where petrels and other seabirds abundantly forage (Haney 1986, p. 282; Bakun et al. 2015, p. 88). In a study of effects of climate change on foraging habitats of Pacific marine top predators (including Procellarid seabirds), it was predicted there would be up to a 35% change in core habitat for some species, with Hazen et al. (2013, p. 234) stating: "*For already stressed species, increased migration times and loss of pelagic habitat could exacerbate population declines or inhibit recovery*".

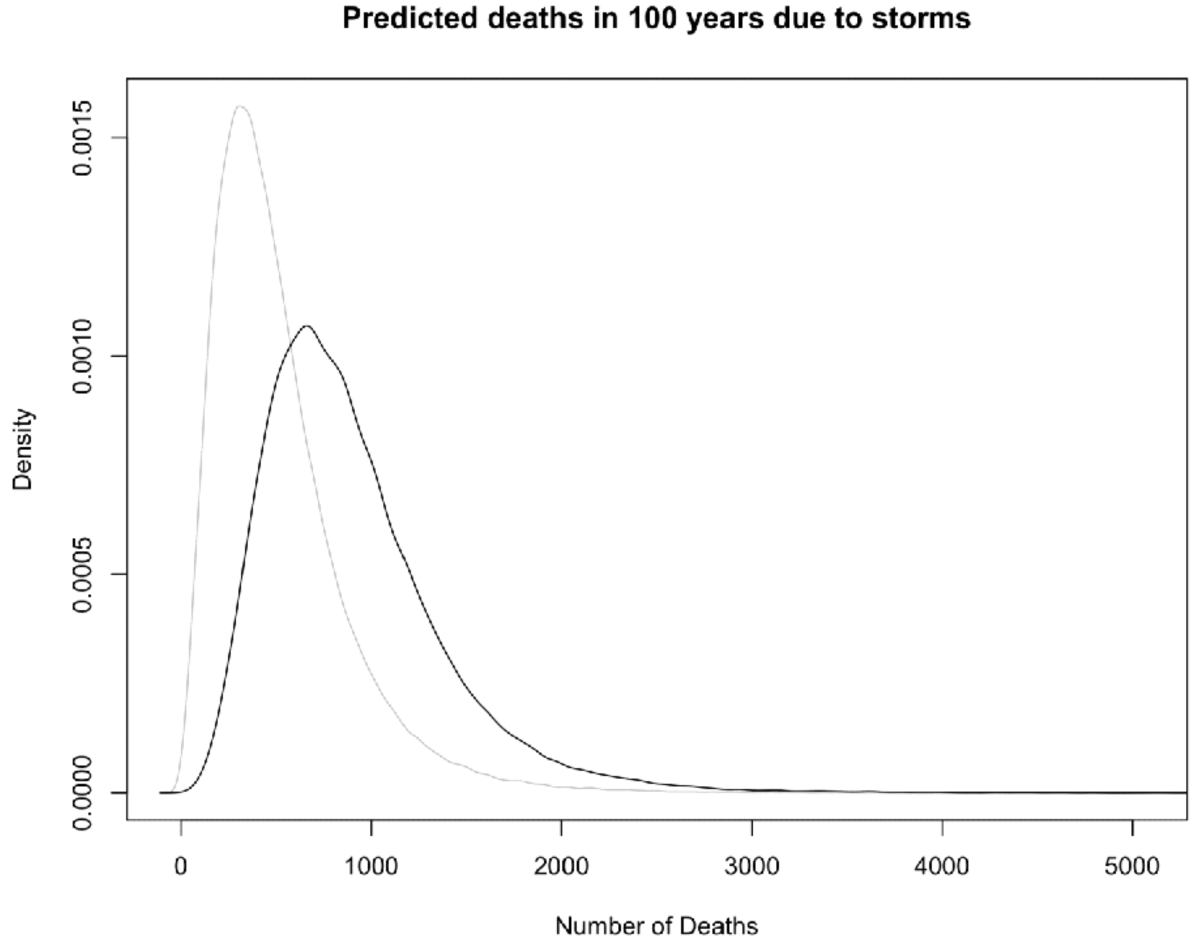


Figure 5.2. Predicted Black-capped Petrel mortality in 100 years due to Atlantic storms. Assuming hurricane activity over the next century mirrors the past century, median cumulative mortalities is 437 (gray line). 1% annual increases due to climate change results in 807 petrel deaths (black line). Figure adapted from Hass et al. (2012, p. 257).

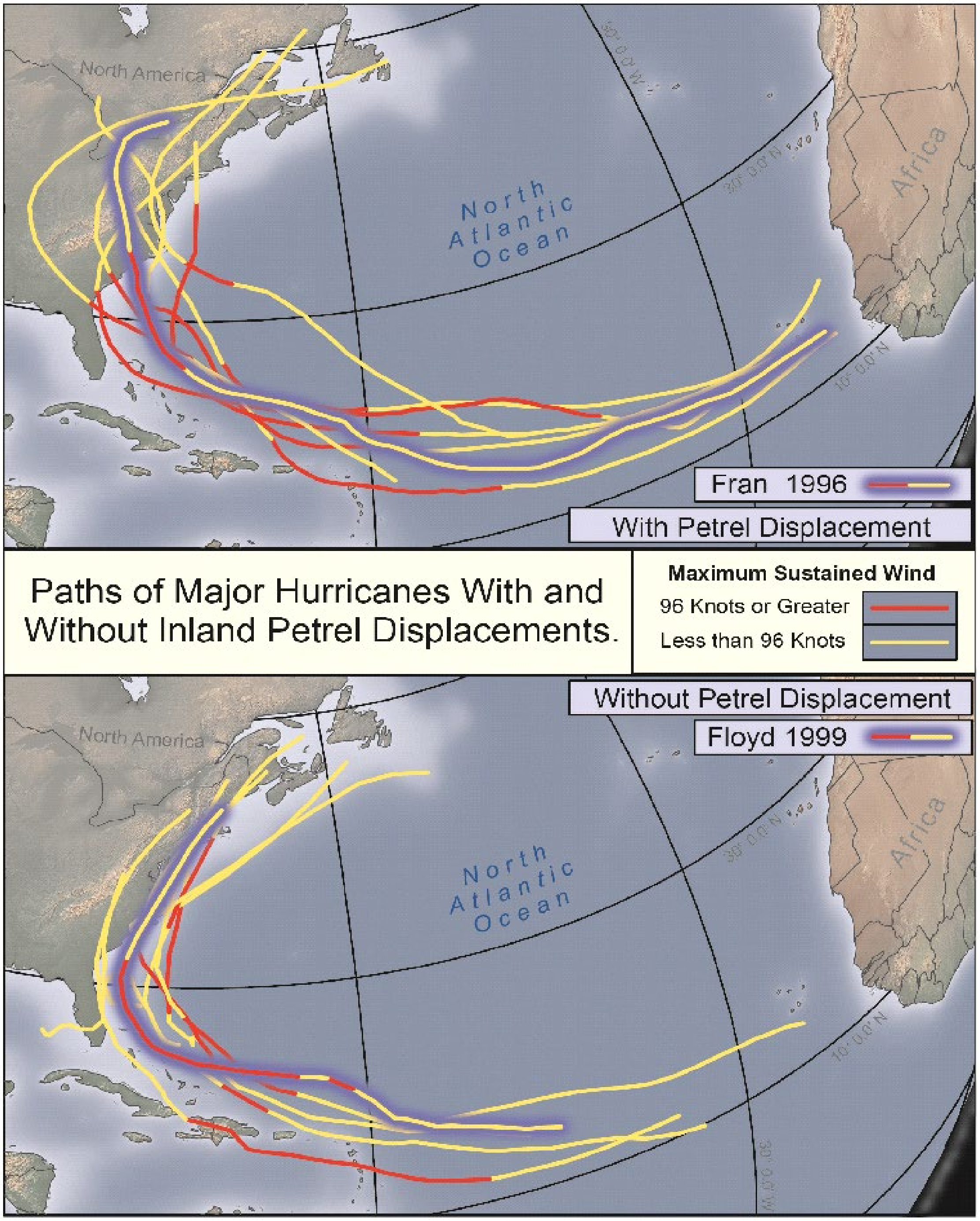


Figure 5.3. Top: Trajectories of all major landfalling hurricanes (1893-2003) that displace Black-capped Petrels inland originate near Cape Verde islands and strike coast before recurving. Hurricane Fran depicts typical path of such storms. Bottom: Trajectories of all major landfalling hurricanes (1960-2003 only) that did not displace Black-capped Petrels inland display more westward origins and recurved paths prior to landfall. Hurricane Floyd depicts typical path of such storms. Figure adapted from Hass et al. (2012, p. 254) and used with permission of primary author.

5.1.2 Anthropogenic Stress - Hispaniola

Haiti is the second most densely populated country in the western hemisphere, with increasing numbers of people living in densely populated lowland urban areas (Smucker et al. 2007, p. 4). This has significant environmental implications. Associated impacts of anticipated future environmental resource demand that will impact viability of the Black-capped Petrel may include wind energy and communication towers, which increase probability of collisions; offshore oil and gas production, plastic pollution, and marine fisheries, which decrease suitability of marine habitat; as well as subsistence agriculture, forest fires, and charcoal demand, which increase deforestation.

Eighty percent of household energy requirements in Haiti are met with firewood and charcoal. Household consumption of charcoal is on the decline in the Dominican Republic, while in Haiti, charcoal consumption is predicted to increase (Smucker et al. 2007, pp. 113-115; Checo 2009, entire). Although charcoal is also used for household cooking in the Dominican Republic, the use there (3.1% of households) is significantly less than that of Haiti, given that most Dominican households have access to – and can afford – liquefied propane gas, which supplies 79% of the country's energy needs. Most of the charcoal produced and exported to Haiti from the Dominican Republic is done illegally, therefore, accurate estimates of the total amount exported are elusive. Recent published estimates range from 21 to 50 thousand tons per year (Smucker et al. 2007, pp. 113-115; Checo 2009, p. 1).

This analysis assumes a linear relationship between projected human populations on Hispaniola and environmental resource demand. For each scenario, predicted anthropogenic stress and published estimates of charcoal demand are used to inform estimated area of forest cleared; based on area/volume studies, an average of 12.2 tons of charcoal is produced per hectare of forest cleared (Checo 2009, unpaginated). Estimates of forest conversion are conservative given that cutting of forests for charcoal production frequently occurs concurrent with, or prior to, expansion of agricultural production into previously forested areas. Thus, these population-driven anthropogenic factors (charcoal production, agricultural clearing) are not mutually exclusive.

For each of the following scenarios, we assessed how resiliency (a population-level metric) of Black-capped Petrel populations may be impacted by fuel charcoal demand changes due to population pressures, and the projected amount of forest hectares lost from this demand over the next 50 years (i.e., 2020 to 2070):

> ***Scenario 1*. Baseline growth and charcoal demand**: Human population growth on Hispaniola remains consistent with current UN projections (i.e., "baseline scenario"), charcoal demand increases at baseline rate, and amount of land cleared for charcoal increases at baseline rate.

> ***Scenario 2*. Low growth and charcoal demand**: Human population growth on Hispaniola occurs at annual rates 20% less than UN projections, charcoal demand decreases, and amount of land cleared for charcoal decreases.
>
> ***Scenario 3*. High growth and charcoal demand**: Human population growth on Hispaniola occurs at annual rates 20% greater than UN projections, charcoal demand increases, and amount of land cleared for charcoal increases.

We determined proportional change in redundancy under each scenario through dividing the sum of predicted resiliency across sites (at the 2070 timestep) by the average of historic optimal resiliency; we then used this value, which is the proportion of optimal redundancy the species is predicted to have in each scenario, by current redundancy (*Rcov*), expressed as:

$$\left(\sum_1^n (PRs)/PRopt\right)/\ Rcov$$

For each nesting area and scenario, a population-level resiliency value of low (one), medium (two), or high (three) was assigned for predicted resiliency (*PRs*).

The sum of all individual population resiliency values was taken to quantify overall resiliency, which can be interpreted as redundancy (a species-level metric) for the species. Next, we determined the optimal resiliency value (*PRopt*) by which the sum of *PRs* could be divided in each scenario; this was calculated by dividing the sum of current population resiliencies by the historical optimal resiliency. This equated to seven (current resiliency sum) divided by 24 (historical optimal resiliency), for a current redundancy (i.e., overall resiliency) of 0.292. Redundancy for the species in a particular scenario was considered low if the average of resiliency across all sites was <0.34; medium if 0.34-0.66; and high if >0.66. As redundancy is characterized by having multiple, resilient populations distributed within a species' spatial extent, this redundancy value was evaluated alongside the spatial extent of Black-capped Petrel breeding areas.

Scenario 1. Baseline growth and charcoal demand

Human population and density projections in the baseline scenario are expected to result in increased pressure on black-capped petrel breeding habitat. In 2005, estimated demand for charcoal as fuel in Haiti was 352,942 tons. Currently, the human population of Hispaniola is approximately 21 million, of which Haiti contributes approximately 10.7 million, and the Dominican Republic approximately 10.5 million (Fig. 5.4; UN 2017, unpaginated). From 2010-2015, the annual rate of population growth for Haiti was 1.38%, and for the Dominican Republic, 1.24% (UN 2017, unpaginated). The current rate of population growth is projected to gradually decline for each country, with rates for Haiti declining at a lesser rate than that of the Dominican Republic. In ten years, the projected demand for charcoal as fuel in Haiti under this scenario is 477,942 tons; in 25 years, this rises to 525,211 tons (Checo 2009, unpaginated).

Overall human population on Hispaniola is projected to increase by approximately 33% over the next 50 years. Each country is projected to increase, both in total population and population densities, at least 2055 (Figs. 5.5, 5.6, 5.7); the Dominican Republic has slight negative growth through 2070, at which point, its total human population will be 13 million. In 2070, the human population in Haiti will be approximately 15 million and is projected to continue increasing, with fuel charcoal in expected to be 647,060 tons. This represents an estimated increase in forest conversion of 62% over 2005 fuel charcoal demand. At such time, the human population density of Haiti will exceed 545 persons/km^2, with most people living in densely populated urban areas where charcoal is currently the primary fuel used for cooking. Deforestation concurrent with population growth is expected to occur in both in Haiti and adjacent areas of the Dominican Republic (Fig. 5.8). Anthropogenic fires associated with land-clearing activities are also expected to increase, further threatening Black-capped Petrel nesting habitat. Given the level of these threats to nesting areas, resiliency of the Black-capped Petrel is predicted to be very low:

$(\sum_{1}^{n}(PRs)/PRopt)$/Rcov =
((0+0+1+1+0+0+0+0)/(3*8))/0.292 =
0.083/0.292 =
0.285 of current overall resiliency (**-71.5% of current**)

Analysis units most likely to be adversely affected under this scenario are the Morne Vincent and Pic La Visite nesting areas in Haiti, which have apparently suffered the greatest recent declines in habitat quality and quantity; with a combined area currently of < 0.2 km^2 and subsequent loss in the number of nesting petrels, extirpation is likely (Goetz et al. 2012, pp. 9-10; Simons et al. 2013, p. S13-S15; Satgé et al. 2021, p. 583; Wheeler et al. 2021, p. 10). This scenario could potentially result in a loss of 60-70% of the currently known breeding population (Wheeler et al. 2021, p.10; Brown and Jean, 2020, entire; IBPCG 2021, entire).

Scenario 2. Low growth and charcoal demand

Under this low growth scenario, fuel charcoal demand in Haiti is expected to be 473,741 tons in 10 years, and in 25 years, 519,959 tons. Overall, the human population of Hispaniola will increase to 30% beyond the current level, resulting in approximately 27.5 million inhabitants by 2070. At this point, the population in Haiti will be approximately 14.6 million (Fig. 5.5) with a fuel charcoal demand of 777,313 tons. The human population of the Dominican Republic will be approximately 12.8 million (Fig. 5.6). The projected total population is only about 2% less than that projected in Scenario 1. Likewise, the projected population density of Haiti under this scenario is 532 persons/km^2, only about 2% less than projected in Scenario 1 (Fig. 5.7). This results in an estimated annual clearing of 45,728 ha (112,996.4 ac) of forest on Hispaniola to supply future demand and increase in forest conversion of 58% over 2005 (Fig. 5.8; Checo 2009, unpaginated).

Future condition of the Black-capped Petrel under scenarios one and two (baseline and low growth) is expected to look very similar, resulting in a prediction of low future resiliency:

$(\sum_{1}^{n}(PRs)/PRopt)$/Rcov =
((0+0+1+1+0+0+0+0)/(3*8))/0.292 =
0.083/0.292 =
0.285 of current overall resiliency (**-71.5% of current**)

***Scenario 3*. High growth and charcoal demand**

Under this high growth scenario, fuel charcoal demand in Haiti is expected to be 487,396 tons in 10 years, and in 25 years, 580,883 tons. The human population of Hispaniola will increase to 62% beyond its current size, reaching approximately 34 million inhabitants by 2070. At such time, the human population of Haiti will be approximately 20.4 million (Fig. 5.5). In the Dominican Republic, the population will be approximately 13.7 million (Fig. 5.6). Haiti will have a population density of 740 persons/km^2, and the Dominican Republic, 285 persons/km^2 (Fig. 5.7). Fuel charcoal demand is projected at 777,313 tons, resulting in an estimated annual clearing of 63,598 ha (157,154.1 ac) of forest on Hispaniola to supply this future demand (Fig. 5.8; Checo 2009, unpaginated). This represents an estimated increase in forest conversion of 220% over 2005 fuel charcoal demand.

Note that projections are asymmetric with respect to distribution around the baseline projections. This asymmetry is because of "population momentum" associated with the progressively larger and comparatively faster-growing population of this scenario. In this instance, slight decreases in annual population growth rates have less effect on changes in total population than that of slight increases in rate of growth.

In addition to deforestation for charcoal, additional forest lost is projected to occur because of intensified agricultural activities. The magnitude of forest conversion would likely result in widespread catastrophic loss of nesting habitat, and in turn, likely extinction of the species. Because of the inherent uncertainty of projections for this more severe outcome, we opted to subdivide this scenario into two equally likely outcomes:

***Scenario 3a* (one remaining very low resiliency population - Valle Nuevo NP)**

$(\sum_{1}^{n}(PRs)/PRopt)$/Rcov =
((0+0+0+1+0+0+0+0))/(3*8))/0.292 =
0.042/0.292 =
0.144 of current overall resiliency (-**85.6% of current**)

***Scenario 3b* (no remaining populations, - species extinction)**

$(\sum_{1}^{n}(PRs)/PRopt)/Rcov =$
((0+0+0+0+0+0+0+0)/(3*8))/0.292 =
0.00 = **Extinction**

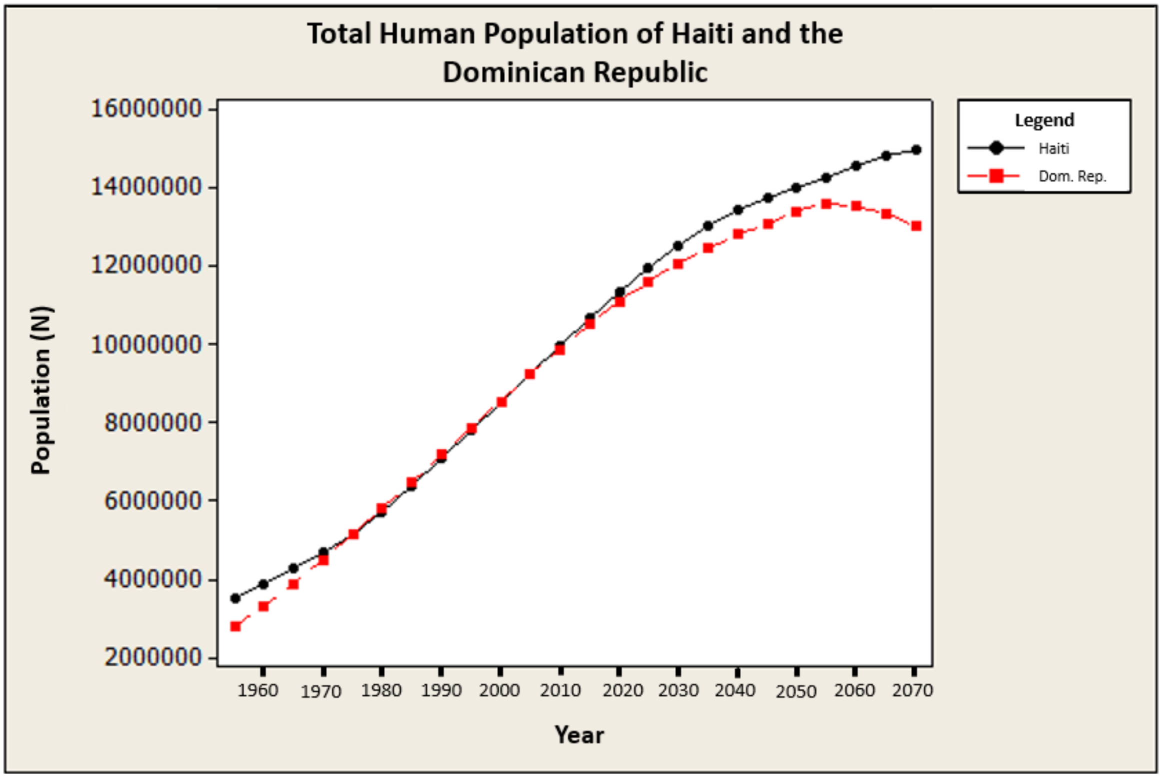


Figure 5.4. Total human population of Haiti and the Dominican Republic from 1955 to 2070, based on projections from the United Nations (2017, unpaginated).

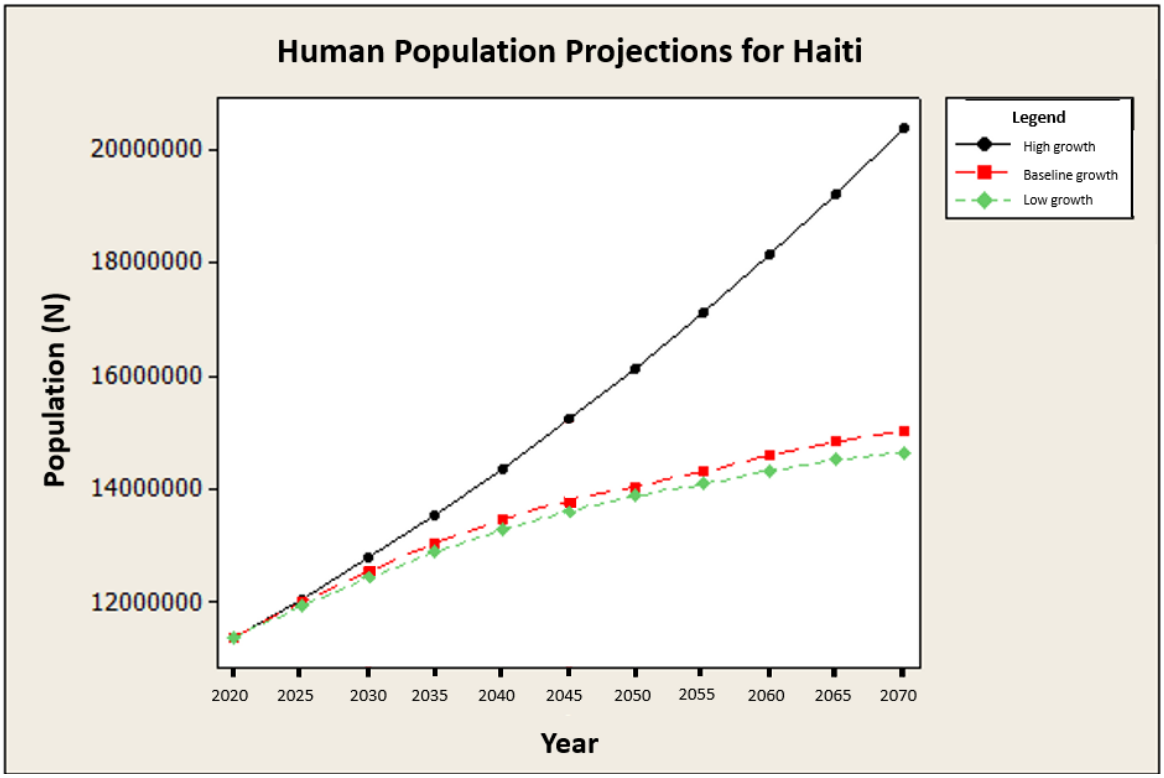


Figure 5.5. Human population projections for Haiti from 2020 to 2070 for each future scenario, based on projections from the United Nations (2017, unpaginated).

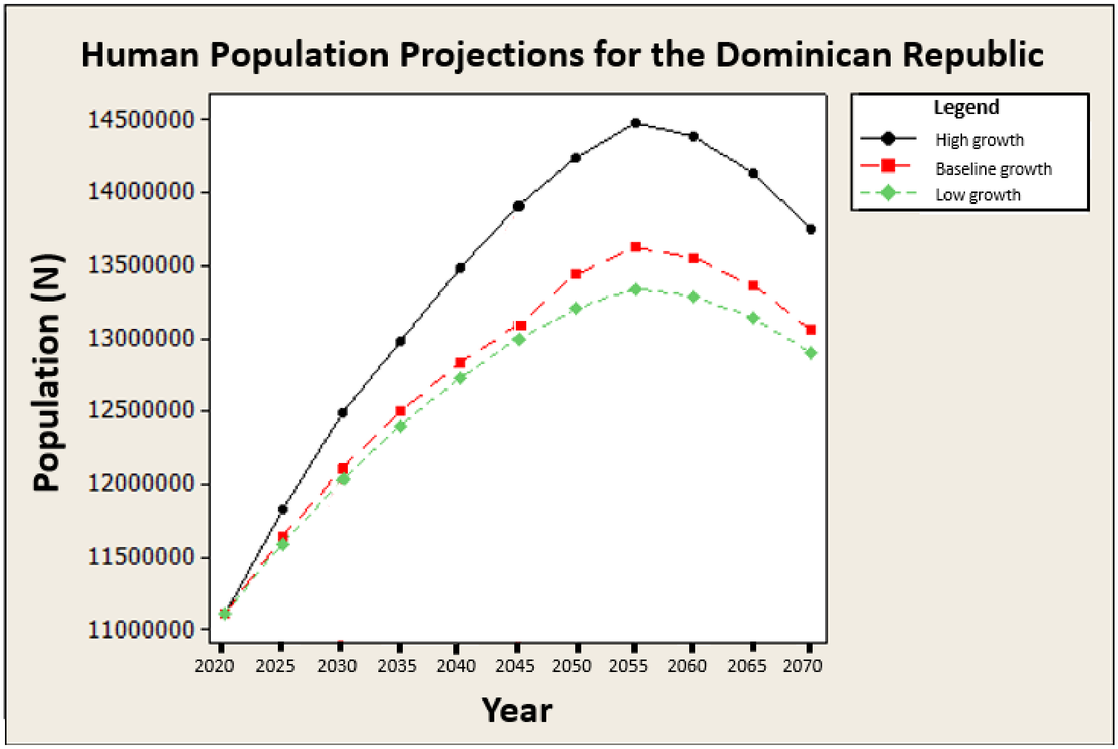


Figure 5.6. Human population projections for Dominican Republic from 2020 to 2070 for each scenario, based on projections from the United Nations (2017, unpaginated).

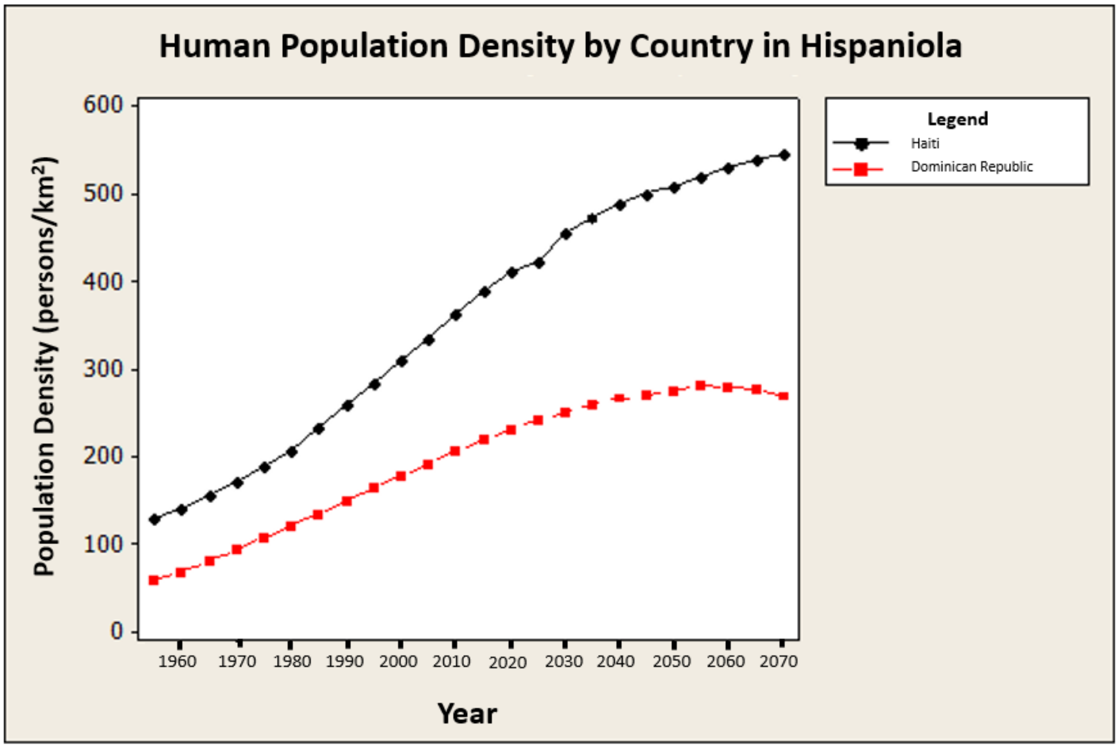


Figure 5.7. Human population density (persons/km^2) in Haiti and the Dominican Republic from 1955 to 2070 (UN 2017, unpaginated).

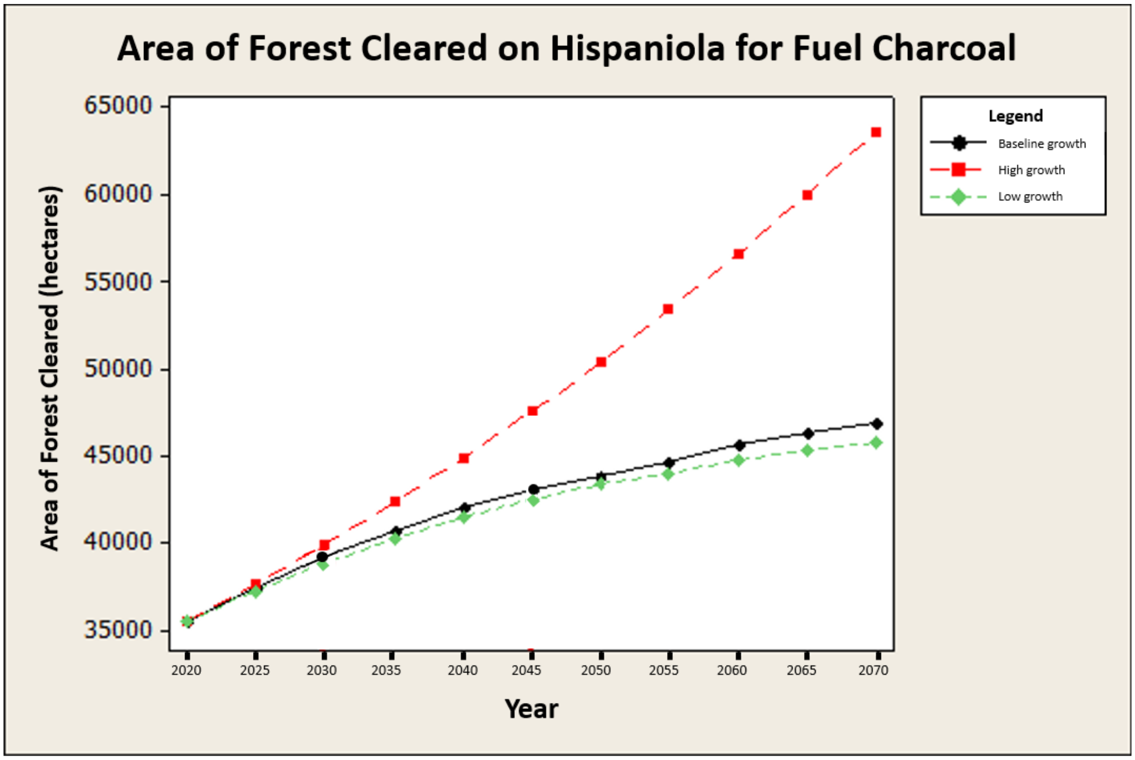


Figure 5.8. Estimated amount of annual forest clearing on Hispaniola (hectares) to meet demand for charcoal as fuel in Haiti, from 2020 to 2070. Projections based on data and assessments of Checo (2009, entire) and United Nations population projections for Haiti (UN 2017, unpaginated).

5.2. Future Resiliency Summary

After a 50-75% decline over the past 50 years, the Black-capped Petrel has an estimated population of 2,000 to 4,000 individuals (Simons et al. 2013, p. S22). A similar decline over the next 50 years could result in as little as 500 to 1,000 birds remaining, rendering the species more vulnerable to stochastic environmental and anthropogenic disturbances. This assumes no change in the recent or current extent or intensity of those factors and threats adversely affecting the species (see section 3.1). Under each scenario, substantial changes are predicted in regional climate change and human population growth, resulting in further ecological demand placed on resources necessary to maintain species viability for the Black-capped Petrel over the remainder of this century. Continued anthropogenic stress has significant implications for Black-capped Petrel resiliency, as 60-70% of all known nests occur in Haiti, where the species is increasingly threatened by anthropogenic activities. Barring unforeseen events, projected anthropogenic stress on the Black-capped Petrel is very likely to increase over the next 50 years, with the rate of increase projected as greater in Haiti than the Dominican Republic.

The species will likely experience reduced fecundity and overall reproductive success resulting from continued exposure to several impacts on its viability, such as: loss or degradation of existing nesting areas, increased occurrence of natural and anthropogenic forest fires, loss of nest sites to combined effects of increased erosion, as well as landslides and structural collapse. This is in addition to potential habitat-related changes arising from overall hotter and drier conditions (e.g., plant species composition, nest cavity microclimate), which would have the greatest impact to the species during the active nesting season. For example, in the montane tropical rainforests of Australia, significant reductions in breeding habitat were forecasted for the Golden bowerbird (*Prionodura newtonia*); this reduction in breeding habitat with concurrent increases in mean annual temperatures lead to probable extinction of the species (Hilbert et al. 2004, p. 375).

It is predicted that all currently remaining areas of primary forests in Haiti will be lost by 2036, with virtually no forested mountains remaining (Fig. 5.9; Hedges et al. 2018, p. 11852). Based on recent (since 2000) rates of site-specific forest loss, Hedges et al. (2018, Table S2) projected loss of all primary forests (defined as becoming <0.5% of land area) at Pic Macaya National Park by 2032, and at La Visite National Park by as early as 2025 (p. 11852). If those projections are accurate, it would have a devastating effect on up to 70% of the currently known or probable petrel nest sites, with a concomitant substantial reduction in species resiliency.

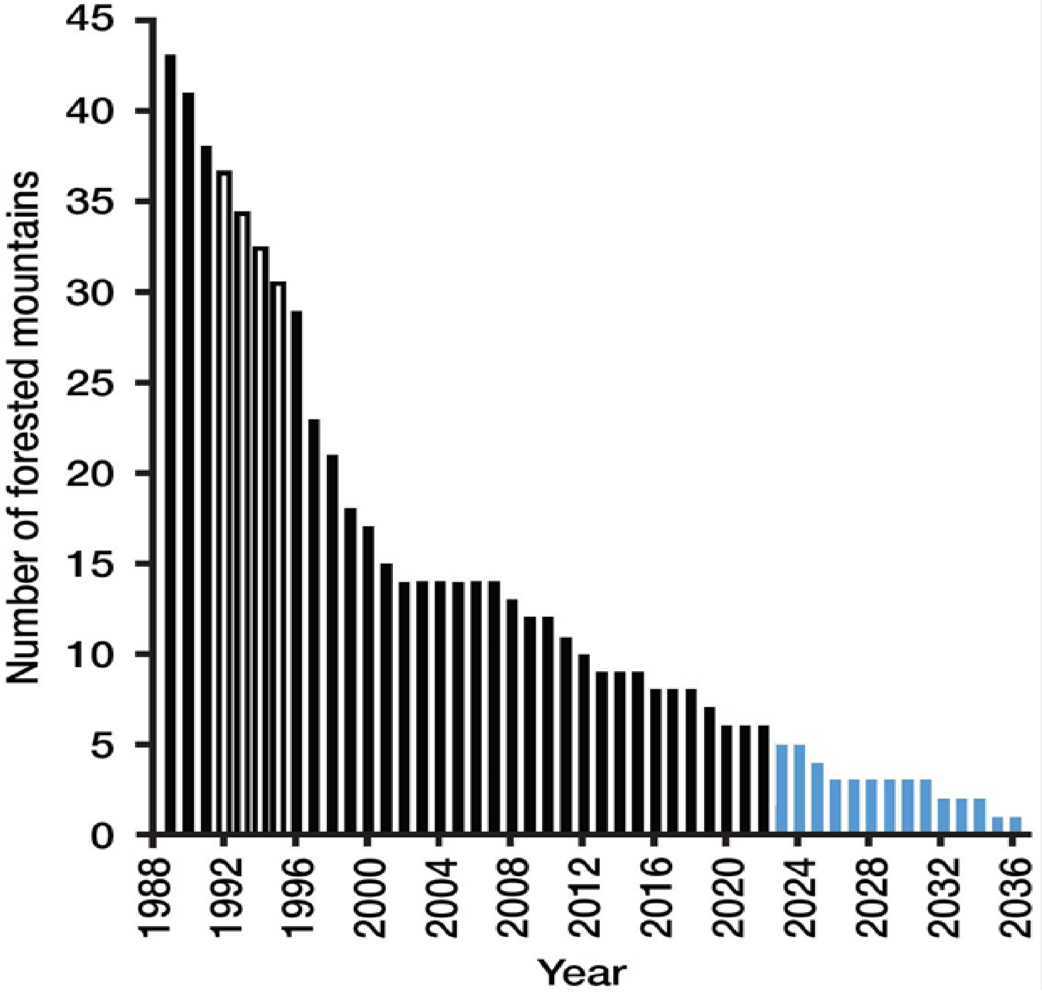


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Figure 5.9. Number of mountains with primary forest in Haiti by year, with future years (blue bars) projected on current mountain-specific rates of deforestation. Figure adapted from Hedges et al. (2018, p. 11852) and used with permission of primary author.

Projected increases in numbers of direct mortalities of Black-capped Petrels due to hurricane-induced inland strandings may also adversely affect resiliency, particularly at lower population levels. As populations become smaller, the per capita demographic effect of mortalities on overall population persistence increases (Courchamp et al. 1999, entire). Small populations of *k*-selected species are particularly susceptible (White et al. 2014, pp. 49-51).

5.3. Future Redundancy Summary

Redundancy is a measure of both the number and distribution of resilient populations across a species' range. A species with numerous, broadly distributed resilient populations is more likely to withstand catastrophic events than those with few, closely clustered populations. The Black-capped Petrel has few resilient breeding populations over a relatively small area and is likely to continue to decline in the face of threats towards species viability. The most likely catastrophic event for the Black-capped Petrel would be an extremely intense hurricane that results in significant degradation or loss of suitable nest sites via accelerated erosion, flooding and collapse of nesting burrows, and extensive landslides. The incidence of intense hurricanes is forecast to increase 1% annually over the next 100 years (Hass et al. 2012, pp 255-257). This means that the annual probability of such storms will be at least 50% greater in 2070 than present. The contemporary population of Black-capped Petrel is predicted to have little to no redundancy to protect the species in the face of a catastrophic event that affects their nesting habitat on Hispaniola (Table 5.2).

Table 5.2. Resiliency scores for individual sites.

Site	Historic Optimal	Current Condition	Scenario 1	Scenario 2	Scenario 3a	Scenario 3b
Pic La Visite	High (3)	High (3)	Extirpated (0)	Extirpated (0)	Extirpated (0)	Extirpated (0)
Morne Vincent/ Loma Del Toro	High (3)	Medium (2)	Extirpated (0)	Extirpated (0)	Extirpated (0)	Extirpated (0)
Loma Quemada	High (3)	Low (1)	Low (1)	Low (1)	Extirpated (0)	Extirpated (0)
Valle Nuevo	High (3)	Low (1)	Low (1)	Low (1)	Low (1)	Extirpated (0)
Pic Macaya	High (3)	Extirpated (0)	Extirpated (0)	Extirpated (0)	Extirpated (0)	Extirpated (0)
Martinique	High (3)	Extirpated (0)	Extirpated (0)	Extirpated (0)	Extirpated (0)	Extirpated (0)
Guadeloupe	High (3)	Extirpated (0)	Extirpated (0)	Extirpated (0)	Extirpated (0)	Extirpated (0)
Dominica	High (3)	Extirpated (0)	Extirpated (0)	Extirpated (0)	Extirpated (0)	Extirpated (0)

Because all known breeding populations occur on a single island and are in relative proximity to one another, they are all susceptible to the effects of any given hurricane that makes landfall at or near the nesting areas. Moreover, all four known breeding populations nest within the area of Hispaniola most vulnerable to hurricane effects. Further exacerbating their susceptibility to storms is their occupation of nesting areas that have high soil erosion potential (Smucker et al. 2007, pp 54-61).

5.4. Future Representation Summary

Representation reflects the adaptive potential of a species. Although few data exist regarding genetic diversity of the Black-capped Petrel, a 1.2% fixed genetic difference was reported between the light and dark color forms of the species, suggesting the possibility of potential isolation or segregation (seasonal or spatial) of the two forms (Manly et al. 2013, p. 232). While these findings do not rule out the possibility of distinct taxa, a more rigorous analysis is needed on genetic identity of individuals from known breeding colonies to either refute or substantiate this possibility (Howell and Patteson 2008, p. 81; Manly et al. 2013, p. 232).

In the absence of conclusive data on species genetic and ecological diversity, we consider the extent and diversity of habitat characteristics within the geographic range, in this case, the known current breeding range. The breeding areas occur in a region subject to stochastic, periodic disturbances in the form of tropical storms and hurricanes. The timing of their nesting season (January-June) allows them to effectively avoid direct effects of such atmospheric events during a critical life phase. Moreover, their high adult survival rates and longevity make populations resilient to occasional stochastic fluctuations in annual reproductive output (see section 2.6). There are reports of several montane avian species shifting their ranges upward along elevational gradients in response to climate-related changes (Tingley et al. 2009, entire); however, Black-capped Petrels already nest at some of the highest elevations on Hispaniola, leaving them few options for a similar adaptive response.

Assuming that potential for colonization is limited due to the behavioral and biological characteristics of the species, alongside the lack of widespread suitable nesting habitat in the region, it is unlikely that breeding pairs on Hispaniola would re-colonize alternate islands should habitat conditions on Hispaniola be rendered unsuitable. Based on past extirpations of the species from other islands, once an island-specific population is extirpated, the island is apparently not recolonized. Given that all known breeding populations nest on one island, and within similar habitat types, any further reduction in the number of breeding populations will have adverse effects on representation.

Future Conditions Summary and Synthesis

We used the best available information to assess predicted future condition of the Black-capped Petrel relative to its continued viability as a species. In doing so, we reviewed recognized threats to the species and how they may impinge upon species viability. Through this review, we identified numerous distinct threats that could be summarized by regional climate change and human population growth – particularly on Hispaniola, where all currently known nesting by the petrel occurs. Rather than attempting to predict future levels of diverse threats, many of which lack adequate quantitative data, we chose instead to examine future projections for these overarching drivers, which encompass all threats identified in this SSA. We used a combination of Black-capped Petrel population trajectories over the past 50 years, past trends, and current levels of threats, in addition to recognized causal relationships between threats, to arrive at what we believe to be the most likely future conditions of the Black-capped Petrel.

Because of the species' highly specific nesting habitat requirements, found only in areas highly sensitive to climatic change, it is among the most vulnerable to adverse effects of climate change (Williams et al. 2007, p. 5739; Sekercioglu et al. 2008, pp. 146-149; Thurman et al. 2020, p. 520). In the case of regional climate regimes, the best available information suggests a hotter and drier future climate within the specific area where Black-capped Petrels currently nest, along with a steady increase in the number of intense hurricanes (Category 3-5) across the region over the next century (Bender et al. 2010, entire). Adverse effects to the petrel will likely include increased mortalities of adults on the western Atlantic foraging grounds due to increased frequency of hurricane-induced inland strandings (Hass et al. 2012, entire). This increase in hurricanes, combined with reduced translation speeds, may further accelerate erosion and degradation of nesting areas (Hass et al. 2012, p. 259; Simons et al. 2013, p. S33; Kossin 2018, p. 104). Concurrence of the resultant fewer and smaller breeding populations, ongoing nesting habitat loss and degradation, and more frequent and intense tropical storms would adversely affect the petrel.

The past 5 years have revealed a variable but steady decline in Black-capped Petrel nesting success across nearly all known breeding populations, and there are currently no indications that this trend will improve anytime soon. Once breeding populations of the Black-capped Petrel became geographically limited to southwestern Hispaniola, a suite of additional factors begins to work synergistically to further reduce the overall population of the species (see section 3.1). Our estimate of low resiliency for the Black-capped Petrel reflects extensive nesting habitat loss and degradation and subsequent declines in petrel population size.

The primary effects of anthropogenic actions on Black-capped Petrel viability have occurred over the past four to five centuries, a relatively short time in an evolutionary context. The petrel has been subject to the stochastic occurrences of tropical storms and hurricanes for much longer and has presumably evolved adaptive strategies in response to these events. Such adaptations evolved in the context of multiple breeding populations across multiple islands, larger populations, and under previous regional climatic regimes. The conditions in which the Black-capped Petrel evolved have experienced drastic changes which are predicted to worsen. As discussed previously, the species is currently known to nest only on Hispaniola and seems unlikely to re-colonize alternate islands in the future. If additional breeding sites were found in Dominica or Guadeloupe, neither of those possible populations may be large enough to change the projected species condition. Geographic isolation has the associated effect of increasing the vulnerability of the species to catastrophic events, such as major hurricanes. Our estimates of little to no redundancy and representation are reflective of the species vulnerability to such events.

As anthropogenic pressures from demand for cooking fuels increase, the associated impacts on deforestation will negatively impact petrel nesting areas, and therefore, future species viability. Based on our three scenarios and the most recent estimate of the annual fuel charcoal demand in Haiti, projections over the 50 years would be as follows (Table 5.3):

Table 5.3. Projected demand of charcoal, in tons, at three time intervals.

Scenario	Description	10 years	25 years	50 years
1	Baseline growth and charcoal demand	477,942 tons	525,211 tons	647,060 tons
2	Low growth and charcoal demand	473,741 tons	519,959 tons	558,824 tons
3	High growth and charcoal demand	487,396 tons	580,883 tons	777,313 tons

This represents an estimated annual forest loss of approximately 1,700 to 4,100 hectares in the Dominican Republic, of which approximately 45-70% occurs within the Provinces of Independencia and Bahoruco. The montane forest of the Sierra del Bahoruco, located within the Bahoruco Province, supports known Black-capped Petrel nesting.

All future scenarios indicate three breeding areas that are likely to face extirpation by 2070. If recent projections from 2018 of upper elevation primary forest loss hold forth, loss of these nesting areas could occur at rates faster than those of our projections:

Pic Macaya *- lack of control of human access or ongoing conservation efforts*
Pic La Visite *and* ***Morne Vincent*** *- ongoing and increasing rates of degradation*

It is possible Pic Macaya may already have been extirpated (Wheeler et al. 2021, pp. A2-83, 84). The proximity of Pic La Visite and Morne Vincent to the capital city, Port-au-Prince, will increase the likelihood of anthropogenic demand in this area for resources (food, fuel, building material). In the case of Pic La Visite, the discovery of any additional petrel nesting sites in the adjacent and contiguous areas of Pic La Selle could potentially attenuate such losses, but only two additional nest sites have been found there to date (IBPCG 2022, p. 3).

In the protected area of Morne Vincent, there is little suitable nesting habitat remaining (2.3 km^2) (Wheeler et al. 2021, p. A2-75). This portion of the breeding colony, having already been largely deforested, may experience slightly less adverse effects from continued deforestation; however, there exists a significant potential for increased land clearing for agricultural activity in this nesting area as it is not within any officially protected area. The Dominican Republic portion of this nesting area, as well as the Loma Quemada area, will likely be subject to at least some increased clearing for agricultural activities as well as charcoal production. Because much of the nesting habitat lies within an officially protected area, which is at least somewhat protected in the Dominican Republic, may help to reduce, or slow future degradation. The remaining nesting area is in Valle Nuevo National Park in the central mountains of the Dominican Republic. This nesting area faces many similar threats but is nevertheless more remote and slightly more distant from the growing market for charcoal in Haiti. This distance from anthropogenic influence, along with its protected status, may result in this nesting area being less adversely affected than the others. It should be noted, however, that only 13 Black-capped Petrel nests have thus far been identified in this park (all of which failed in 2020 from predation), so its overall importance to species resiliency and persistence is uncertain at best.

Any other potential nesting areas in Haiti would be subject to the same threats as those areas currently known. This includes predation; it is possible that with an increase in human presence in the future near breeding sites, this will increase the likelihood of Black-capped Petrel interactions with invasive mammals. The loss of the breeding populations in Haiti would therefore represent a potential catastrophic loss of up to 70% of the currently known breeding population of the Black-capped Petrel. These projections also closely parallel similar predictions regarding a likely 75% decline in the total Black-capped petrel population over the next 50 years (Wheeler et al. 2021, pp. 18-19).

There remains an additional factor which could conceivably influence Black-capped Petrel viability that we were unable to evaluate in this document. For many species that form breeding colonies, they may reach a “critical level” as population numbers decline, below which normal social and ecological interactions become impaired. This is commonly referred to as the Allee effect (Courchamp et al. 1999, p. 405; Stephens and Sutherland 1999, p. 401; and many others). Examples of such effects include increased per capita demographic effects of mortalities, disruption of normal pair-bond formation, skewed sex ratios, lower reproductive success, and reduced foraging efficiency (Schippers et al. 2011, pp. 3061-3062). These combined effects can result in an extinction vortex from which a species cannot demographically recover (Dennis 2002, p. 389). We do not know if the Black-capped Petrel is currently subject to such effects and, if so, to what extent. However, the recent significant losses of large proportions of active nests due to a few, or in some cases even a single predator (IBPCG 2019, p. 4; Brown and Jean 2021, pp. 4-5), strongly suggest the nascent emergence of demographic Allee effects in this species. Consequently, as Black-capped Petrel populations decline under all predicted scenarios, the potential for irreversible Allee effects should not be discounted.

In any given year, up to as many as 60% of all known Black-capped Petrel nest sites occur in a country with intense and increasing demand on its natural resources and with nearly 75% of those nests found within a highly vulnerable area of only one hectare. The best available science at the time of this analysis indicates that the future viability of the Black-capped Petrel is inextricably linked to the complex and challenging socioeconomic and environmental landscape that is Haiti.

Literature Cited

American Bird Conservancy. 2014. Interim Report to the U.S. Fish and Wildlife Service. Submitted September 2014.

ABS Consulting. 2016. Update of Occurrence Rates for Offshore Oil Spills. Retrieved from https://www.bsee.gov/sites/bsee.gov/files/osrr-oil-spill-response-research/1086aa.pdf

Bakun, A., Black, B., Bograd, S., García-Reyes, M., Miller, A., Rykaczewski, R., and W. Sydeman. 2015. Anticipated Effects of Climate Change on Coastal Upwelling Ecosystems. Curr Clim Change Rep, 1:85-93.

Ballance, L. and M. Force. 2016. Seabird Distribution and Abundance Survey Protocols: A summary of seabird protocols and data collection procedures used on NEFSC/AMAPPS surveys.

Barun. A., C.C. Hanson, K.J. Campbell and D. Simerloff. 2011. A review of small Indian mongoose management and eradications on islands. In C. R. Veitch, M. N. Clout and D. R. Towns (eds). Island Invasives: Eradication and Management. IUCN, Gland, Switzerland, pp. 17–25.

Batlle, M., and J. Ramón. 2021. Forest loss and fire in the Dominican Republic during the 21st Century. Peer Community Journal. doi: https://doi.org/10.1101/2021.06.15.448604

Bender, M.A., T. R. Knutson, R. E. Tuleya, J. J. Sirutis, G. A. Vecchi, S.T. Garner, I. M. Held. 2010. Modeled Impact of Anthropogenic Warming on the Frequency of Intense Atlantic Hurricanes. Science 327, 454.

Birdlife International. 2010. Catastrophic forest fire delivers huge blow to Europe's rarest seabird. http://www.birdlife.org/news/news/2010/08/Zinos-petrel-disaster.html. Visited 13 March 2018.

Birdlife International. 2022a. Data Zone: Terms & Definitions – IUCN Red List Criteria. Downloaded from http://datazone.birdlife.org/species/spcredcrit on 10/20/2022.

BirdLife International. 2022b. Species factsheet: *Pterodroma hasitata*. Downloaded from http://www.birdlife.org on 08/07/2022.

BirdLife International. 2022c. Species factsheet: *Pterodroma sandwichensis*. Downloaded from http://www.birdlife.org on 08/07/2022.

BirdLife International. 2022d. Species factsheet: *Pterodroma cahow*. Downloaded from http://www.birdlife.org on 08/07/2022.

Brad Keitt. 2022. Personal communication. Information communicated to USFWS in comments from Brad Keitt's review of the Black-capped Petrel SSA draft.

Bureau of Ocean Energy Management (BOEM). 2014. Supplement to Final Report BOEM 2017-071. Atlantic Marine Assessment Program for Protected Species: 2010-2014. Appendix II – Appendix V.

Bureau of Ocean Energy Management (BOEM). 2022a. Atlantic OCS Region. https://www.boem.gov/regions/atlantic-ocs-region. Visited 18 April 2022.

Bureau of Ocean Energy Management (BOEM). 2022b. Outer Continental Shelf Leases (Active) - Gulf of Mexico Region NAD27. Published 1 March 2022.

Bureau of Ocean Energy Management (BOEM). 2022c. Offshore Wind in the U.S. Gulf of Mexico: Regional Economic Modeling & Site-Specific Analyses.

Brown, A. 2013. Results of 2013 radar surveys on Hispaniola. Report for American Bird Conservancy.

Brown, A. 2015, Radar surveys for the endangered Black-capped Petrel on Dominica, West Indies. Report by Environmental Protection in the Caribbean.

Brown, A. 2016. Diablotin Conservation Expedition: Haiti 2016. Environmental Protection in the Caribbean.

Brown, A. 2020. Radar Surveys for Black-capped Petrel (*Pterodroma hasitata*) on the island of Dominica during January/February 2020: Progress Report. Unpublished report from Environmental Protection in the Caribbean. Green Cove Springs, Florida, USA.

Brown, A.C., and N.S. Collier. 2001. Results of Search for Black-capped Petrel (Pterodroma hasitata) in Dominica: Report for 2000-2001. Unpublished Report. Environmental Protection in the Caribbean (EPIC), Green Cove Springs, Florida, USA

Brown, A. and Jean, A. 2020. Results of Black-capped Petrel Nest Monitoring on Morne Vincent, Haiti: 2020 Breeding Season. Unpublished report from Environmental Protection in the Caribbean. Green Cove Springs, Florida, USA.

Brown, A. and Jean, A. 2021. Black-capped Petrel Nest Monitoring in La Visite National Park, Haiti: 2021 Breeding Season. Unpublished report from Environmental Protection in the Caribbean. Green Cove Springs, Florida, USA.

Campbell, J.D., M.A. Taylor, T.S. Stephenson, R.A. Watson and F.S. Whyte. 2011a. Future climate of the Caribbean from a regional climate model. International Journal of Climatology 31: 1866–1878.

Campbell, K.J., G. Harper, D. Algar, C.C. Hanson, B.S. Keitt, and S. Robinson. 2011b. Review of feral cat eradications on islands. Pages 37–46 in Veitch CR Clout MN Towns DR , eds. Island Invasives: Eradication and Management. International Union for Conservation of Nature.

Castro, M., C. Mataya and J. Stark. 2005. Environmental Security in the Dominican Republic: Promise or Peril? Report for the Foundation for Environmental Security and Sustainability.

Chavez, F., Messié, M., and J. Pennington. 2011. Marine Primary Production in Relation to Climate Variability and Change. Annu. Rev. Mar. Sci., 3:227-60.

Checo, I.H. 2009. Identificación y descripción de la red de comercialización del carbón vegetal en comunidades de las provincias Independencia y Bahoruco. Red de comercialización del carbón en Independencia y Bahoruco Página.

Churches, C.E., P.J. Wampler, W. Sun and A.J. Smith. 2014. Evaluation of forest cover estimate for Haiti using supervised classification of Landsat data. International Journal of Applied Earth Observation and Geoinformation, Vol 30, pp. 203-216.

Clapp, R., D. Morgan-Jacobs and R.C. Banks. 1982. Marine birds of the southeastern United States and Gulf of Mexico. Part I. Gaviiformes through Pelecaniformes. Washington, DC: US Fish & Wildlife Service. FWS/DBS-83/30.

Collar, N.J., L.P. Gonzaga, N. Krabbe, A. Madroño Nieto, L.G. Naranjo, T.A. Parker, and D.C. Wege. (1992) Threatened Birds of the Americas: the ICBP/IUCN Red Data Book. Cambridge, UK: International Council for Bird Preservation.

Cooke, R. S. C., Gilbert, T. C., Riordan, P. and D. Mallon. 2018. Improving generation length estimates for the IUCN Red list. PLoS One 13(1):e0191770.

Courchamp, F. T. Clutton-Brock and B. Grenfell. 1999. Inverse density dependence and the Allee effect. Trends in Ecology and Evolution (10):405-410.

Davis, S. 2019. Impact of an invasive fern (Dicranopteris pectinate) on bird diversity and birdwatching in a Jamaican Ramsar Site. The Journal of Caribbean Ornithology, 32: 57-64.

Dennis, B. 2002. Allee effects in stochastic populations. OIKOS 96, pp. 389-402.

Devokaitis, M. 2018. Black-capped Petrel up for ESA protection, but does the proposal go far enough? All about birds. Accessed 7 November 2022: https://www.allaboutbirds.org/news/black-capped-petrel-up-for-esa-protection-but-does-the-proposal-go-far-enough/

Dirección General de Alianzas Público-Privadas (DGAPP). 2021. Plan de Desarrollo Turístico de Cabo Rojo, Pedernales. Impreso en República Dominicana por Editora Corripio S.A.S.

Deepwater Horizon Natural Resource Damage Assessment Trustees (DHNRDAT). 2016. Deepwater Horizon oil spill: Final Programmatic Damage Assessment and Restoration Plan and Final Programmatic Environmental Impact Statement. Retrieved from http://www.gulfspillrestoration.noaa.gov/restoration-planning/gulf-plan. Accessed 08/12/2022.

Department of Energy (DOE). 2022. How Do Wind Turbines Survive Severe Storms? Accessed from: https://www.energy.gov/eere/articles/how-do-wind-turbines-survive-severe-storms

Dowdy, A., and G. Mills. 2012. Atmospheric and Fuel Moisture Characteristics Associated with Lightning-Attributed Fires. American Meteorological Society, 51: 2025-2037.

Dominican Republic Sun (DRS). 2022. Protest Breaks Out in the Dominican Republic Over New Tourism Project. Available from https://dominicanrepublicsun.com/protest-breaks-out-in-the-dominican-republic-over-new-tourism-project/

Dutta, T., Kim, K., Uchimiya, M., Kwon, E., Jeon, B., Deep, A., and S. Yun. 2016. Global demand for rare earth resources and strategies for green mining. Environmental Research, 150: 182-190.

Elsner, J.B., J.P. Kossin and T. H. Jagger. 2008. The increasing intensity of the strongest tropical cyclones. Nature Vol 455|4 September 2008.

Environmental Protection Agency (EPA). 2022a. Climate Change Indicators: Heavy Precipitation. Accessed 7 November 2022: https://www.epa.gov/climate-indicators/climate-change-indicators-heavy-precipitation

Environmental Protection Agency (EPA). 2022b. Climate Change Indicators: West Nile Virus. Accessed 7 November 2022: https://www.epa.gov/climate-indicators/climate-change-indicators-west-nile-virus.

Faulquier, L., R. Fontaine, E. Vidal, M. Salamolard and M. Le Corre. 2009. Feral Cats *Felis catas* threaten the endangered endemic Barau's Petrel Pterodroma baraui at Reunion Island (Western Indian Ocean). Waterbirds: The International Journal of Waterbird Biology, Vol. 32, No. 2 (June2009), pp. 330-336.

Furness, E.F. 2003. Impacts of fisheries on seabird communities. Scientia Marina, 67 (Supple. 2):33-45.

Gallagher, T. 2015. Illegal deforestation continues in the Dominican Republic; Threatens Bicknell's Thrushes. Living Bird magazine, Summer 2015 edition.

Garthe, S., N. Markones and A. Corman. 2017. Possible impacts of offshore wind farms on seabirds: a pilot study in Northern Gannets in the southern North Sea. Journal of Ornithology, Vol. 158, pp. 345-349.

Goetz, J.E., J. H. Norris, and J.A. Wheeler. 2012. Conservation Action Plan for the Black-capped Petrel (*Pterodroma hasitata*). International Black-capped Petrel Conservation Group.

Grupo Jaragua. 2011. Repetidos cortes de bosque dentro del Parque Nacional Lago Enriquillo e isla Cabritos y Reserva Científica Loma Charco Azul para la fabricación de carbón vegetal.

Por Grupo Jaragua. Denuncia ante la procuraduría para la Defensa del Medio ambiente y los recursos naturales.

Grupo Jaragua. 2021. Grupo Jaragua BCPE Conservation and monitoring 2021-2021. Endo f Period Report. Project #1715L.

Hamer, K. C., Schreiber, E. A. and J. Burger. 2002. Breeding biology, life histories and Life history-Environment Interactions in Seabirds. Pp. 217-263 in Biology of Marine Birds. E. Schreiber and J. Burger (eds.). CRC Press, LLC. Boca Raton, FL USA

Haney, J. C. 1986. Seabird segregation at Gulf Stream frontal eddies. Mar. Ecol. Prog. Ser., 28: 279-285.

Haney, J.C. 1987. Aspects of the pelagic ecology and behavior of the Black-capped Petrel. The Wilson Bulletin, Vol. 99, No. 2, pp. 153-312.

Haney, J.C., K.M. Fristrup, and D.S. Lee. 1992. Geometry of visual recruitment by seabirds to ephemeral foraging flocks. Ornis Scandinavica 23: 49–62.

Haney, J.C., H.J. Geiger, and J.W. Short. 2014. Bird mortality from the Deepwater Horizon MC 252 oil spill I: Exposure probability estimates for offshore Gulf of Mexico. Marine Ecology-Progress Series 513: 225-237. doi: 10.3354/meps10991

Haney, J.C., H.J. Geiger, and J.W. Short. 2015. Bird mortality due to the Deepwater Horizon oil spill: reply to Sackmann & Becker (2015). Marine Ecology-Progress Series 534: 279-283.

Hass, T., J. Hyman and B. X. Semmens. 2012. Climate change, heightened hurricane activity, and extinction risk for an endangered tropical seabird, the Black-capped Petrel *Pterodroma hasitata.* Marine Ecology Progress Series 454:251-261.

Hazen, E., Jorgensen, S., Rykaczewski, R., Bograd, S., Foley, D., Jonsen, I., Shaffer, S., Dunne, J., Costa, D., Crowder, L., and B. Block. 2013. Predicted habitat shifts of Pacific top predators in a changing climate. Nature Climate Change, 3: 234-238.

Hedges, S. B., Cohen, W. B, Timyan, J. and Z. Yang. 2018. Haiti's biodiversity threatened by nearly complete loss of primary forest. Proceedings of National Academy of Science 115(46):11850-11855.

Helm R.C., H.R. Carter, R.G. Ford, D.M. Fry, R.L. Moreno, C. Sanpera, and F.S. Tseng. 2015. Overview of efforts to document and reduce impacts of oil spills on seabirds. In Handbook of Oil Spill Science and Technology (pp. 431-453).

Henderson, R. W. 1992. Consequences of predator introductions and habitat destruction on amphibians and reptiles in the post-Columbus West Indies. Caribbean Journal of Science 28:1–10.

Hilbert, D.W., M. Bradford, T. Parker and D.A. Westcott. 2004. Golden bowerbird (*Prionodura newtonia*) habitat in past, present and future climates: predicted extinction of a vertebrate in tropical highlands due to global warming. Biological Conservation, Vol. 116:367-377.

Howell, S.N.G. and J.B. Patteson. 2008. Variation in the Black-capped Petrel- one species or more? Alula 14: 70-83.

Howell, Steve N. G., and Kirk Zufelt. *Oceanic Birds of the World: A Photo Guide*. Princeton University Press, 2019. https://doi.org/10.2307/j.ctvg254dg.

International Black-capped Petrel Conservation Group (IBPCG). 2016. Update on Activities June 2016.

International Black-capped Petrel Conservation Group (IBPCG). 2017. Update on Activities February 2017.

International Black-capped Petrel Conservation Group (IBPCG). 2018. Update on Activities April 2018.

International Black-capped Petrel Conservation Group (IBPCG). 2019. Update on Activities April 2019.

International Black-capped Petrel Conservation Group (IBPCG). 2020. Update on Activities May 2020.

International Black-capped Petrel Conservation Group (IBPCG). 2021. Update on Activities June 2021.

International Black-capped Petrel Conservation Group (IBPCG). 2022. Update on Activities August 2022.

Imber, M.J. 1975. Behaviour of petrels in relation to the moon and artificial lights. Notornis 22: 302–306.

Imber, M.J. 1985. Origins, phylogeny and taxonomy of the gadfly petrels Pterodroma spp. Ibis 127: 197–229.

Jodice, P., R. A. Ronconi, E. Rupp, G. E. Wallace and Y. Satgé. 2015. First satellite tracks of the Endangered Black-capped Petrel. Endangered Species Research 29:23-33.

Jodice, P., Michael, P., Gleason, J., Haney, J., and Y. Satgé. 2021. Revising the marine range of the endangered black-capped petrel *Pterodroma hasitata*: occurrence in the northern Gulf of Mexico and exposure to conservation threats. Endangered Species Research, 46:49-65.

Jon Moore, N.D. Personal communication, as related to J. Chris Haney, regarding incident of Black-capped Petrel collision with a fisheries vessel. Information communicated to USFWS in comments from J. Chris Haney's review of the Black-capped Petrel SSA draft.

Karmalkar, A., Taylor, M., Campbell, J., Stephenson, T., New, M., Centella, A., Benzanilla, A., and J. Charlery. 2013. A review of observed and projected changes in climate for the islands in the Caribbean. Atmósfera 26(2), 283-309.

Kim. E.Y., T. Murakami, K. Saeki and R. Tatsukawa. 1996. Mercury levels and its chemical form in tissues and organs of seabirds. Archives of Environmental Contamination and Toxicology, 30, 259-266.

Kimball, M., Allen, D., Kenny, P., and V. Ogburn-Matthews. 2020. Decadal-Scale Changes in Subtidal Nekton Assemblages in a Warm-Temperate Estuary. Estuaries and Coasts, 43: 927-939.

Knutson, T.R., J.L. McBride, J. Chan, K. Emanuel, G. Holland, C. Landsea, I. Held, J.P. Kossin, A.K. Srivastava, and M. Sugi. 2010. Tropical Cyclones and Climate Change. Nature Geoscience 3.3 (2010): 157-163.

Knutson, T.R., J.J. Sirutis, G.A. Vecchi, S. Garner, M. Zhao, H. Kim, M. Bender, R.E. Tuleya, I.M. Held, and G. Villarini. 2013. Dynamical downscaling projections of twenty-first-century Atlantic hurricane activity: cmip3 and cmip5 model-based scenarios. Journal of Climate 26:17 6591-6617.

Kojadinovic, J., M. Le Corre, R. Cosson, and P. Bustamante. 2007a. Trace elements in three marine birds breeding on Reunion Island (Western Indian Ocean) Part 1: Factors influencing their bioaccumulation. Archives of Environmental Contamination and Toxicology, Springer Verlag, 52, pp. 418-430.

Kojadinovic, J., P. Bustamante, C. Churlaud, R. Cosson and M. Le Corre. 2007b. Mercury in seabird feathers: Insight on dietary habits and evidence for exposure levels in the western Indian Ocean. Science of the Total Environment, Elsevier, 384 (1-3), pp. 194-204.

Kossin, J. 2018. A global slowdown of tropical-cyclone translation speed. Nature, 558: 104-107.

Le Corre, M., and P. Jouventin. 2002. Light-induced mortality of petrels: a 4-year study from Réunion Island (Indian Ocean). Biological Conservation, Vol 105, pp. 93-102.

Lee, D., and W. Mackin. 2008. Black-capped Petrel. West Indian Breeding Seabird Atlas. Accessed 7 November 2022: http://www.wicbirds.net/bcpe.html

Leila Nagatani, 2022. Personal communication. Information communicated to USFWS in comments from Leila Nagatani's review of the Black-capped Petrel SSA draft.

Leopold, M., Geelhoed, S., Scheidat, M., Cremer, J., Debrot, A., and R. Van Halewijn. 2019. A review of records of the Black-capped Petrel *Pterodroma hasitata* in the Caribbean Sea. *Marine Ornithology* 47: 235–241.

Lewis, D.S., R. van Veen and B.S. Wilson. 2010. Conservation implications of small Indian mongoose (Herpestes auropuntatus) predation in a hotspot within a hotpsot: the Hellshire Hills, Jamaica. Biological Invasions, 13, pp. 25-33.

Lloyd, J.D., León, Y.M., 2019. Forest change within and outside protected areas in the Dominican Republic, 2000-2016. bioRxiv 558346. https://doi.org/10.1101/558346

Longcore, T., C. Rich and S.A. Gauthreaux, Jr. 2008. Height, guy wires and steady-burning lights increase hazard of communication towers to nocturnal migrants: a review and meta-analysis. The Auk, Vol. 125, No. 2, pp. 485-492.

Longcore, T., C. Rich, P. Mineau, B. MacDonald and D.G. Bert. 2013. Avian mortality at communication towers in the United States and Canada: which species, how many, and where? Biological Conservation, Vol. 158, pp. 410-419.

Lugo, A.E. 2008. Visible and invisible effects of hurricanes on forest ecosystems: an international review. Austral Ecology 33, 368–398.

Madeiros, J.C., C. Nicholas and D. Priddel. 2012. Breeding biology and population increase of the Endangered Bermuda Petrel Pterodroma cahow. Bird Conservation International 22: 35–45.

Manly, B., B.S. Arbogast, D.S. Lee and M. van Tuinen. 2013. Mitochondrial DNA Analysis Reveals Substantial Population Structure within the Endangered Black-capped Petrel (Pterodroma hasitata). Waterbirds 36: 228-233.

McKown M. 2014. Acoustic monitoring of diablotin activity on Hispaniola: Pilot data and potential next steps. Report by Conservation Metrics.

Michael, P., Hixson, K., Haney, C., Satgé, Y., Gleason, J., and P. Jodice. 2022. Seabird vulnerability to oil: Exposure potential, sensitivity, and uncertainty in the northern Gulf of Mexico. Frontiers in Marine Science, 9: 880750.

Ministerio de Turismo. 2012. Plan Sectorial de Ordenamiento territorial turístico.

Moser, M.L. and D.S. Lee. 1992. A fourteen-year survey of plastic ingestion by western North Atlantic seabirds. Colonial Waterbirds: 83–94.

Myers, R., J. O’Brien, D. Mehlman, and C. Bergh, Fire Management Assessment of the Highland Ecosystems of the Dominican Republic. GFI publication no. 2004-2a. The Nature Conservancy, Arlington, VA.

Nelson, C. E., Proenza, J. A., Lewis, J. F., and López-Kramer, J. 2011. The metallogenic evolution of the Greater Antilles. Geologica Acta 9(3-4): 229-264.

O'Connell, A., B. Gardner, A. Gilbert, and K. Laurent. 2009. Compendium of avian occurrence information for the continental shelf waters along the Atlantic coast of the United States. Final report to US Fish & Wildlife Service and Minerals Management Service. Laurel, MD: Patuxent Wildlife Research Center.

Plasencia, C., Fuentes, J., Sánchez, L., Álvarez, F., Mustelier, A., Barrientos, Y., and A. Viña. 2022. Informe sobre expedición para comprobar la presencia del Pájaro de la Bruja (*Pterodroma hasitata*) en la localidad de la Bruja, Santiago de Cuba.

Presidential Memorandum. 2020. Presidential Determination on the Withdrawal of Certain Areas of the United States Outer Continental Shelf from Leasing Disposition. Issed on 25 September 2020. Accessed on 11 April 2022 https://trumpwhitehouse.archives.gov/presidential-actions/presidential-determination-withdrawal-certain-areas-united-states-outer-continental-shelf-leasing-disposition/

Proenza, J., Aiglsperger, T., Villanova-de-Beanavent, C., Torró, L., Rodriguez-Garcia, D., Ramírez, A., and J. Rodríuez. 2017. Discovery of REE minerals hosted in karst bauxite ores from the Sierra de Bahoruco, Pedernales, Dominican Republic. 14th SGA Biennial Meeting 2017, Volume 4.

Proenza, J., Villanova-de-Beanavent, C., Torró, L., Aiglsperger, T., Ramírez, A., and J. Rodríuez. 2021. Recursos de tierras raras en la Rep. Dominicana: Bauxitas kársticas de la Sierra de Bahoruco. Geonoticias 17(46): 21-25.

Redwood, S. 2015. Dominican Republic on the mining map. Mining Journal, 12-18.

RIMMER, C., GOETZ, J., GOMEZ, E., BROCCA, J., BAYARD, P. & J. HILAIRE. 2010. Avifaunal Surveys in LaVisite National Park—Last Vestiges of Montane Broadleaf Forest in Eastern Haiti. Journal of Caribbean Ornithology 23 (1): 31.

Robbins, A.M.J., C. Eckelmann and M.Q. Ambio. 2008. Forest Fires in the Insular Caribbean. Fire Ecology and Management, Vol. 37, No. 7/8, pp. 528-534.

Rodríguez, A. and B. Rodríguez. 2009. Attraction of petrels to artificial lights in the Canary Islands: effects of moon phase and age class. Ibis 151: 299–310.

Rodríguez A, Holmes ND, Ryan PG, Wilson KJ, Faulquier L, Murillo Y, Raine AF, Penniman JF, Neves V, Rodríguez B, Negro JJ, Chiaradia A, Dann P, Anderson T, Metzger B, Shirai M, Deppe L, Wheeler J, Hodum P, Gouveia C, Carmo V, Carreira GP, Delgado-Alburqueque L, Guerra-Correa C, Couzi FX, Travers M, Corre ML. 2017a. Seabird mortality induced by land-based artificial lights. Conserv Biol. 2017 Oct;31(5):986-1001.

Rodríguez, A., Dann, P., and A. Chiaradia. 2017b. Reducing light-induced mortality of seabirds: High pressure sodium lights decrease the fatal attraction of shearwaters. Journal for Nature Conservation, 39(2017): 68-72.

Rorig, M., McKay, S., Ferguson, S., and P. Werth. 2007. Model-Generated Predictions of Dry Thunderstorm Potential. Journal of Applied Meteorology and Climatology, 46: 605-614.

Rueda-Roa, D., and F. Muller-Karger. 2013. The southern Caribbean upwelling system: Sea Surface temperatura, wind forcing and chlorophyll concentration patterns. Deep-Sea Research, 178: 102-114.

Rupp, E., E. Garrido, J.I. Matos, G. Feliz, J.L. Castillo, J. Goetz, and J. Gerwin. 2011. Discovery of a new nesting location for Black-capped Petrel (Pterodroma hasitata) in Haiti. 2011 Annual Meeting of the Society for the Conservation and Study of Caribbean Birds, 21-25 July 2011, Freeport, Grand Bahama.

Rupp, E., E. Garrido, and G.E. Wallace. 2012. Summary of Black-capped Petrel (Pterodroma hasitata) nesting activity during the 2011/2012 nesting season at Loma del Toro and Morne Vincent, Hispaniola. International Black-capped Petrel Conservation Group. http://www.fws.gov/birds/waterbirds/petrel.

Rupp, E. and E. Garrido. 2013. Interim Report on Black-capped Petrel Activities. Grupo Jaragua, May 16, 2013.

Saba, V., Griffies, S., Anderson, W., Winton, M., Alexander, M., Delworth, T., Hare, J., Harrison, M., Rosati, A., Vecchi, G., and R. Zhang. 2016. Enhanced warming of the Northwest Atlantic Ocean under climate change. Journal of Geophysical Research: Oceans, 121: 118-132.

Saether, B.E. and B. Oyvind. 2000. Avian life history variation and contribution of demographic traits to the population growth rate. Ecology, Vol 81, No. 3, pp. 642-653.

Satgé, Y. and G. Millischer. 2022. Thermal surveys for the Diablotin Black-capped Petrel on Dominica: Results from an expedition during January and February 2022. Unpublished report from Environmental Protection in the Caribbean. Green Cove Springs, Florida, USA.

Satgé, Y.G., E. Rupp, and P.G.R. Jodice. 2019. A preliminary report of ongoing research of the ecology of Black-capped Petrel (*Pterodroma hasitata*) in Sierra de Bahoruco, Dominican Republic – I: GPS tracking of breeding adults. Unpublished Report, South Carolina Cooperative Research Unit, Clemson University, Clemson, South Carolina, USA. https://doi.org/10.5066/P9UHASY4

Satgé, Y. 2021. Grupo Jaragua - BCPE Conservation and monitoring 2020-2021. Project #1715L.

Satgé, Y., Rupp, E., Brown, A., and P. Jodice. 2021. Habitat modelling locates nesting areas of the Endangered Black-capped Petrel *Pterodroma hasitata* on Hispaniola and identifies habitat loss. Bird Conservation International, 31: 573-590.

Satgé, Y.G, Keitt, B.S., Gaskin, C.P., Patteson, J.B., & Jodice, P.G.R. 2022. Temporal and spatial segregations between phenotypes of the Diablotin Black-capped Petrel Pterodroma hasitata during the breeding and non-breeding periods. bioRxiv 2022.06.02.491532; https://doi.org/10.1101/2022.06.02.491532.

Satgé et al. (*in litt*). Mesopelagic diet as pathway of high mercury levels in body feathers of the endangered Diablotin Black-capped Petrel (*Pterodroma hasitata*). (Manuscript in review).

Schippers, P., Stienen, E., Schotman, A., Snep, R., and P. Slim. 2011. The consequences of being colonial: Allee effects in metapopulations of seabirds. Ecological Modelling, 222: 3061-3070.

Schumacher, S., Reineking, B., Sibold, J., and H. Bugmann. 2006. Modeling the impact of climate and vegetation on fire regimes in mountain landscapes. Landscape Ecology, 21:539-554.

Sekercioglu, C., Schneider, S., Fay, J., and S. Loarie. 2008. Conservation Biology, 22(1): 140-150.

Sergile, F.E., C.A. Woods and P.E. Paryski. 1992. Final Report of the Macaya Biosphere Reserve Project. Florida Museum of Natural History, Gainesville, Florida USA.

Shaffer, S. A., Costa, D. P. and Weimerskirch, H. 2001. A comparison of methods to evaluate energy expenditure of incubating wandering albatrosses. Physiological and Biochemical Zoology (2001):823-831.

Shoji, A., Elliott, K. H., Aris-Brosou, S., Wilson, R. P. and A. J. Gaston. 2015. Predictors of incubation costs in seabirds: an evolutionary perspective. Ibis 157:44-53.

Simons, T.R. 1984. A population model of the endangered Hawaiian Dark-rumped Petrel. Journal of Wildlife Management, Vol 48, No. 4, pp. 1065-1076.

Simons, T.R. 1985. Biology and behavior of the endangered Hawaiian Dark-rumped Petrel. The Condor, Vol 87, No. 2, pp. 229-245.

Simons, T. R. and C. N. Bailey (2020). Hawaiian Petrel (*Pterodroma sandwichensis*), version 1.0. In Birds of the World (A. F. Poole and F. B. Gill, Editors). Cornell Lab of Ornithology, Ithaca, NY, USA. https://doi.org/10.2173/bow.hawpet1.01

Simons, T.R., D.S. Lee, and J.C. Haney. 2013. Diablotin Pterodroma hasitata: a Biography of the endangered Black-capped Petrel. Marine Ornithology 41(Special Issue): S 3–S 43.

Siqueira, L., and B. Kirtman. 2016. Atlantic near-term climate variability and the role of a resolved Gulf Stream, Geophysical Research Letters, 43: 3964-3972.

Slocum, M., Aide, T., Zimmerman, J., Navarro, L. 2006. A Strategy for Restoration of Montane Forest in Anthropogenic Fern Thickets in the Dominican Republic. Restoration Ecology, 14(4): 526-536.

Smucker, G.R., M. Bannister, H. D'Agnes, Y. Gossin, M. Portnoff, J. Timyan, S. Tobias and R. Toussaint. 2007. Environmental Vulnerability in Haiti Findings & Recommendations. This publication was produced for review by the United States Agency for International Development, prepared by Chemonics International Inc. and the U.S. Forest Service.

Stephens PA, Sutherland WJ. Consequences of the Allee effect for behaviour, ecology and conservation. Trends Ecol Evol. 1999 Oct;14(10):401-405. doi: 10.1016/s0169-5347(99)01684-5.

Tanner, E., Bellingham, P., Healey, J., and K. Feeley. 2022. Hurricane disturbance accelerated the thermophilization of a Jamaican montane forest. Ecography. doi: 10.1111/ecog.06100.

Taylor, M., Stephenson, T., Chen, A., and K. Stephenson. 2012a. Climate Change and the Caribbean: Review and Response. Caribbean Studies, 40(2): 169-200.

Taylor, G., Muller-Karger, F., Thunell, R., Scranton, M., Astor, Y., Varela, R., Ghinaglia, L., Lorenzoni, L., Fanning, K., Hameed, S., and O. Doherty. 2012b. Ecosystem responses in the southern Caribbean Sea to global climate change. PNAS, 109(47): 19315-19320.

Thurman, L., Stein, B., Beever, E., Foden, W., Geange, S., Green, N., Gross, J., Lawrence, D., LeDee, O., Olden, J., Thompson, L., and B. Young. 2020. Persist in place or shift in space? Evaluating the adaptive capacity of species to climate change. *Frontiers in Ecology and the Environment*, *18*(9), 520–528. https://doi.org/10.1002/fee.2253

Tingley, M.W., W.B. Monahanc, S.R. Beissinger, and C. Moritz. 2009. Birds track their Grinnellian niche through a century of climate change. Proceedings of the National Academy of Science (USA) 106:19637–19643.

Travers, M. S., S. Driskill, A. Stemen, T. Geelhoed, D. Golden, S. Koike, A. A. Shipley, H. Moon, T. Anderson, M. Bache, and A. F. Raine. 2021. Post-collision impacts, crippling bias, and environmental bias in a study of Newell's Shearwater and Hawaiian Petrel powerline collisions. Avian Conservation and Ecology 16(1):15. https://doi.org/10.5751/ACE-01841-160115

Travis, J. 2003. Climate change and habitat destruction: a deadly anthropogenic cocktail. The Royal Society, 270: 467-473.

U.S. Fish and Wildlife Service (USFWS). 2022. Hawaii Wind Facilities Hawaiian Petrel Take. USFWS Pacific Islands Fish and Wildlife Office.

United Nations, Department of Economic and Social Affairs, Population Division (UN). 2017 Revision of World Population Prospects, https://esa.un.org/unpd/wpp/. Accessed 27 February 2018.

van Berkel, J., Burchard, H., Christensen, A., Mortensen, L., Peterson, O., and F. Thomsen. 2020. The Effects of Offshore Wind Farms on Hydrodynamics and Implications for Fishes. Oceanography, 33(4): 108-117.

Weaver, A., Sedláček, J., Eby, M., Alexander, K., Crespin, E., Fichefet, T., Philippon-Berthier, G., Joos, F., Kawamiya, M., Matsumoto, K., Steinacher, M., Tachiiri, K., Tokos, K., Yoshimori, M., and K. Zickfeld. 2012. Stability of the Atlantic meridional overturning circulation: A model intercomparison. Geophysical Research Letters, 39: 1-7.

Wetmore, A. 1952. A record for the Black-capped Petrel, Pterodroma hasitata, in Martinique. Auk 69:460.

Weibel, P., Reineking, B., and H. Bugmann. 2009. Projecting forest fires in mountain forests under climate change. IOP Conf. Series: Earth and Environmental Science, 6: 382005.

Wheeler, J. 2020. Missteps and Miracles while pursuing the Petrel. Accessed 7 November 2022: https://www.birdscaribbean.org/2020/02/missteps-and-miracles-while-pursuing-the-petrel/

Wheeler, J., Y. Satgé, A. Brown, J. Goetz, J., B. Keitt, H. Nevins, and E. Rupp. 2021. Black-capped Petrel. Conservation Update and Action Plan. Conserving the Diablotin. International Black-capped Petrel Conservation Group. https://www.birdscaribbean.org/our-work/working-groups/black-capped-petrel-wg/

White, Jr., T.H., J. A. Collazo, S. J. Dinsmore and I. Llerandi-Román. 2014. Niche restriction and conservatism in a neotropical psittacine: the case of the Puerto Rican Parrot. Pgs. 1-83 in Habitat Loss: Causes, Impacts on Biodiversity and Reduction Strategies. Nova Science Publishers, New York, NY, USA.

Whittow, G. C. 2002. Seabird reproductive physiology and energetics. Pp. 409-439 in Biology of Marine Birds. E. Schreiber and J. Burger (eds.). CRC Press, LLC. Boca Raton, FL USA.

Wiese, F., Montevecchi, W., Davoren, G., Huettmann, F., Diamond, A., and J. Linke. 2001. Seabirds at Risk around Offshore Oil Platforms in the North-west Atlantic. Marine Pollution Bulletin, 42(12): 1285-1290.

Williams, J., Jackson, S., and J. Kutzbach. 2007. Projected distributions of novel and disappearing climates by 2100 AD. PNAS, 104(14): 5738-5742.

Wingate, D.B. 1964. Discovery of breeding Black-capped Petrels on Hispaniola. The Auk, Vol. 81, No. 2, pp. 147-159.

Winship, A.J., B.P. Kinlan, T.P. White, J.B. Leirness, and J. Christensen. 2018. Modeling At-Sea Density of Marine Birds to Support Atlantic Marine Renewable Energy Planning: Final Report. OCS Study BOEM 2018-010. Sterling, VA. 67 pp.

Wolf, S., B. Hartl, C. Carroll, M.C. Neel, and D.N. Greenwald. 2015. Beyond PVA: Why Recovery under the Endangered Species Act Is More than Population Viability. BioScience, Volume 65, Issue 2, 1 February 2015, Pages 200–207, https://doi.org/10.1093/biosci/biu218

Woods, C.A. 1987. The threatened and endangered birds of Haiti: lost horizons and new hopes. Proceedings Jean Delacour/IFCB Symposium: 385–429.

Woods, C.A., F.E. Sergile and J.A. Ottenwalder. 1992. Stewardship Plan for the National Parks and natural areas of Haiti. Florida Museum of Natural History. Prepared for United States Agency for International Development/Haiti.

WSFA 12 News. 2017. Hurricane pushes new and threatened species into state. Accessed on 18 November 2022: https://www.wsfa.com/story/36540239/hurricane-pushes-new-and-threatened-species-into-state/

Wurster, Jr., C.F. and D.B. Wingate. 1968. DDT residues and declining reproduction in the Bermuda Petrel. Science, New Series, Vol. 159, No. 3818, pp. 979-981.

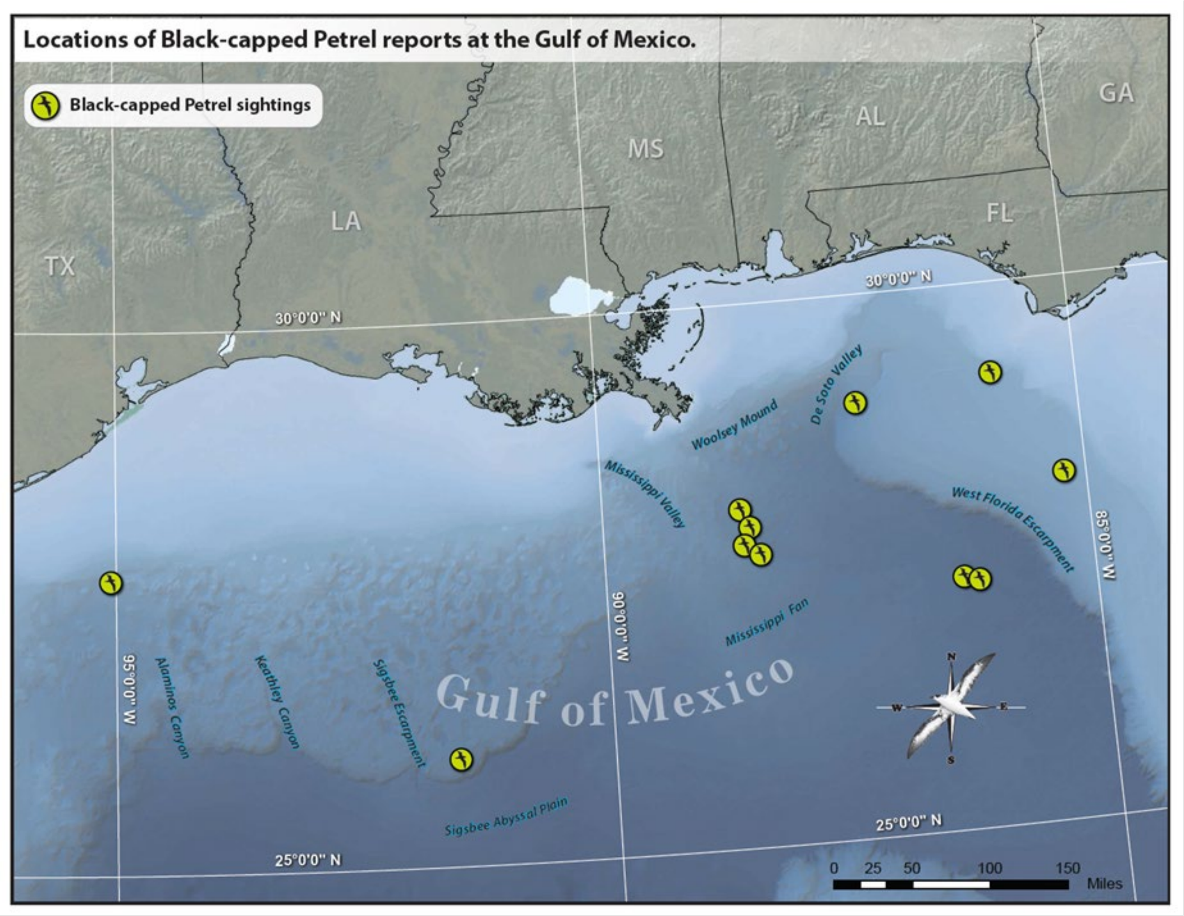
Zhang, W., Chai, F., Xue, H., and L. Oey. 2020. Remote sensing linear trends of the Gulf Stream from 1993 to 2016. Ocean Dynamics, 70: 701-712.

Zhou, C., Y. Jiao, and J. Browder. 2019. Seabird bycatch vulnerability to pelagic longline fisheries: Ecological traits matter. *Aquatic Conservation: Marine and Freshwater Ecosystems*, 29:1325–1335.

Appendices

Appendix A – Black-capped Petrel Gulf of Mexico sightings May 2017-2018

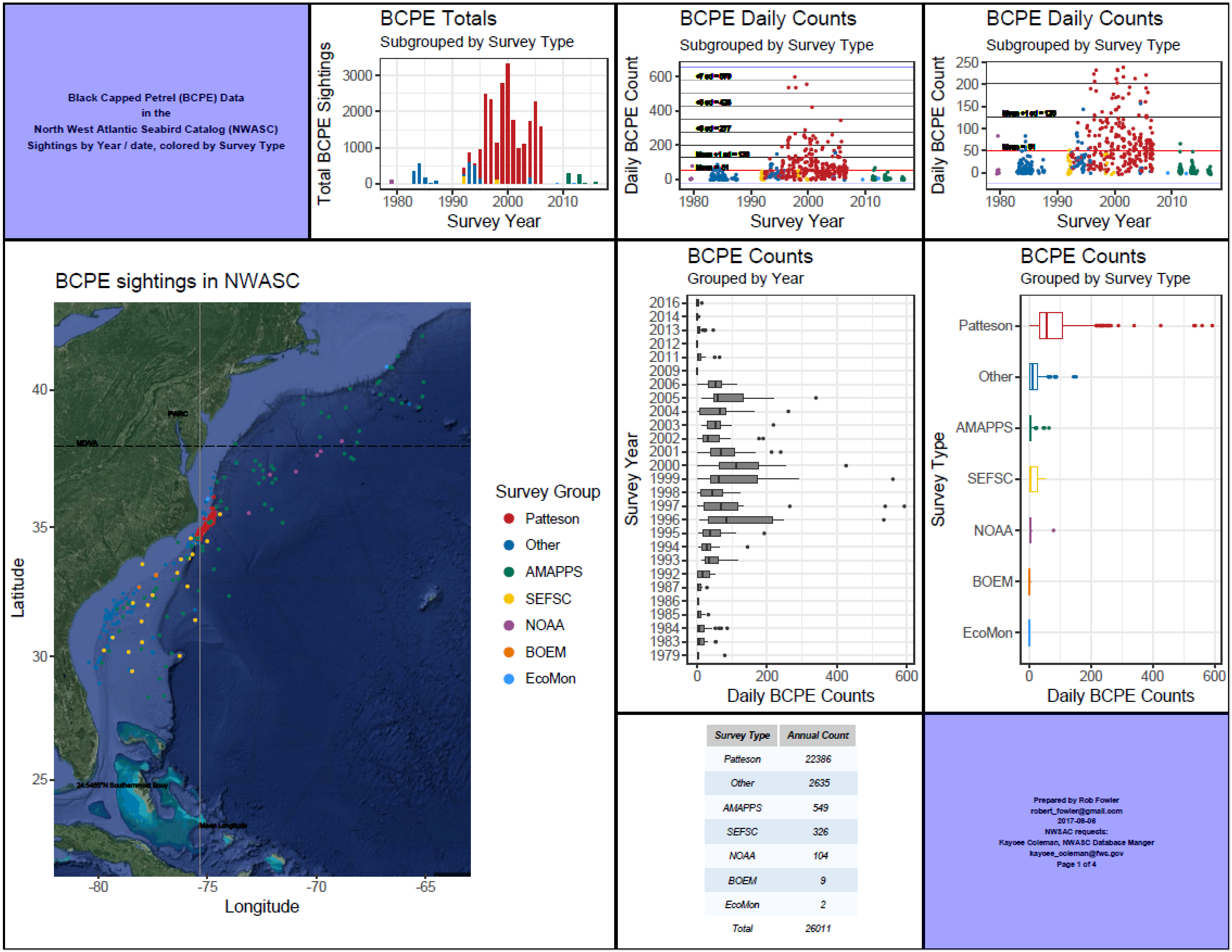
CRUISE #	DATE	LAT	LONG	OBS #1	OBS #2	COMMENT(S)
Oregon II	170518	26.0	-91.6	C. Haney	M. McDowell	Got up and flew, diagnostic to id, when did fly, flight height 2
Gordon Gunter	170723	27.3	-86.3	C. Haney	J. Gleason	95% certain on ID; very far; gray to gray brown dorsally, likely white nape/black cap. Following slick line
Gordon Gunter	170723	27.3	-86.2	C. Haney	J. Gleason	Feeding back and forth along a convergence line with Sargassum, dispersed, post-feeding flock
Gordon Gunter	170726	29.2	-85.9	C. Haney	J. Gleason	Actively feeding over predator fish school; white underwing, black cap, white rump
Gordon Gunter	170810	27.9	-88.5	C. Haney	D. Bauer	Gray-brown dorsal, white rump, flying low, sitting and feeding for short while
Gordon Gunter	170810	27.8	-88.5	C. Haney	D. Bauer	White rump, gray-brown dorsal
Gordon Gunter	170810	27.8	-88.5	C. Haney	D. Bauer	Mixed foraging flock over tuna; most time on water (gray-brown dorsal, white rump)
Gordon Gunter	170810	27.7	-88.4	C. Haney	D. Bauer	Dynamic soaring
Gordon Gunter	170821	27.7	-95.1	C. Haney	D. Bauer	White rump, nape; arcing flight
Gordon Gunter	180311	29.0	-87.3	C. Haney	J. Andrew	White face; gray-brown plumage, arced wings; direct comparison with AUSH
Gordon Gunter	180314	28.2	-85.2	C. Haney	J. Andrew	White-faced morph; zig-zag foraging flight, doubling back



Data are from ship-based surveys supporting the Gulf of Mexico Marine Assessment Program for Protected Species (GoMMAPPS); reports from the surveys can be found on https://www.boem.gov/GOMMAPPS. Methods described in Ballance, L. and M. Force. 2016. Seabird Distribution and Abundance Survey Protocols: A summary of seabird protocols and data collection procedures used on NEFSC/AMAPPS surveys. All Black-capped Petrel records were single birds.

Appendix B – Black-capped Petrel Data in the Northwest Atlantic Seabird Catalog (NWASC)

U.S. Fish and Wildlife Service, U.S. Department of Interior. Accessed through U.S. Department of Interior, Northwest Atlantic Seabird Catalog, Version 2. Accessed 25 Aug. 2017.



Black Capped Petrel (BCPE) Data
in the
North West Atlantic Seabird Catalog (NWASC)
Sightings by Year / date, colored by Survey Type

Survey Type	*Annual Count*
Patteson	*22386*
Other	*2635*
AMAPPS	*549*
SEFSC	*326*
NOAA	*104*
BOEM	*9*
EcoMon	*2*
Total	*26011*

Prepared by Rob Fowler
robert_fowler@gmail.com
2017-08-08
NWSAC requests:
Kayoee Coleman, NWASC Database Manger
kayoee_coleman@fws.gov
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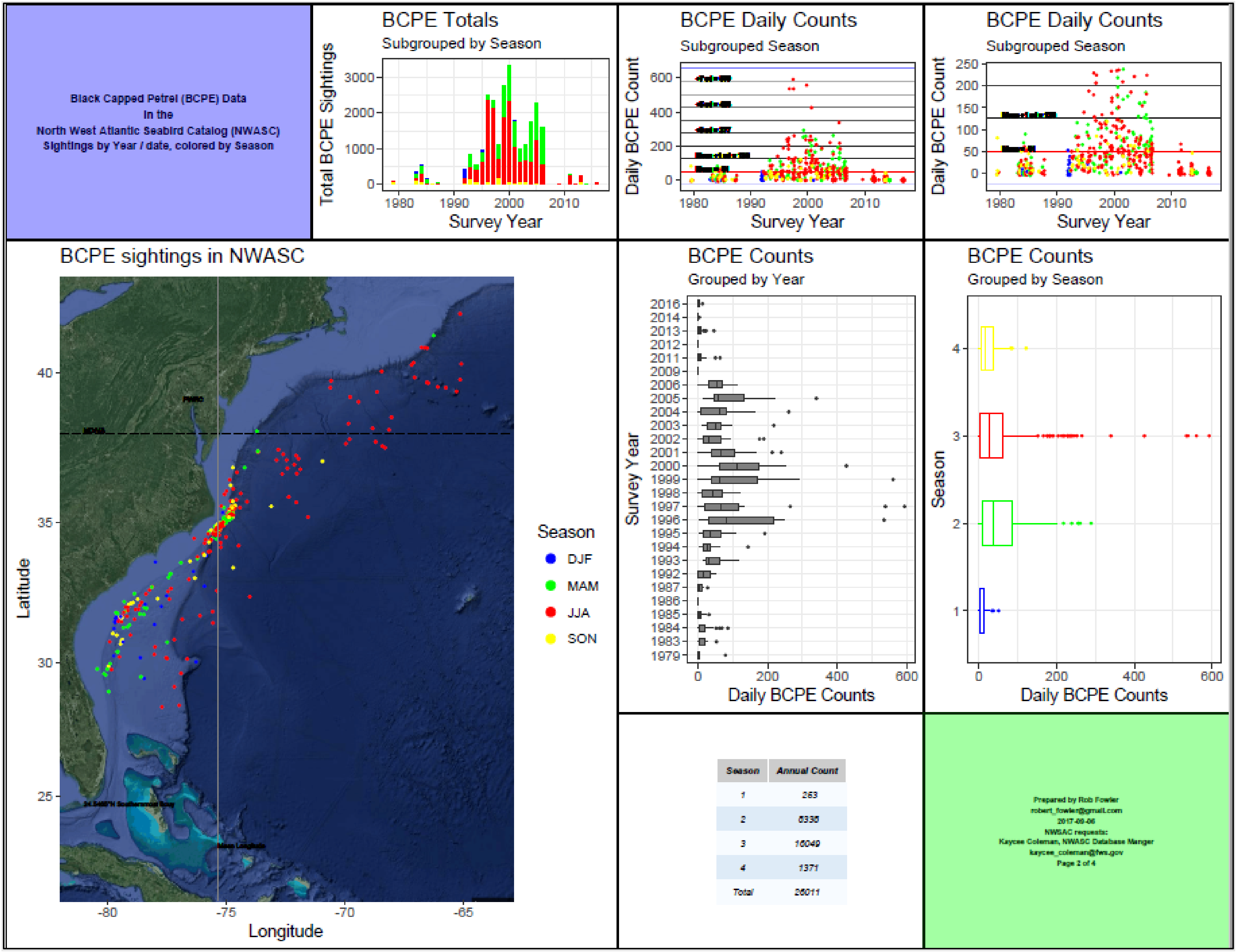
(i) Black-capped Petrel data in the Northwest Atlantic Seabird Catalog (NWASC) sightings by year/data, colored by survey type.



Black Capped Petrel (BCPE) Data
in the
North West Atlantic Seabird Catalog (NWASC)
Sightings by Year / date, colored by Season

Season	Annual Count
1	263
2	8338
3	16049
4	1371
Total	26011

Prepared by Rob Fowler
robert_fowler@gmail.com
2017-08-08
NWSAC requests:
Kaycee Coleman, NWASC Database Manger
kaycee_coleman@fws.gov
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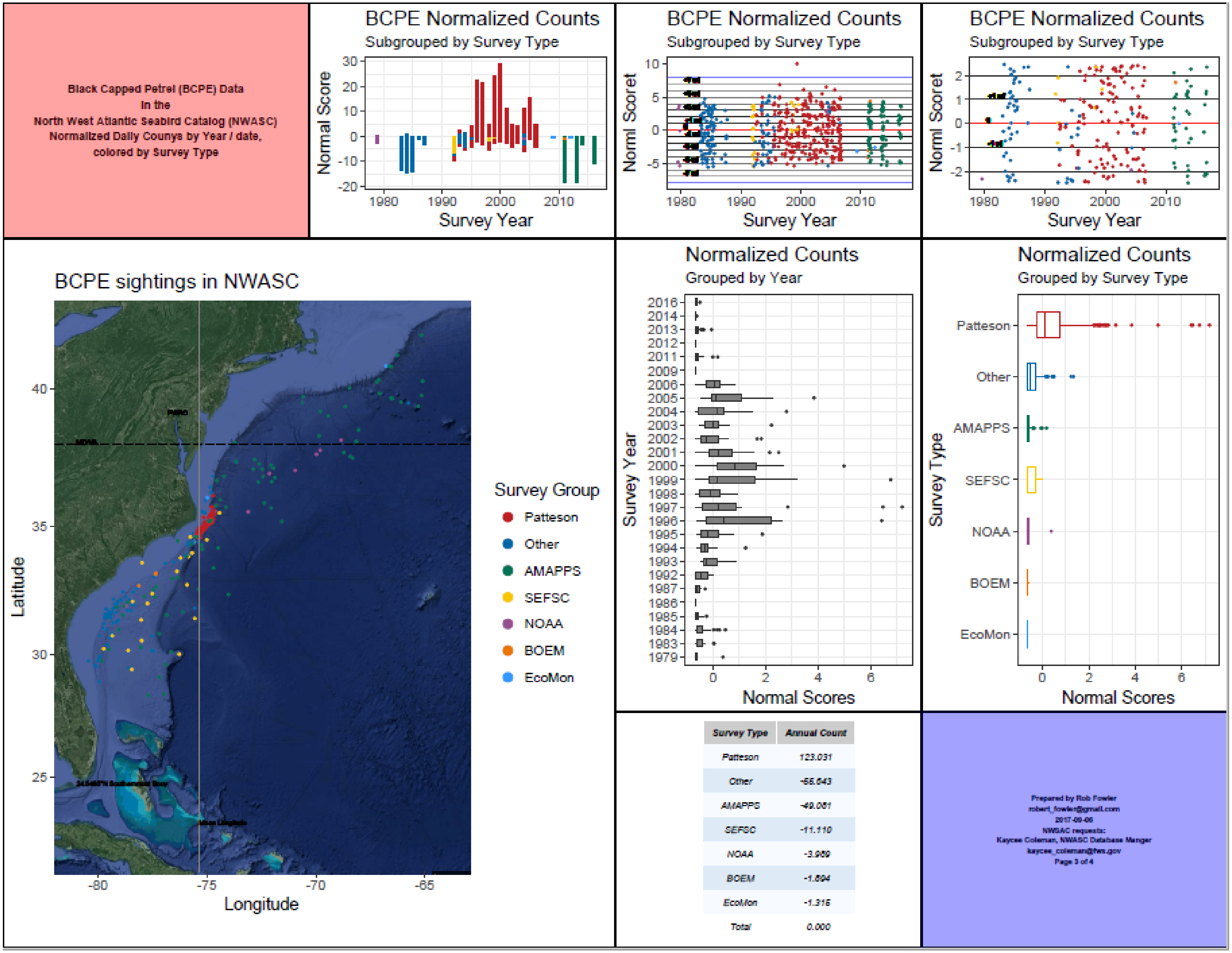
(ii) Black-capped Petrel data in the North West Atlantic Seabird Catalog (NWASC) sightings by year/data, colored by season.

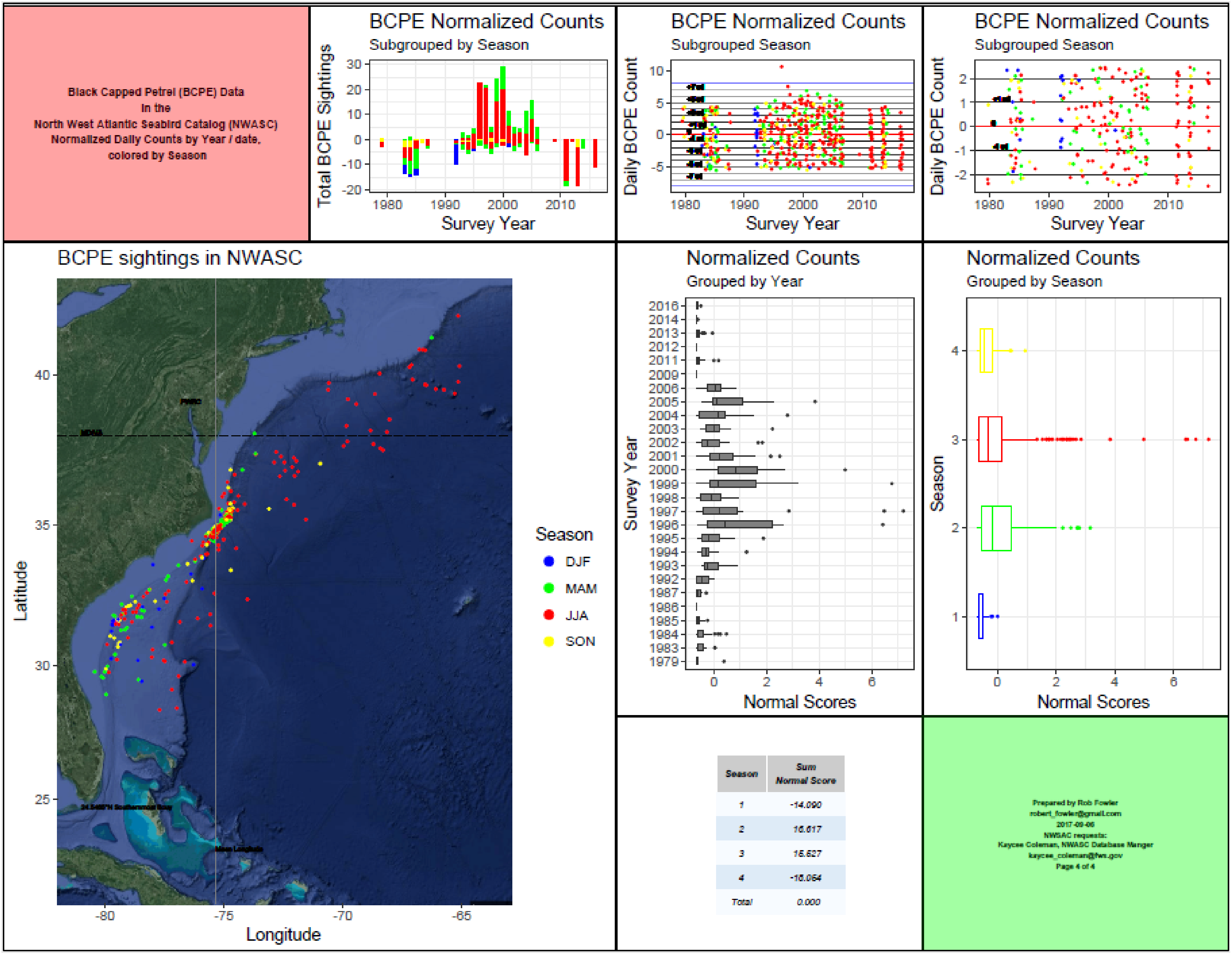


Black Capped Petrel (BCPE) Data
In the
North West Atlantic Seabird Catalog (NWASC)
Normalized Daily Counys by Year / date,
colored by Survey Type

Survey Type	Annual Count
Patteson	123.031
Other	-65.643
AMAPPS	-49.081
SEFSC	-11.110
NOAA	-3.969
BOEM	-1.694
EcoMon	-1.316
Total	0.000

Prepared by Rob Fowler
robert_fowler@gmail.com
2017-09-06
NWSAC requests:
Kaycee Coleman, NWASC Database Manger
kaycee_coleman@fws.gov
Page 3 of 4

(iii) Black-capped Petrel data in the North West Atlantic Seabird Catalog (NWASC) normalized daily counts by year/date, colored by survey type.


Black Capped Petrel (BCPE) Data
In the
North West Atlantic Seabird Catalog (NWASC)
Normalized Daily Counts by Year / date,
colored by Season

Season	Sum Normal Score
1	-14.090
2	16.617
3	16.627
4	-19.064
Total	0.000

Prepared by Rob Fowler
robert_fowler@gmail.com
2017-09-06
NWSAC requests:
Kaycee Coleman, NWASC Database Manger
kaycee_coleman@fws.gov
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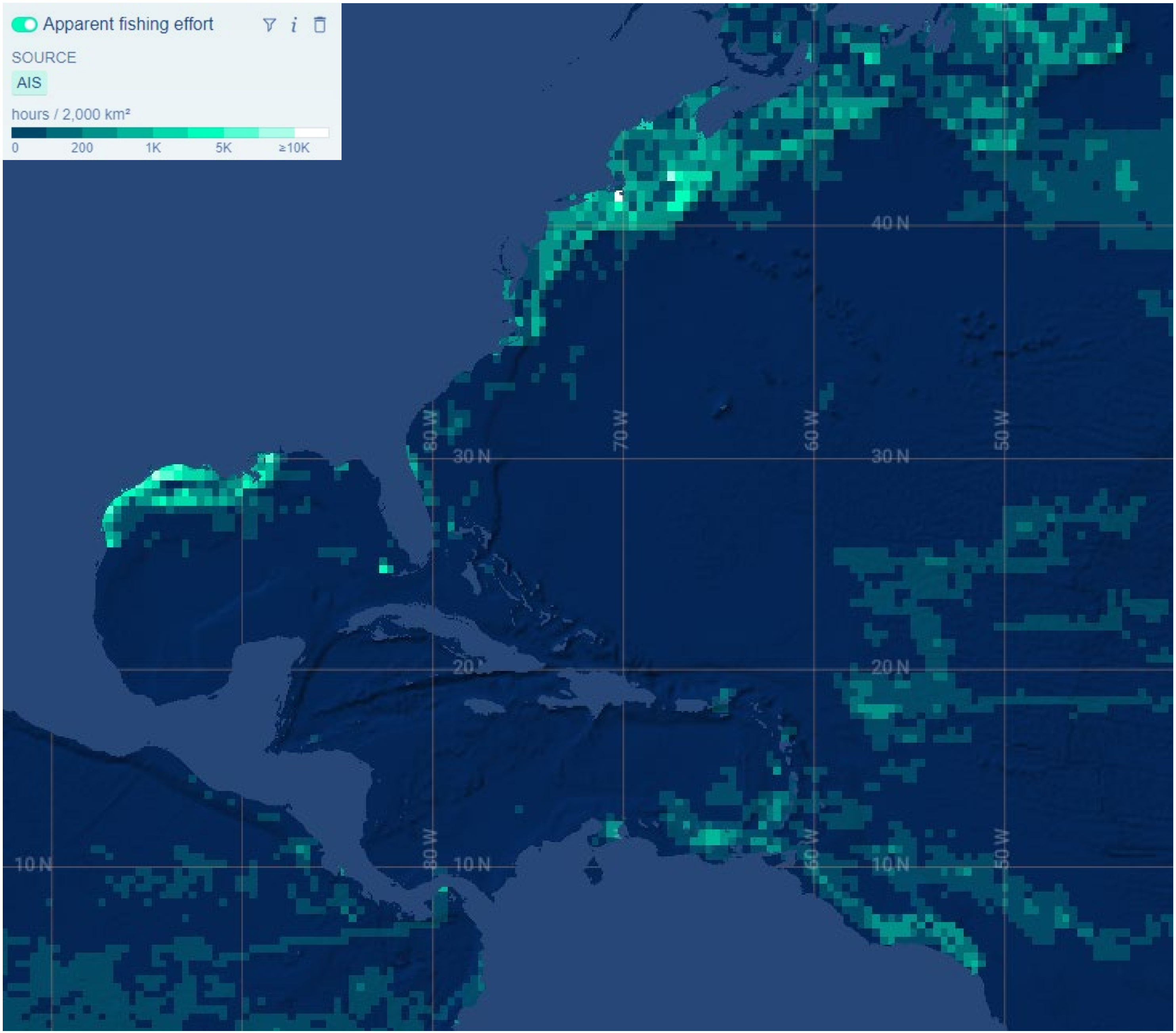
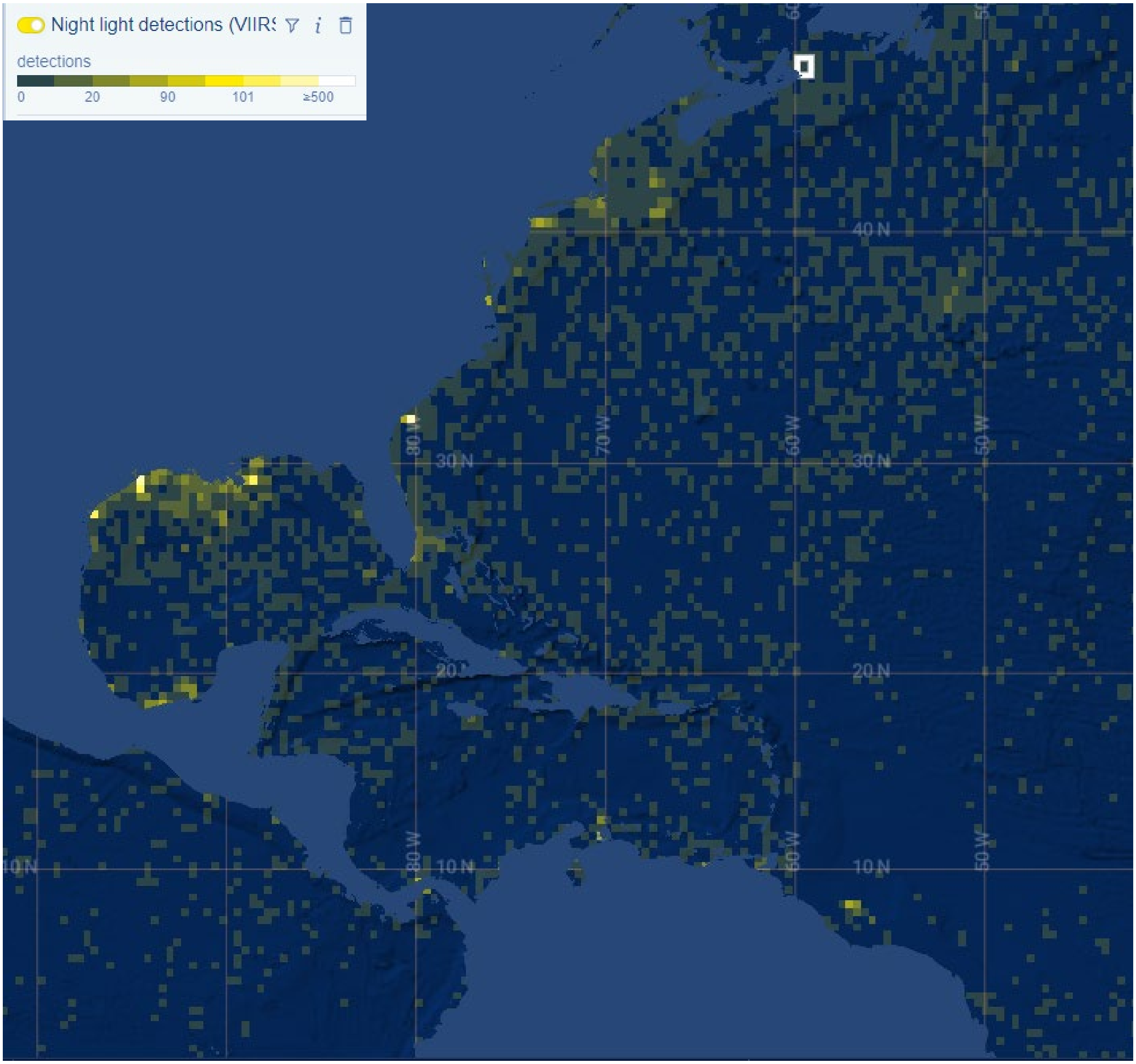
(iv) **Black-capped Petrel data in the North West Atlantic Seabird Catalog (NWASC) normalized daily counts by year/date, colored by season.**

Appendix C –Fishing Effort and Night Light Detections within the Black-capped Petrel range.



Apparent fishing effort in hours per 2000 km^2 (27 June 2022 to 7 July 2022) using Automatic Identification System (AIS) collected via satellite and land-based receivers in proximity to the Black-capped Petrel range from Global Fishing Watch (https://globalfishingwatch.org/map/).



Night light detections (27 June 2022 to 7 July 2022) using visible infrared imaging radiometer suite (VIIRS), shows vessels at sea that emit light at night within the Black-capped Petrel range from Global Fishing Watch (https://globalfishingwatch.org/map/).

Appendix D – Location, survey effort, habitat characteristics, and management status at confirmed, probable and suspected Black-capped Petrel nesting sites.

Wheeler, J., Y. Satgé, A. Brown, J. Goetz, J., B. Keitt, H. Nevins, and E. Rupp. 2021. Black-capped Petrel. Conservation Update and Action Plan. Conserving the Diablotin. International Black-capped Petrel Conservation Group. https://www.birdscaribbean.org/our-work/working-groups/black-capped-petrel-wg

Location			**Survey effort** [a]			**Habitat characteristics**				**Management**			
Site Name	**Geographic Area**	**Country**	**Audio/ Visual**	**Ground Searches**	**Radar**	**Number of known Nests**[b]	**Known nesting surface (km^2)** [c]	**Suitable contiguous habitat?**[d]	**Habitat Quality**[e]	**National Park** [f]	**IBA**[g]	**KBA**[h]	**Mng level** [i]
CONFIRMED BREEDING LOCATIONS													
La Visite (Tet Opak)	Massif de la Selle	Haiti	high	high	fully covered	57	0.06	Y	2	La Visite	Y	Y	1
Morne Vincent (Boukan Chat)	Massif de la Selle	Haiti	high	high	fully covered	17	0.13	N	3	Foret de Pins I	N	Y	1
Loma del Toro	Sierra de Bahoruco	Dominican Republic	high	thorough	fully covered	28	1.48	Y	5	Sierra de Bahoruco	Y	Y	3
Loma Quemada	Sierra de Bahoruco	Dominican Republic	med	med	fully covered	7	0.11	Y	5	Sierra de Bahoruco	Y	Y	3
Valle Nuevo	Cordillera Central	Dominican Republic	low	med	fully covered	11	0.14	Y	4	Valle Nuevo	Y	Y	4
PROBABLE OR SUSPECTED LOCATIONS ON HISPANIOLA													
Macaya (1)	Massif de la Hotte	Haiti	low	low	¾ covered	0	-	N	5	Macaya	N	Y	2
La Visite (remainder of escarpment)	Massif de la Selle	Haiti	medium	low	fully covered	0	-	Y	2	La Visite	Y	Y	1
Zapoten	Sierra de Bahoruco	Dominican Republic	medium	medium	fully covered	0	-	Y	5	Sierra de Bahoruco	Y	Y	4
Pic de la Selle	Massif de la Selle	Haiti	low	low	¼ covered	0	-	Y	3	Foret de Pins II	N	Y	1
Neiba (suspected)	Sierra de Neiba	Dominican Republic	low	low	⅓ covered	0	-	N	5*	Sierra de Neiba	Y	Y	3
Central and Northern range (suspected)	Cordillera Central	Dominican Republic	none	none	¼ covered	0	-	Y	5*	Del Carmen Ramirez, Bermudez	Y	Y	4
PROBABLE OR SUSPECTED LOCATIONS ON OTHER ISLANDS													
Dominica	Various peaks	Dominica	medium	medium	covered	0	-	N	5	Morne Trois Pitons, Morne Diablotin	Y	Y	4
Guadeloupe (suspected)	Nez Cassé/ Soufrière	Guadeloupe	low	low	½ covered	0	-	N	5	Guadeloupe	Y	Y	5
Pico Turquino (suspected)	Sierra Maestra	Cuba	low	none	No coverage	0	-	N	5	Pico Turquino Pico La Bayamesa	Y	Y	?
Blue Mountains (suspected)	Blue Mountains	Jamaica	low	low	1/10 covered	0	-	N	5	Blue Mountains	Y	Y	2

[a] Survey effort information provided by Rupp (pers. comm., as cited in Wheeler 2021 and Brown (2015, 2016, 2017, 2020a, 2020b). Level of effort for audio/visual and ground searches are the surveyors' qualitative rating of coverage. For radar coverage, coverage refers to the proportion of likely flyways (drainages) surveyed.

[b] Number of known nests at the site as of October 2020.

[c] Calculated as the surface of the 95% minimum convex polygon around known nest sites in the nesting area.

[d] Refers to the likelihood that nests are likely to be found nearby, based on surveyor's opinion and habitat suitability modeling by Satgé et al. (2020).

[e] Defined as: 5 = intact vegetative cover, to 1 = cleared vegetation.

[*] Indicates that habitat modeling did not define areas as suitable for nesting (Satgé et al. 2020).

[f] UNEP-WCMC and IUCN (2020).

[g] Area defined within an important bird area (IBA) (BirdLife International 2020).

[h] Area defined within a key biodiversity area (KBA) (Key Biodiversity Areas Partnership 2020).

[i] Defined institutional infrastructure, services and activities to protect and manage the area as it relates to the Black-capped Petrel: 5 = park fully staffed (guards or rangers); park leads projects that benefit petrels, 4 = staff present regularly; park supportive with equipment housing or services, 3 = staff presence irregular; periodic logistical support for activities, 2 = staff rarely present; rarely support for activities, 1 = essentially none.

(1) Macaya was listed as confirmed in the 2012 Conservation Action Plan, based on the observations of flying and vocalizing birds; however, in the 2020 Plan, this site was considered "probable" based on the fact that no nests have been located yet.