

# Creation of a Database of Nest Monitoring Data for the Black-capped Petrel (*Pterodroma hasitata*)



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## 1. Summary

The Database of Nest Monitoring Data for Black-capped Petrel coalesces all nest monitoring data collected annually from the 2011-2012 to the 2023-2024 breeding seasons by Grupo Jaragua, Environmental Protection in the Caribbean, and Action pour la sauvegarde de l'écologie en Haïti. These organizations retain the ownership of all the data entered in the database through a Memorandum of Understanding signed by members of the International Black-capped Petrel Conservation Group in 2020. Between 2011 and 2024, more than 181 Black-capped Petrel nests were located in Hispaniola. Data from 13 seasons have been collected. Twenty-five nests had more than 10 years of monitoring data, and nine nests had more than 10 years of consecutive monitoring data. The creation of this comprehensive Database of Nest Monitoring Data for the Black-capped Petrel is intended to allow for standardized comparisons between nests, nesting areas, and across years and for future nest monitoring data to be entered as it is collected.

## 2. Introduction

The Black-capped Petrel (*Pterodroma hasitata*) is an endangered pelagic seabird endemic to the Caribbean, where it is known as Diablotin. Considered extinct during the early 20th century, the locations of its breeding areas were lost to science until 1963 when breeding activity was confirmed in Haiti (Wingate 1964). The first active nest was located in 2002 (Simons et al. 2002), and the first chick was observed in 2011 near the border between Haiti and the Dominican Republic (Rupp et al. 2012). Since then, nesting activity has been confirmed at five sites on Hispaniola (La Visite and Morne Vincent in Haiti; Loma del Toro, Loma Quemada, and Valle Nuevo in the Dominican Republic), is highly suspected to occur in Dominica and Cuba, and is probable in Guadeloupe and Jamaica (Wheeler et al. 2021).

In Hispaniola, three organizations monitor and steward nesting areas: Grupo Jaragua in the Dominican Republic, and Action pour la sauvegarde de l'écologie en Haïti (ACSEH) and Environmental Protection in the Caribbean (EPIC) in Haiti. Starting in 2012 (2011-2012 breeding season) in Loma del Toro and Morne Vincent, they searched for nests and monitored reproductive success of known nests during each breeding season.

The monitoring data collected annually may be used to assess two Key Ecological Attributes (KEAs; Wheeler et al. 2021): colony occupancy (the number of active nests divided by the total number of known nests at each site) and reproductive success (the number of fledged nests divided by the number of active nests at each site). It also enables for analysis of a proxy for the KEA adult survivorship by quantifying active nest occupation rates between years. The data can also be used to assess population resiliency factors (PRF) defined by the U.S. Fish and Wildlife Service (2023): number of active nests, and nest success (percentage of nests fledging young). However, given the increasing number of monitored nests, the annual variability in accessing nests, and the different (though comparable) monitoring methodology used in Haiti and the Dominican Republic, it became difficult to assess these KEAs and PRFs with disaggregated/uncollated data.

Therefore, I collated nest monitoring data from Grupo Jaragua, ACSEH and EPIC into a single database comprising individual nest metadata (i.e. nest location and, when available, measurements, substrate, etc.)

and annual monitoring data (i.e. biological metrics: presence of a nest, presence of breeding activity, hatching, and fledgling; and associated information). To ensure that endpoints (i.e. reproductive activity and reproductive success) were comparable between organizations, and allow for better reliability of KEA and PRF calculations, I created confidence levels (i.e. low, medium, high, confirmed) based on the strength of the data recorded in the field, confidence levels describe the quality of the biological metrics stored in the database. Although confidence levels do not apply to KEAs or PRF directly (i.e. they do not describe the quality of the KEAs or PRFs – only of the data being used to calculate these factors), they can be used to weigh data used in calculations, thus providing more reliable KEA and PRF values.

### **3. Monitoring protocols, data, and assumptions**

#### **3.1 Monitoring protocols**

In the Dominican Republic, Grupo Jaragua started monitoring reproductive success during the 2011-2012 breeding season. Monitoring visits are scheduled to occur every two months from September (Valle Nuevo) or October (Loma del Toro and Loma Quemada), to July. Since the 2017-2018 breeding season, Grupo Jaragua is consistently using camera traps to monitor a subset of nests continuously during the breeding season (Table 1). During the 2023-2024 breeding season, Grupo Jaragua monitored 66% of all known nests with camera traps.

In Haiti, Grupo Jaragua monitored reproductive success in Morne Vincent from 2011 until 2019, handing over leadership to ACSEH and EPIC in the final season. ACSEH and EPIC started monitoring reproductive success in La Visite a year earlier, during the 2017-2018 breeding season. Monitoring visits are scheduled to occur every month from January to July. Camera traps are used occasionally in Haiti to assess predation (Table 1).

In both countries, the number of monitoring visits that take place depends on weather, logistics and funding and thus varies between years (Figure 1).

During nest monitoring visits, Grupo Jaragua, ACSEH and EPIC follow comparable monitoring protocols. They revisit each known petrel nest and search for new unknown nests within the same area. Within the known nesting area, they then determine the contents of nests by (1) inspecting the burrow entrance to see if spider webs or vegetation are present (signs of a lack of breeding activity); (2) recording the presence of a petrel smell, petrel feces, feathers or chick down at the burrow entrance (signs of breeding activity); and (3) when the configuration of the burrow allows, visually inspecting the inner part of the nest cavity for additional evidence of breeding activity such as the presence of adult petrel(s), an egg, or a chick (using a phone or an endoscope if possible and available). If a new nest is located, it is assigned a unique number: Grupo Jaragua then places flagging tape with the nest number near the entrance of the cavity; since 2021, ACSEH and EPIC use numbered metal tags placed near the entrance.

#### **Note on sensory clues:**

Besides observation of petrels, eggs, or chicks, sensory clues include feces, smell, and feathers, which are deposited by petrels using their burrows. These three sensory clues can persist in and around burrows

from one monitoring visit to the next; thus it is important to understand how they can be used to infer breeding activity.

Petrels defecate outside burrows, typically before taking off. Feces dry out in a matter of hours and, in cloud-forest climates, they do not persist over a few days (McInnes et al. 2017). Therefore, it is possible to estimate the age of feces, and the presence of feces by a burrow is a good indicator of recent petrel activity.

Smell is deposited through preening oils (Stettenheim 1972) and can persist in places where petrels rub against burrow walls. Faint smells can remain for long periods of time (weeks to months; Zidat et al. 2023) but the strength of smell in a burrow can inform on the recency of breeding activity.

Feathers are the most persistent, and observations show that they can remain for a year in a burrow before breaking down. It is possible, nevertheless, to distinguish year-old from month-old, from fresh feathers based on the degree of degradation (Schweitzer et al. 2022), the amount of dirt they carry, and the strength of their smell. Therefore, feathers can be used to infer breeding activity, though the evidence is stronger when in association with other sensory clues.

These sensory clues are additive in time, i.e. finding several clues (of the same or different types) at different times during the period assessed for a biological metric (e.g. during the whole breeding season for evidence of breeding activity; or during the period from hatch to fledge for evidence of hatching) provides stronger evidence for activity than several clues on a single day.

### **3.2 Data collection and digitizing**

In the field, data are typically collected in notebooks; in recent years, they are also collected as notes in smartphones. Data are entered into Excel spreadsheets nightly or within a few days of collection. The format of Excel spreadsheets has changed slightly between 2012 and 2024, but they record the same basic information: nest ID, nest coordinates, visit date, nest content or sensory evidence. Spreadsheets are also used to record accessory information such as nest characteristics, or evidence of predation. With time, the three organizations have adapted their spreadsheet to meet changes in protocols. For example, Grupo Jaragua now records the dates of first and last presence of adult and juvenile Black-capped Petrels in camera trap photographs. See Figures 2 – 5 for examples of spreadsheets used by Grupo Jaragua, and ACSEH and EPIC.

Sensory evidence collected by the three groups during nest monitoring visits is comparable. However, for the last 10 years, Grupo Jaragua has increasingly supported its monitoring visits with camera trapping. While monitoring visits represent discrete observations in a point in time, camera trapping provides continuous monitoring. Therefore, although both protocols provide valuable information on breeding activity and breeding success, results cannot be directly compared.

### **3.3 Biological metrics**

Four biological metrics are assessed annually as a result of nest monitoring:

- Existing: whether a nest existed during a given breeding season;
- Active: whether the nest was occupied by breeding adults;
- Hatched: whether an egg hatched;

- Fledged: whether a young fledged.

Assessments of these biological metrics rely on the overarching assumption that adult Black-capped Petrels travel to breeding areas to breed and that they remain at the breeding area only if they are actively breeding. Signs of petrel presence at a nest during the breeding season therefore suggest breeding attempts. Below I describe the evidence (i.e. sensory clues) and assumptions used to assess existence, breeding activity, hatching, and fledging.

### **3.3.1 Evidence of existing nest**

A nest is considered to exist if it can be located and is in a good enough condition for a petrel to enter its cavity. For example, a nest whose entrance has been blocked by displaced rocks would be reported as not existing unless the rocks are removed by the field team and access to the cavity can be restored.

### **3.3.2 Evidence of breeding activity**

Breeding activity is defined as successful or unsuccessful attempts at breeding. From least conclusive to most conclusive, evidence includes: feather (single or old < multiple or fresh) < smell < feces < adult or egg or chick.

Unless an egg has been observed, if activity persists until (or beyond) the typical egg-laying period (early December in Valle Nuevo; late January elsewhere; see phenology diagrams in Appendix 1), it is assumed that an egg has been laid.

### **3.3.3 Evidence of hatching**

From least conclusive to most conclusive: irregular adult presence beyond the typical hatching period < sustained adult activity beyond the typical hatching period < fresh eggshell < chick down, chick or fledgling.

Absent the most conclusive data of a chick or chick down observed later in the season, if activity persists until (or beyond) the typical hatching period (early February in Valle Nuevo; mid-March elsewhere), it is assumed that the egg has hatched. Nevertheless, it is possible that petrels showing irregular presence are incubating a failed egg – i.e. not raising a chick. Petrels have also been observed visiting nests after the hatching period and later abandoning, without observers being able to confirm if the egg had hatched. For these reasons, I considered irregular adult presence beyond the typical hatching period to be the least conclusive of hatching. Moreover, if monitoring visits only reported observations of irregular activity, I assigned a “Low” confidence level to the biological metric (see 3.4.1).

### **3.3.4 Evidence of fledging**

From least conclusive to most conclusive: regular presence of adults until the typical fledging period (late April in Valle Nuevo; late June elsewhere) < presence of down feathers outside the burrow entrance around the typical fledging period (small amount < large amount) < partially-feathered chick practicing its wings outside the burrow entrance (single day < multiple days) < fully feathered fledgling last observed on a camera trap walking away from the burrow.

Except on specific occasions when the death of the fledgling can be confirmed, it is assumed that fledgling has occurred when one or several of these evidences has been met. Based on the assumption that adult petrels travel to breeding sites only to breed, regular adult presence until the typical fledging period therefore suggests that petrels are continuing their breeding activity, and rearing a chick.

### **3.4 Database assumptions**

While building the database, I assessed the data provided by the three groups. I strived to keep the data as intact as possible though, when necessary, I made modifications to match a common format (see 4.2). This common format is intended to provide clear and consistent data (Yes/No/Unknown) on the four biological metrics.

Two additional parameters (Confidence and Evidence) provide details on these four metrics and create points of comparison between and among datasets.

#### **3.4.1 Confidence**

The Confidence parameter is intended to (1) categorize results based on the evidence associated with the metrics detailed earlier (see 3.3); and (2) provide categories that can be used to calculate ecological endpoints (i.e. reproductive activity and reproductive success) with more comparable data. The parameter has four categories: Low, Medium, High, and Confirmed. Table 2 shows the main criteria used to assign Confidence levels to the four biological metrics.

In some cases, the evidence for Low or Medium confidence levels for positive metrics (responses of “Yes” to Existing, Active, Hatched, or Fledged) can coincide with evidence for Medium or High confidence levels for negative metrics (“No”) (Table 3). When the available evidence (or lack thereof) could support assigning either a Medium or Low Confidence to both positive and negative outcomes, a conservative approach would favor assigning “No” to the metric. This approach helps prevent overestimating positive biological outcomes and avoids biasing ecological endpoint calculations toward favorable results. However, when data providers had already assigned a positive response, I retained that “Yes” but marked it with a low confidence level.

#### **3.4.2 Evidence**

For each biological metric, I recorded which evidence was used to assign a Confidence level such as: the type of sensory clues observed during monitoring visits, or camera trap data (see 3.3).

#### **3.4.3 Mid-season nests**

Nests that were discovered mid-season should not be included in calculations of reproductive activity and reproductive success for that breeding season because they might bias results positively. This is because, nests still active mid-season have a higher chance of being discovered than nests that failed earlier, and their inclusion would lead to an overestimate of reproductive success. As much as possible, information about activity, hatching, and fledging is recorded in the database but these nests are flagged in the “Mid-season” column of the Breeding Data sheet.

## 4. Database of Nest Monitoring Data for the Black-capped Petrel

The Database of Nest Monitoring Data for the Black-capped Petrel is currently available at this link: <https://docs.google.com/spreadsheets/d/1bmcqSCDQEn72TbkImeeNlp9TCnVXNIm2e02JVjFP89o/> To limit sharing sensitive data about the location of Black-capped Petrel nests, users wanting to access the database must require permission. Access is currently limited to data providers, funders, and core members of the International Black-capped Petrel Conservation Group

Note: The database is a living document that is subject to change to incorporate new data, or correct discrepancies in archived data. Therefore, when using and citing the database, I recommend that indicating the date the database was accessed. The database can be cited as:

International Black-capped Petrel Conservation Group. 2025. Database of Nest Monitoring Data for the Black-capped Petrel (*Pterodroma hasitata*). Unpublished online resource. Accessed on [DATE ACCESSED].

### 4.1 Data ownership

The database of nest monitoring data for Black-capped Petrel coalesces all nest monitoring data collected from the 2011-2012 to the 2023-2024 breeding seasons by Grupo Jaragua, ACSEH, and EPIC. Thanks to a Memorandum of Understanding signed by members of the International Black-capped Petrel Conservation Group in 2020, Grupo Jaragua, EPIC, and ACSEH (through EPIC) retain the ownership of all the data entered in the database. Any use of the data in the database must be approved by the concerned organization(s).

### 4.2 Nesting database

The database contains three main sheets: README, Locations, and Breeding Data; the latter two are described below. Two additional sheets (Site Summaries, and Statistics) have been created for the working group to easily use the data within the database.

#### 4.2.1 Locations

The Locations sheet contains identification, geographical and physical information about each nest. The data within the Locations sheet can be considered metadata to the annual nest monitoring data. Each row corresponds to an individual nest. Parameters are:

- **ID:** Unique code for each individual nest.
- **ID\_other:** Other code that may be used locally for an individual nest.
- **Manager:** Initials of group managing the nest: ACSEH = Action pour la Sauvegarde de l'Ecologie en Haiti; EPIC = Environmental Protection in the Caribbean; GJ = Grupo Jaragua.
- **UniqueID:** A unique identifier created for the purpose of this database by concatenating the two-letter code of the country (HA = Haiti; RD = Dominican Republic) with an incrementing number starting at 0001.
- **YearDiscovered:** The calendar year or breeding season when the nest was first discovered.
- **Country:** Name of the country in which the nest is located.

- **MountainRange:** Name of the mountain range in which the nest is located (e.g. Sierra de Bahoruco).
- **Area:** Name of the area, within the mountain range, where the nest is located (e.g. Loma del Toro, within the Sierra de Bahoruco range).
- **Site:** Name of the site, within the area, where the nest is located. A site is an aggregation of nests within an area (e.g. the TRO site within the Loma del Toro area). Some areas may have a single site (e.g. Loma Quemada).
- **N\_latlon:** Latitude of the nest, in decimal degrees (WGS84).
- **E\_latlon:** Longitude of the nest, in decimal degrees (WGS84).
- **Hemisphere:** Initial of the hemisphere in which the nest is located (UTM). Hemisphere is “n” (north) for all nests. Used by Grupo Jaragua only.
- **UTMZone:** UTM zone in which the nest is located (UTM). The UTM zone is “19” for all nests. Used by Grupo Jaragua only.
- **N\_NA83:** Latitude of the nest, in meters (NAD83). Used by Grupo Jaragua only.
- **E\_NAD83:** Longitude of the nest, in meters (NAD83). Used by Grupo Jaragua only.
- **N\_corrected:** Latitude to which a correction has been applied ( $N\_NAD83 + 194m$ ; NAD83). Used by Grupo Jaragua only.
- **E\_corrected:** Longitude to which a correction has been applied ( $E\_NAD83 + 46m$ ; NAD83). Used by Grupo Jaragua only.
- **Type:** Type of nest: Natural, Artificial. Nest boxes placed within damaged cavities or nests with entrances reconstructed with stone or wood are considered natural.
- **Habitat:** Type of habitat in which the nest is located (e.g. “Karst limestone, broadleaf forest”, “Foraging grass”).
- **Substrate:** Type of substrate in which the nest is dug (e.g. “Rock, soil”, “Under dry tree trunk”).
- **EntranceWidth (cm):** Width of the nest entrance, in cm.
- **LengthToChamber (cm):** Length of the tunnel leading to the nesting chamber, in cm.
- **Improved:** Whether the nest has been improved by managing group (e.g. install a wooden tunnel, replace a nest chamber); Yes or No.
- **Comment:** Any comment about the nest, or about the nest data.

#### 4.2.2 Breeding Data

The Breeding Data sheet contains the annual nest monitoring data. Breeding seasons are repeated horizontally. Row 1 lists the breeding seasons; row 2 lists the column headers; row 3 lists the number of Existing, Active, Hatched, and Fledged nests (of any confidence level); each row beyond row 3 corresponds to an individual nest. A row is left blank if no data were available for that nest during the corresponding breeding season. A row is colored red during a breeding season if that nest was located mid-season.

- **Area:** Name of the area where the nest is located (e.g. Loma del Toro).
- **ID:** Unique code for each individual nest.
- **UniqueID:** A unique identifier created for the purpose of this database by concatenating the two-letter code of the country (HA = Haiti; RD = Dominican Republic) with an incrementing number starting at 0001.

- **Manager:** Initials of the data provider (ACSEH: Action pour la Sauvegarde de l'Écologie en Haiti; EPIC: Environmental Protection in the Caribbean; GJ: Grupo Jaragua).
- **Existing:** Whether the nest existed during the given breeding season (Y; N; UNK; blank). Values Y, N, and UNK (unknown) were recorded by the data provider.
- **Confidence\_E:** Level of confidence related to whether a nest existed.
- **Evidence\_E:** Type of evidence to support whether a nest existed.
- **Active:** Whether the nest was active during the given breeding season (Y; N; UNK; blank). Values Y, N, and UNK (unknown) were recorded by the data provider.
- **Confidence\_A:** Level of confidence related to whether a nest was active.
- **Evidence\_A:** Type of evidence to support whether a nest was active.
- **Hatched:** Whether the egg in the nest hatched during the given breeding season (Y; N; UNK; blank). Values Y, N, and UNK (unknown) were recorded by the data provider.
- **Confidence\_H:** Level of confidence related to whether the egg hatched.
- **Evidence\_H:** Type of evidence to support whether the egg hatched.
- **Fledged:** Whether a chick fledged from the nest during the given breeding season (Y; N; UNK; blank). Values Y, N, and UNK (unknown) were recorded by the data provider.
- **Confidence\_F:** Level of confidence related to whether a chick fledged.
- **Evidence\_F:** Type of evidence to support whether a chick fledged.
- **Cause of failure:** The known or suspected cause of failure.
- **Frequency of checks:** The frequency of monitoring visits.
- **Mid-season:** Whether a nest was discovered mid-season (Y; blank).
- **Comment:** Any comment about the nest, including list of additional sensory clues when available.

## 5. Results

### 5.1 Number of known and monitored nests

As of the 2023-2024 breeding season, 41 nests have been located in Loma del Toro (an additional 18 artificial nests were created, only one of which has been active), 40 in Valle Nuevo, and 9 in Loma Quemada.

It is currently not possible to determine the overall number of known Black-capped Petrel nests in Morne Vincent and La Visite (and, by extension, the overall number of known nests in Hispaniola). In 2019 in Morne Vincent, nest monitoring switched from Grupo Jaragua (2011-2019) to ACSEH (2019-2024) but nest IDs were not transferred in the switch; therefore, in Morne Vincent, it is currently not possible to link IDs in the Grupo Jaragua and ACSEH datasets. In 2019 and 2020 in La Visite, nest IDs were standardized to match numbers on metal plates available to mark nests but matches between old and new IDs were lost or were not recorded; therefore, in La Visite, it is not possible to link IDs between 2017-2019, 2019-2020, and 2020-2024.

Nevertheless, it is possible to calculate the number of nests monitored during each breeding season (Figure 7). In 2023-2024, 181 individual nests were monitored in Hispaniola: 55 in La Visite, 45 in

Morne Vincent, 42 in Loma del Toro, 31 in Valle Nuevo, and 8 in Loma Quemada. This is a sharp increase from the 28 nests monitored during the 2011-2012 breeding season (Figure 7).

## 5.2 Monitoring visits

The number of monitoring visits per season ranged from one (2015-2016 breeding season, in Loma del Toro) to 10 (2022-2023, in Valle Nuevo) (Table 4 and Figure 6). On average, 4.5 visits were made per per site per season: La Visite received the highest average of visits per season ( $6.1 \pm 0.9$  SD), and Loma Quemada the lowest ( $3.0 \pm 0.8$  SD). Valle Nuevo received 5.8 visits per season in average but with a high standard deviation ( $SD = 3.3$ ): this is due to the limited number of visits during the two first seasons, followed by an increase in the frequency of visits to attempt to control invasive predators after they were confirmed to affect petrel reproductive success (Figure 1).

## 5.3 Monitoring seasons

Black-capped Petrel nest monitoring data were available for 13 seasons in Loma del Toro (2011 to 2024), 12 seasons in Morne Vincent (2011 to 2024, data from the 2015-2106 season unavailable), eight seasons in Loma Quemada (2015-2016, and 2017 to 2024), seven seasons in La Visite (2017 to 2024), and five seasons in Valle Nuevo (2020 to 2024) (Tables 1 and 4, and Figure 1).

The number of monitoring seasons per nest ranged from 1 to 13 and averaged 3.8 ( $3.1 \pm$  SD); twenty-five nests had more than 10 years of monitoring data (Table 4 and Figure 8). The number of consecutive seasons per nest also ranged from 1 to 13 and averaged 3.4 ( $\pm 2.6$  SD); nine nests had more than 10 years of consecutive monitoring data (Table 4 and Figure 9). Loma del Toro had the highest average number of consecutive seasons per nest ( $5.3 \pm 3.7$  SD), and six nests in this area were monitored for 13 consecutive seasons: TRO1, TRO2, TRO3, TRO4, TRO5, and TRO7/8.

## 5.4 Data quality

In nests where breeding activity was confirmed, confidence levels were distributed as follows: 66.6% of “Confirmed” observations, 24.3% of “High”, 6.7% of “Medium”, and 2.5% of “Low”, across all biological metrics. The quality of data decreased with the chronology of biological metrics: Active and Hatched metrics had higher proportions of observations in “Confirmed” confidence levels (72.3% and 62.3%, respectively); Fledged had a higher proportion of observations in “High”, followed by “Confirmed” and “Medium” confidence levels (47.9%, 27.0%, and 20%, respectively) (Figure 10).

## 6. Caveats and suggestions

Twenty-three years after the discovery of the first active Black-capped Petrel nest (in Loma del Toro), and 14 years after the discovery of the first nest with a chick (in Morne Vincent, safeguarding the nest monitoring data collected throughout the years is a priority. The creation of this single, comprehensive Database of Nest Monitoring Data for the Black-capped Petrel is intended to allow for standardized comparisons between nests, nesting areas, and across some of the 13 years of available data.

One of the main limitations of the database is that inconsistencies in recording nest names in Morne Vincent and La Visite prevent us from calculating an absolute number of known petrel nests in

Hispaniola. It is unlikely that this issue will be resolved with location information. Indeed, GPS accuracy is limited on the steep slopes and under tree cover characterizing La Visite and Morne Vincent, therefore nest coordinates cannot be used to provide a definite match of nest IDs. Nevertheless, in Morne Vincent, notwithstanding political issues that complicate work on the border, it may be possible to compare nest IDs *in situ* if ACSEH and Grupo Jaragua are able to meet up to visit nests together and, at the same time, match which nest IDs have been used by both groups.

Although ACSEH, EPIC, and Grupo Jaragua collect data in similar ways, comparisons of ecological endpoints like reproductive success are not always possible. The use of camera traps may be the biggest methodological difference. By collecting continuous data, camera traps appear to provide a more precise record of breeding activity and output than discrete visits. Given the depth of nesting burrows, it is typically difficult to observe nest contents or the presence of adults or a chick. Thus discrete visits mostly rely on sensory clues, and breeding activity is more often inferred than observed. Inferring breeding activity from sensory clues can be subjective at times. Therefore, records of breeding activity are more likely to be affected by observer effect during visits than by camera trapping. To attempt to offset these effects, I created confidence levels based on the type of clues used to assess breeding activity. Thus, when calculating rates of reproductive activity and reproductive success, it becomes possible to use confidence levels to weigh data in calculations. For example, the current calculations of reproductive success presented in annual field reports use a weight of 1 for every observation; however, the observations in the Confirmed level could have a weight of 1, High  $\sim 0.75$ , Medium  $\sim 0.5$ , and Low  $\sim 0.25$ . Pending additional refinements in the assignment of Confidence levels and associated weights, this system could help take into account inherent empirical differences in the monitoring data to provide valid calculations of ecological endpoints.

## **7. Acknowledgements**

Although I, Yvan Satgé, built the database of nest monitoring data for Black-capped Petrel and wrote this report, this work would not have been possible without Ernst Rupp (Grupo Jaragua), Adam Brown (EPIC), and Anderson Jean (ACSEH) and their teams. Thanks to them for allowing me to use the Black-capped Petrel nest monitoring data they painstakingly funded, collected, transcribed, and archived. Esteban Garrido, Hector Andújar, Wilson Aubourg, Jose Luis Castillo, Jerson Feliz, Geny Feliz, Maxon Fildor, René Jeune, François Jephthanie, Bazil Jonel, Tinio Louis, Jairo Matos, Juan Pablo Montero, Samuel Nossirel, Julcene Raymond, Lionel Raymond, Victor Renocier, Pierre Sanon, Ivan Terrero, and Juan Vidal participated in collecting the data throughout the years: this database would not exist without them. Thanks also to Dean Demarest (U.S. Fish and Wildlife Service) for providing funding for this effort, and to Brad Keitt (American Bird Conservancy) for facilitating it.

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## Tables and Figures

Table 1. Summary of activities to monitor the reproductive success of Black-capped Petrels on Hispaniola, 2011 – 2024.

Organization	Nesting area	Years monitored	Max. period monitored	Max. nb nests monitored	Sensory clues				Camera trapping
					Smell	Feathers	Feces	Visual obs.	
Grupo Jaragua	Valle Nuevo	2020 – 2024	Sept – Jun	31	x	x	x	x	x
	Loma Quemada	2015 – 2016; 2017 – 2024	Oct – Jul	8	x	x	x	x	x
	Loma del Toro	2011 – 2024	Oct – Jul	42	x	x	x	x	x
	Morne Vincent	2011 – 2019	Oct – Jul	31	x	x	x	x	x
ACSEH, EPIC	Morne Vincent	2019 – 2024	Feb – Jul	45	x	x	x	x	
	La Visite	2018 – 2024	Feb – Jul	56	x	x	x	x	

Table 2. Criteria used to assign Confidence levels to the four biological metrics in the database for Black-capped Petrel nest monitoring data. For the purpose of this table, sensory clues include smell, feces, feathers, and chick down.

		Confidence levels			
		Confirmed	High	Medium	Low
Biological metrics	Existing = Yes*	Nest located, and nesting data provided	Nest not located but habitat intact	N/A	N/A
	Existing = No*	Nesting habitat destroyed (i.e. through agriculture, landslide, etc.)	Nest not located but habitat severely modified	N/A	N/A
	Active = Yes	Adult, egg, chick, or chick down observed	Four types of sensory clues throughout the season; OR less numerous but sustained clues throughout season	3 types of sensory clues throughout the season	2 or less sensory clues throughout the season; OR sensory clues that may persist over time (smell) or from year to year (feathers)
	Active = No	No activity throughout the season	2 or less sensory clues; or nest destroyed but irregular activity reported	NA	N/A
	Hatched = Yes	Fresh egg shell, chick, fledgling, or chick down observed	Four types of sensory clues after the hatching period; OR regular presence of sensory clues; OR egg shell reported late in the season	Irregular presence of 3 types of sensory clues after the hatching period	Irregular presence of 2 or less sensory clues after the hatching period
	Hatched = No	No overall activity; OR egg predation; OR abandoned egg; OR nest abandoned before hatching period	Nest abandoned or suspected predation during or after hatching period; OR irregular activity during the season	Irregular activity after the hatching period	Signs of activity but nest found after hatching period
	Fledged = Yes	Camera image of fully feathered fledgling walking away from the burrow	Fledgling in most recent, pre-fledge visits; OR chick down in most recent, pre-fledge visit AND chick observed before	Chick (not fledgling) observed in last visit of the season; OR chick down in most recent, pre-fledge visit AND NO chick observed before; OR chick observed early in season AND no chick down observed	Data provider considered that fledging occurred but no chick down or no chick observed in fledging-time visits
	Fledged = No	No overall activity; or dead chick; or abandoned egg; or predation	Nest abandoned or suspected predation; OR irregular activity during the season	Some down feathers but irregular adult activity	N/A

\* Whether a nest exists (Existing = Yes) or not (Existing = No), the only Confidence levels used for the Existence of a nest are “Confirmed” and “High”. This is because questionable nests (e.g. promising crevices) are rarely (if ever) reported into a dataset.

Table 3. Comparison of confidence levels between positive (Yes) and negative (No) responses to biological metrics.

		Confidence levels				
Biological metric	Yes	Confirmed	High	Medium	Low	-
	No	-	Low	Medium	High	Confirmed

Table 4. Summary of monitoring visits to Black-capped Petrel nesting areas and of available nest monitoring data, between 2011 – 2024.

Area	Number of seasons	Number of visits per seasons (per area)				Numbers of seasons with data (per nest)				Numbers of consecutive seasons with data (per nest)			
		Average	Max.	Min.	SD	Average	Max.	Min.	SD	Average	Max.	Min.	SD
La Visite	7	6.1	7	5	0.9	2.3	4	1	1.3	2.3	4	1	1.3
Morne Vincent	12	4.5	7	2	1.4	3.8	8	1	2.4	3.4	8	1	2.3
Loma del Toro	13	3.9	6	1	1.2	7.3	13	1	4.4	5.3	13	1	3.7
Loma Quemada	8	3.0	4	2	0.8	5.8	8	1	2.9	4.0	7	1	2.9
Valle Nuevo	5	5.8	10	2	3.3	3.2	5	1	1.6	3.2	5	1	1.6

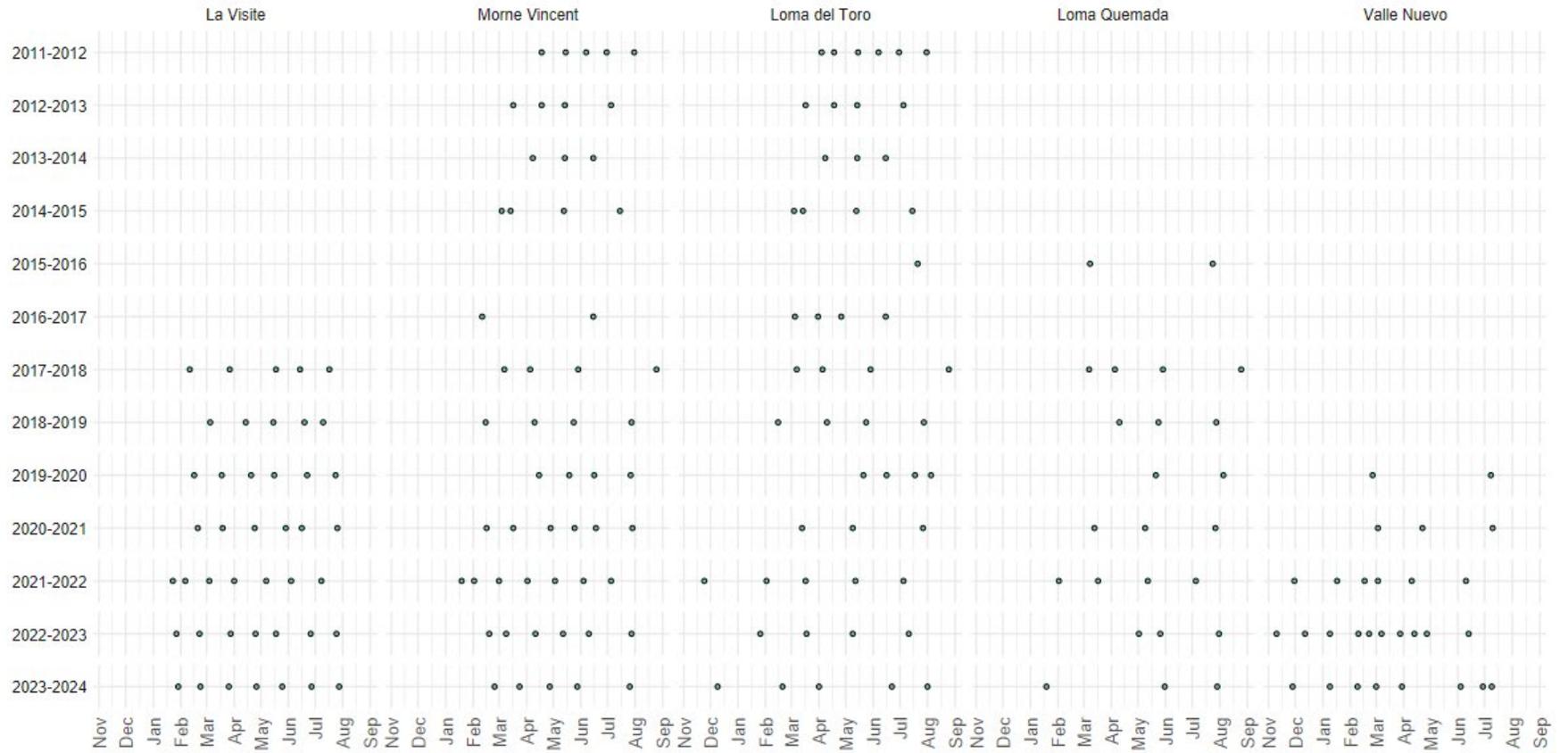


Figure 1. Monitoring visits to Black-capped Petrel nesting areas on Hispaniola during 2011 – 2024. Each visit is represented by a dot. When visits took place over multiple consecutive days, only the first day is shown.

NO	INDICADOR	E	N	04-Apr-12	18-Apr-12	15-16 May 2012	07-Jun-12	30 Jun-1 July 2012	31-Jul-12
12_4	COL:H1	211405	2024778		pichón	pichon vivo y visto	pichon emplumando 52%	totalmente plumado	finiquitado
12_5	COL:H2	211444	2024691		pichón	pichon vivo visto	pichon emplumando 76%	totalmente plumado	finiquitado
12_6	COL:H3	211459	2024690		nido vasillo				
12_7	COL:H4	211449	2024640		pichón	pichon con plumon y plumitas en parte de cola	pichon empumando 88%	finiquitado	
12_8	COL:H5	211451	2024626		pichón	pichon con plumon echando cannes en ala	pichon emplumando 44%	totalmente plumado	finiquitado
12_9	COL:H6	211463	2024636		embrión completamente desarrollado muerto dentro de huevo				
12_10	COL:H7	211438	2024609		no aplica				
12_11	COL:H8	211438	2024608		pichón	cannes en punto de alas	pichon emplumando 48 %	totalmente plumado	finiquitado
12_12	COL:H9	211526	2024516		pichón	pichon con plumon	pichon emplumando 64%	totalmente plumado	finiquitado

Figure 2. Example of Black-capped Petrel monitoring data from Morne Vincent, Haiti, provided by Grupo Jaragua, 2011-2012 breeding season.

nido	cámaras	ubicación		presencia diabloteín adulto				presencia pichón		9-11.12.23	20 – 24.2.24	1.4 – 3.4.24	22.6 – 25.6	1.8 – 3.8.24
		E	N	primera foto	salida	retorno enero	última foto	primera foto	última foto					
jim1		213011	2024269			28.1.24 (21:41)				entrada limpia y no olor, no cámara	entrada limpia, pedazos cascarron fuera del nido, ave no adentro, última foto ave 21.2.24 (3:33), entrada rápida	entrada limpia sin olor, última foto ave entrando nido 31.3.24 ((23:09)	entrada limpia sin olor, última foto 14.4.24 (4:08)	no revisado
jim2		212044	2024563							no revisado	no revisado	no revisado	no revisado	no revisado
TRO 1		213360	2024148	5.11.23 (20:14)	13.12.23 (2:01)	23.1.24 (21:20)				entrada limpia y olor no muy fuerte, última foto ave 25.11, comportamiento de limpieza intensivo	entrada limpia, olor fuerte, excrementos frescos, última foto 22.2 (22:49), perro negro pasando 11.12.23 (9:00), 9.1.24 (7:17) Haitiano, 25.1 (9:19) perro bolo pasa, entrada rápida	entrada limpio, excrementos fuera nido (posible pichon), última foto ave saliendo 31.3.24 (00:31)	entrada tela araña sin olor, última foto ave 14.4.24 (3:01)	no revisado
TRO 2	c60	213340	2024145							entrada limpia, no fotos aves	entrada limpia, no fotos ave	no fotos ave	no fotos ave	no revisado

Figure 3. Example of Black-capped Petrel monitoring data from Loma del Toro, Dominican Republic, provided by Grupo Jaragua, 2023-2024 breeding season.

Cavity N°	Nest N°	Nest access Status	Nest content			Detection method			Colony	Coordinates			Habitat evaluation		Period Checking date (DD-MM-YY)	Weather					Note
			N° Parents	N° egg	N° Chick	Smell	Presence of Feces	Presence of feathers		Site	North	West	Altitude (meter)	Habitat type		Habitat Score	Temperature	Humidity	Cloud cover	Wind speed	
00001	1	1	1	1	0	0	0	1	Site-1A	18.35000	72.23833	2147	Foraging Grass	3	11-Feb-18					N	Nest 1 and 2 are very close
00001	1	1	1	0	1	0	0	1	Site-1A	18.35000	72.23833	2147	Foraging Grass	3	27-Mar-18					N	Nest 1 and 2 are very close
00001	1	1	0	0	1	1	0	1	Site-1A	18.35000	72.23833	2147	Foraging Grass	3	18-May-18					Y	Heavy rain start by 13:00
00001	1	1	0	0	1	1	1	1	Site-1A	18.35000	72.23833	2147	Foraging Grass	3	14-Jun-18					Y	
00001	1	1	0	0	0	0	0	1	Site-1A	18.35000	72.23833	2147	Foraging Grass	3	17-Jul-18					N	Juvenile feathers found at the nest entrance and nearby. The nest cavity is empty, The chick is probably fledge.
00002	2	1	1	1	0	0	0	1	Site-1A	18.35000	72.23833	2147	Foraging Grass	3	11-Feb-18					N	Nest 1 and 2 are very close
00002	2	1	0	0	1	0	0	1	Site-1A	18.35000	72.23833	2147	Foraging Grass	3	27-Mar-18					N	
00002	2	1	0	0	1	1	1	1	Site-1A	18.35000	72.23833	2147	Foraging Grass	3	18-May-18					Y	
00002	2	1	0	0	1	1	0	1	Site-1A	18.35000	72.23833	2147	Foraging Grass	3	14-Jun-18					Y	

Figure 4. Example of Black-capped Petrel monitoring data from La Visite, Haiti, provided by Environmental Protection in the Caribbean, 2017-2018 breeding season.

# Nest	Site	North	West	Altitude (meter)	Date (jj-mm-aa)	N° Parents	Status Egg	N° Chick	Smell	Presence Feces	Presence Feathers	Status	Note
1	S1	18.29412	71.72968	2035 m	25 - Fevier 2024	0	0	0	S	PF	0	Active	
2	S1	18.29411	71.7297	2034 m	25 - Fevier 2024	PP	E	0	S	0	0	Active	
3	S1	18.29341	71.72935	2101 m	25 - Fevier 2024	0	0	0	S	0	0	Active	
4	S1	18.29301	71.72924	2129 m	25 - Fevier 2024	PP	E	0	S	PF	0	Active	
5	S1	18.29291	71.72918	2135 m	25 - Fevier 2024	PP	E	0	S	PF	AF	Active	
6	S1	18.29292	71.72911	2141 m	25 - Fevier 2024	0	0	0	S	0	0	Active	
7	S1	18.29273	71.72897	2156 m	25 - Fevier 2024	0	0	0	S	0	0	Active	
8	S1	18.29257	71.72813	2224 m	25 - Fevier 2024	0	0	0	0	PH	0	Active	
9	S1	18.29261	71.72823	2225 m	25 - Fevier 2024	0	0	0	S	0	AF	Active	

Figure 5. Example of Black-capped Petrel monitoring data from La Visite, Haiti, provided by Environmental Protection in the Caribbean, 2023-2024 breeding season.

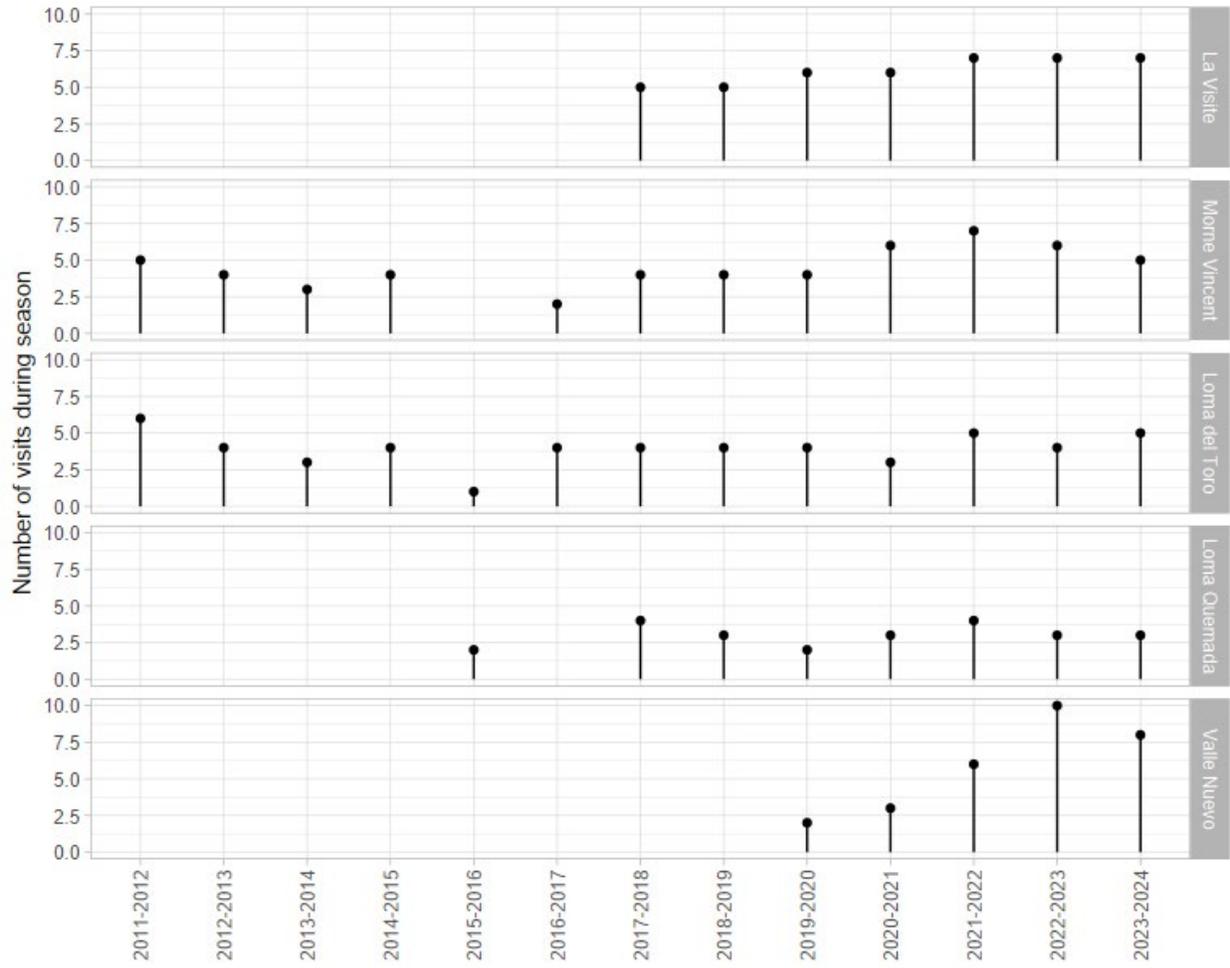


Figure 6. Number of monitoring visits made to each nesting area per breeding season. When visits took place over multiple consecutive days, only the first day is shown.

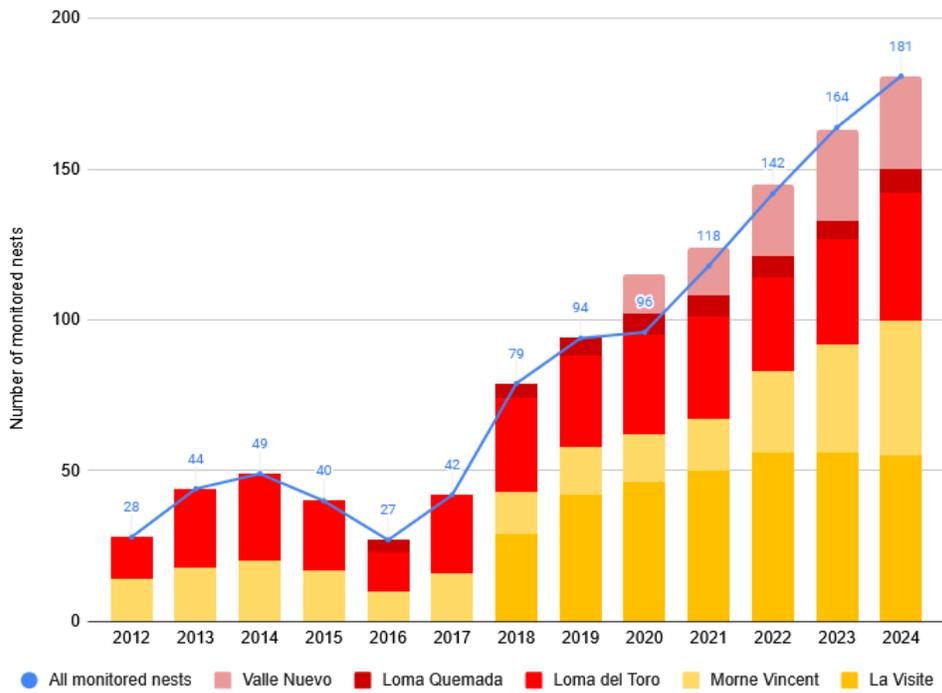


Figure 7. Number of Black-capped Petrel nests monitored yearly in Hispaniola between the 2011-2012 and 2023-2024 breeding seasons.

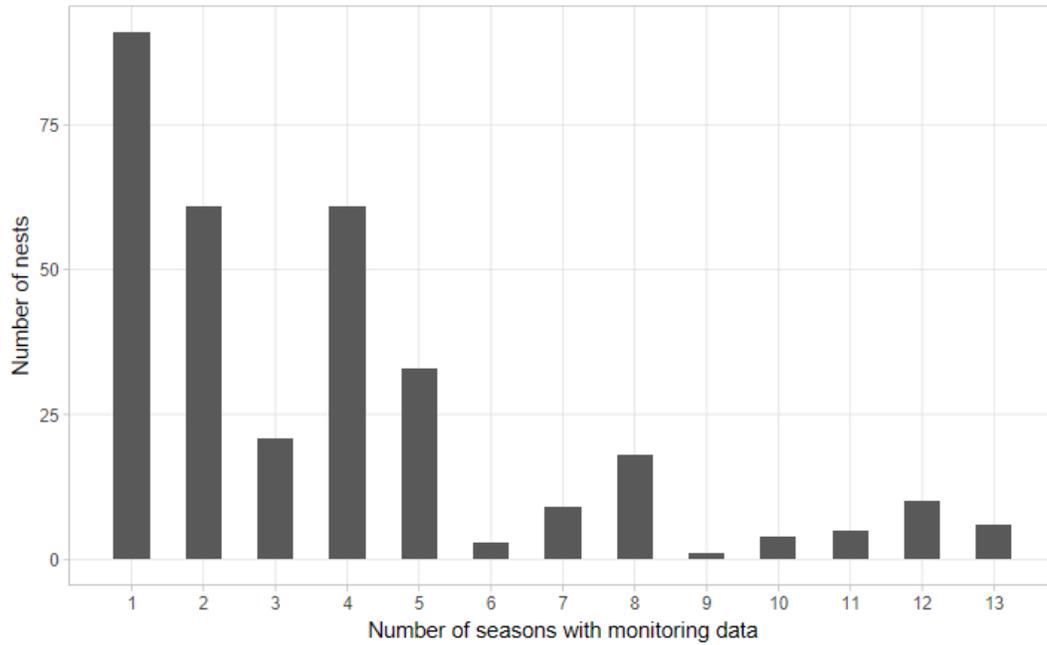


Figure 8. Distribution of the number of seasons with Black-capped Petrel nest monitoring data in Hispaniola between the 2011-2012 and 2023-2024 breeding seasons.

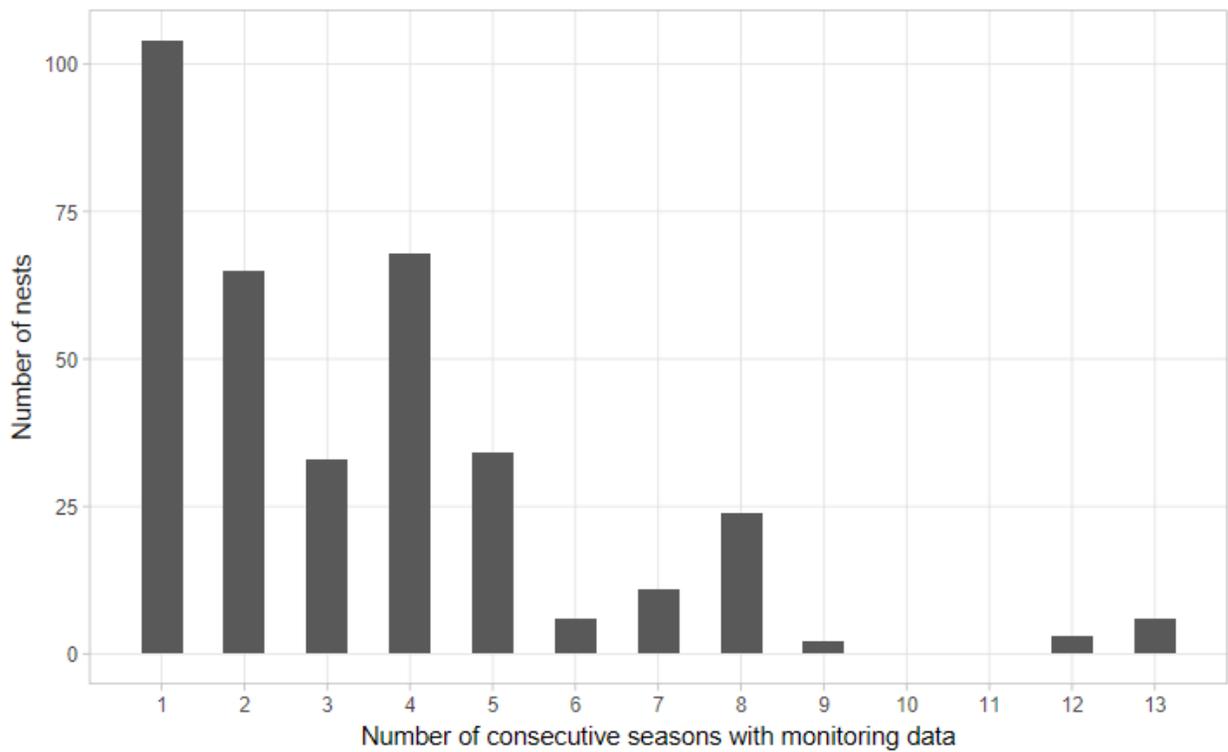


Figure 9. Distribution of the number of consecutive seasons with Black-capped Petrel nest monitoring data in Hispaniola between the 2011-2012 and 2023-2024 breeding seasons.

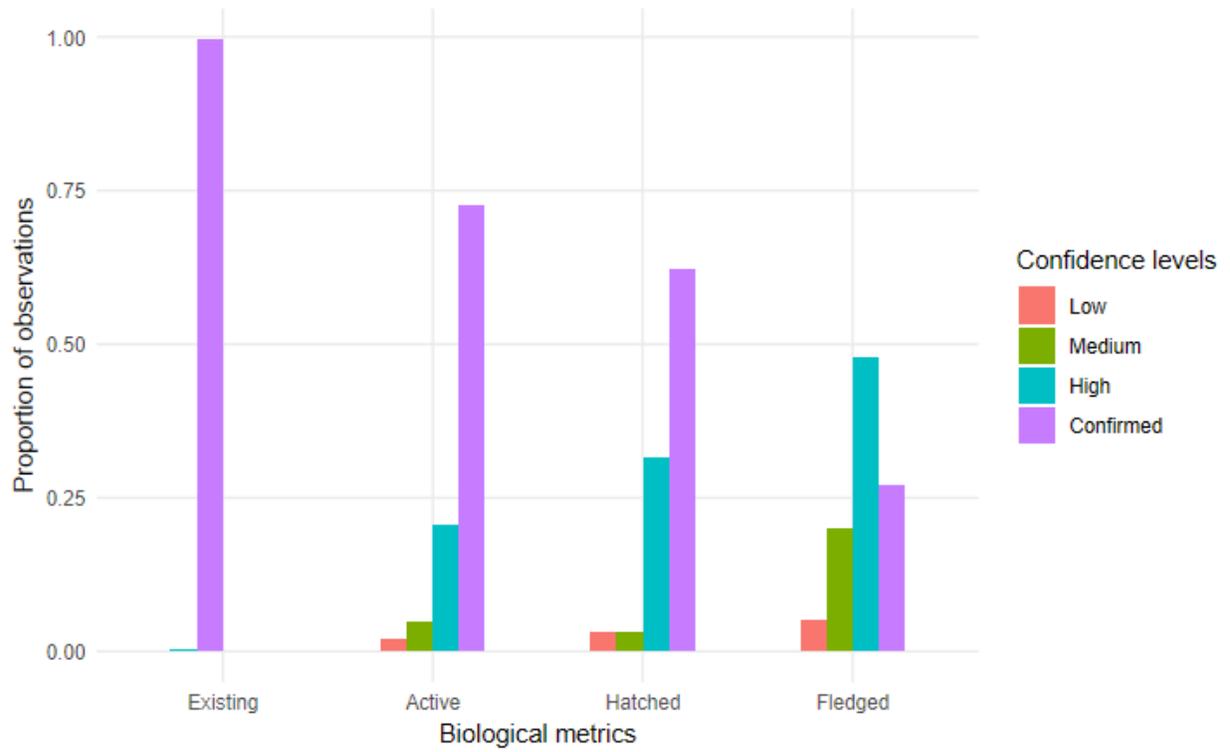


Figure 10. Distribution of observations into confidence levels for the four biological metrics used to categorize Black-capped Petrel nests in Hispaniola between the 2011-2012 and 2023-2024 breeding seasons.

## Appendix 1

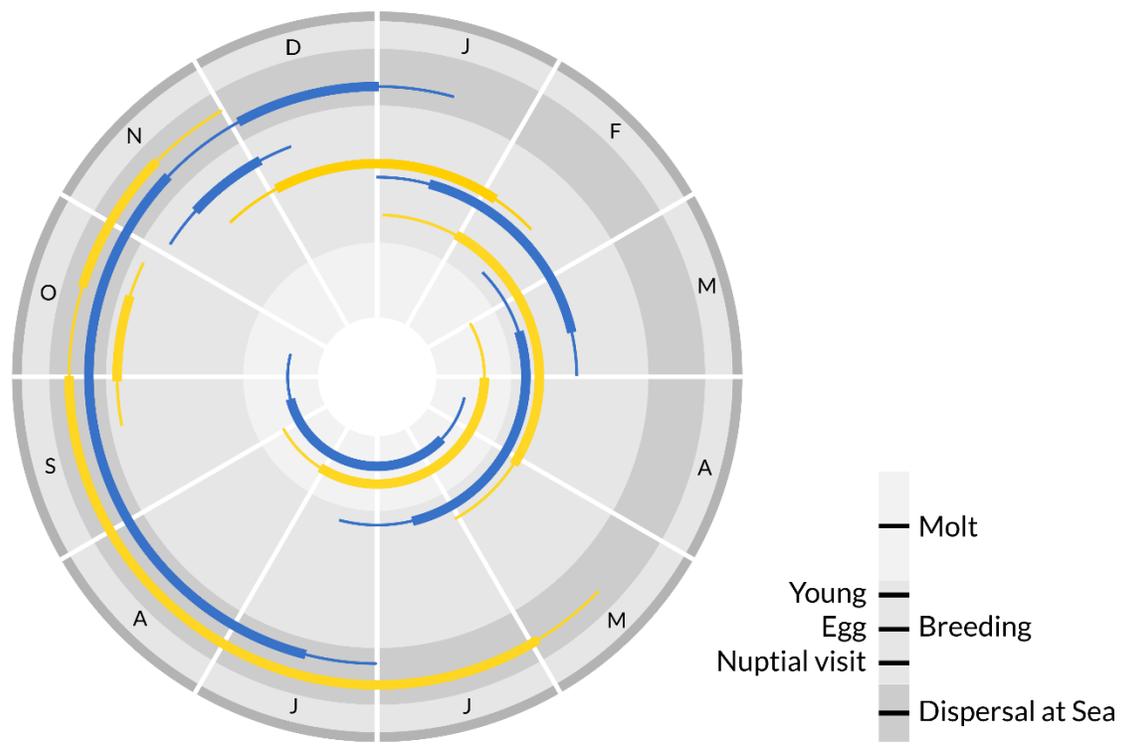


Figure A1. Annual cycle of breeding, molt, and migration in the Black-capped Petrel, showing distinct phenologies between dark and light forms. Blue = dark form (confirmed to nest in La Visite, Morne Vincent, Loma del Toro, and Loma Quemada); yellow = light form (confirmed to nest in Valle Nuevo). Thick lines show peak activity; thin lines, off-peak. Based on Simons et al. (2013), Howell and Patteson (2008), and Satgé et al. (*In Press*).

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

Simons, T.R., D.S. Lee, and J.C. Haney. 2013. Diablotin *Pterodroma hasitata*: a biography of the endangered Black-capped Petrel. *Marine Ornithology* 41:1–43.

Satgé, Y.G., J.B. Patteson, B.S. Keitt, C.P. Gaskin, and P.G.R. Jodice [In Press] Satellite tracking supports hypotheses of breeding allochrony and allopatry in the endangered Black-capped Petrel (*Diablotin*, *Pterodroma hasitata*). *Journal of Caribbean Ornithology*