

**First monitoring of white-faced storm petrel
Pelagodroma marina in Maio's island, Cape Verde,
West Africa.**

Final Report 2016-2017



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1. Introduction

Cabo Verde is composed of nine main islands and eight islets, and is recognised globally both as a terrestrial and marine biodiversity hotspot. Additionally, all the archipelago constitutes an Important Bird Area (IBA) (MAHOT, 2014) and provides a nesting location for several seabird including the Cape Verde shearwater *Calonectris edwardsii*, the red-billed tropicbird *Phaethon aethereus*, the Madeiran storm petrel *Oceanodroma castro* and the white-faced storm petrel (*Pelagodroma marina*), amongst others (INIDA, 2007; MAHOT, 2014). The white-faced storm petrel is a small Procellariiforme and is commonly found in pelagic waters. During the breeding season (local spring and summer), nests are laid inside burrows in flat sandy areas with low vegetation (IUCN 2017). Although the population of the white-faced storm petrel is classified as Least Concern, its population is declining mainly due to predation by invasive species and unsustainable levels of exploitation (IUCN, 2017). Due to a lack of knowledge on its ecology and life history it has been listed as a rare species under the Cabo Verdean National Decree-Law n. 7/2002, and vulnerable to any change in its environment, particularly to the introduction of predators.

In Cabo Verde, the white-faced storm petrel can be found in Rombo and Branco islets, Pássaros islet (Boavista) and Maio (Laje Branca islet). Laje Branca is a small (~0.3ha) and uninhabited islet situated in the north of Maio Island, and it is located within the Natural Park “Parque Natural do Norte da Ilha do Maio – PNNM” (Figure 1), 400 m from the coast. It is also considered a Restricted Protected Zone due to its conservation importance to the reproduction of this species. Spite the relevance of the area and the species, information on population size, trends and breeding ecology remained unknown until this project started.



Figure 1. Maio map with Laje Branca islet circled in orange at the North of the island.

Maio Biodiversity Foundation (FMB) is an NGO founded in 2010 in Maio, Cabo Verde. FMB's mission is to preserve Maio's fauna and flora while creating sustainable opportunities and long-term benefits for its people. Thanks to the support of the Seabird group grants, FMB successfully carried out the first monitoring study of white-faced storm petrel in Maio in 2016. A huge effort has been done due to the study the white-faced storm petrel population in Laje Branca, determine its population size, threats, and to provide baseline information on this species. Additionally, educational workshops were also done to inform and involve the nearby local communities. Thanks to this project, the information would allow the establishment of regular monitoring programs for the species, strengthening its conservation and consequently

insuring its survival at the same time that local residents learnt about research and local biodiversity conservation.

Notice that even though this was 1 year-long project (2016), due to the non-response of the Nacional Directorate of the Environment (DNA), the permits for capturing and handling animals were not delivered on time and, as a consequence, FMB requested to the SeaBird Group for an non-cost extension to be able to collect better data during the next breeding season (2017).

2. Objectives

This project aims to conduct a more in-depth study of the white-faced storm petrel population in Laje Branca, to determine, threats, population size trends, provide baseline information on this species and also conduct educational workshops on the fishing communities that are geographically nearby to the islet in an effort to avoid the introduction of undesirable species, such as feral cats and rats in islet.

The specific objectives of this project were:

- (i) Determine whether breeding pairs were using the burrows
- (ii) Monitor the population's activity via counting surveys at night
- (iii) Capture, ring and data collection on morphometrics, blood and feathers
- (iv) Conduct community work: awareness events to educate local people and particularly fishermen that live in the closest communities to the islet.

Additionally, whilst the project was developed, other objectives were included:

- (i) Monitor nests and chicks
- (ii) Estimate breeding population size
- (iii) Identify the main threats to this species
- (iv) Study of the breeding ecology and chick survivor rate

3. Educational Activities

Date	Activity	Attendees	Description	Photos
May, 2016	World Biodiversity Day.	95 students	Framed under the World Biodiversity Day, this year's theme was "Biodiversity, sustainability and sustainable lifestyle". FMB was in the Secondary School to hold a lecture with 8th grade students in order to raise awareness on biodiversity and the problems that affect it.	
Feb, 2017	World Wetlands Day 2017.	40 students	This year's international theme proposed by RAMSAR was "Healthy wetlands help to cope with extreme weather events". FMB along with the students of the 7th and 12th grades of Secondary school of Vila went to the Salinas of Porto Inglês to teach the students about bird watching. Previously to the field trip, there was a lecture to explain the value of wetlands, the importance of preserving them, and to talk about some wader species possible to see in Salinas.	
Sep, 2016	MAVA National Seabirds Workshop.	Held in Santiago Island, in Rui Vaz, this workshop aimed to create key strategies and budget them in order to prepare the Action Plan for the Conservation of Seabirds in Cape Verde to be practiced until 2022. At the meeting, there were present several NGOs including FMB, that work directly with seabird conservation, some representatives of local and international Universities, Government officials and Birdlife.		
April, 2017	Final presentation of DARWIN Project	120 attendees	A final presentation of a 3-year project (DARWIN Initiative) was presented in all 13 communities of Maio Island. These presentations were spread during 2 weeks. These presentations also consisted in showing FMB's work in other areas which included showing and explaining the Seabird Group Project "First monitoring of White-faced storm petrel <i>Pelagodroma marina</i> in Maio's island, Cape Verde, West Africa".	

May, 2017	World Migratory Bird Day	50 students	Every year people around the world take action and organize public events such as bird festivals, education programmes, exhibitions and bird-watching excursions to celebrate the World Migratory Bird Day. FMB held a workshop in High school for 7 th , 9 th grades and A level students to inform them on the importance of this day and migratory birds.	 
June, 2017	Ornithological touristic course	10 attendees	FMB organised an ornithological touristic course for local people in which 10 local guides from different communities attended the course. The course was divided into 3 modules along practical training in Salinas do Porto Inglês. The aim was to teach about biology of birds, key id features, what tourists are looking for, and the importance of good practices and ethical codes.	

4. Methodology

The monitoring of the white-faced storm petrel started in 2016 and continued in 2017. The preparation of the fieldwork was conducted in January 2016, fieldwork started on 25th February and finished on 8th June 2016 when no more birds were seen in the islet. In 2017, fieldwork started on 19th January and was completed on 12th June. Fieldwork was done in Laje Branca islet, a small islet located 400 m off the North of Maio and inserted within the Parque Natural do Norte de Maio (Natural Park of the North of Maio). All the equipment was taken to the islet and returned it back to land via kayak, whilst the field technicians swam and pull it across the 400 m to the islet. This was done every day that there was a survey. Its methodology was experimental and several different approaches were applied in order to optimise and standardize the methodology used. As a result of having several methodologies used during each season, the results showed some variations. The methodologies trialled were the following:

4.1. Population activity

Surveys were run from January to June in both years (2016 and 2017). Counting surveys were done once a week to monitor the white-faced storm petrels' activity level throughout each

breeding season at Laje Branca (Figure 2). These surveys occurred during night-time when the petrels returned to the islet, and consisted of counting all the birds flying through the torchlight that the observer held, from a fixed point of observation which was located at the south of the islet. All birds were registered in the 180 angle to the north of the islet. In addition of counting the birds, the angle from which they came from and the birds' distance from the observer were also noted.

In 2016, data was collected during the majority of the night (usually from 20:00h to 04:00h). In 2017, this methodology was kept until the end of March. It was then revised and improved after discussing it with FMB's partner Mónica Silva (a PhD from Centro de Ecologia, Evolução e Alterações Ambientais, Faculdade de Ciências, University of Lisbon), who has been helping and supporting this project since the beginning. From April onwards, the new methodology consisted of monitoring for 20 minutes of each 1 hour of the 4 more active hours per night (from 23:00h to 02:00h).

These surveys required two-three people capable of swimming at least 500 m since the island is accessed by swimming and pushing a kayak with all survey material on it. Once in the islet, the team also looked for unusual activity (i.e. predation) by walking around the limits of the island, in order to avoid stepping on and destroying the nests.

Recorded data for the counting survey included: date, name of observers, time of sightings, number of animals, angle the bird was flying from as according to True North and distance from observer (estimated in metres).



Figure 2. White-faced storm petrels seen flying in Laje Branca during count surveys.

4.2. Monitoring of the nests and chicks

In 2016, monitoring of the nests and chicks was done only occasionally. It consisted of walking at the periphery of the islet and making a stop whenever an egg or a chick was observed. At each stop, all the other nests within 1 metre of the first observed nest would also be checked. Data recorded included date, time of observed occupied nest, UTM coordinates, number of eggs, chicks and total number of nests per stop (note: counting all the occupied nests with either eggs or chicks within a 1 metre radius of the first occupied nest, as previously mentioned).

In 2017, we had the opportunity to improve the methodology. We requested a local professional photographer to take detailed pictures and videos of the whole islet with his drone to get a better sense of the burrows (Figure 3). The number of monitored nests was also increased throughout the season from 41 to 100 nests, and all of them were numbered using a small stick containing its number and checked every visit to the island, during daylight hours. Burrows were inspected using an endoscope (CrazyFire, Digital Video Recording Endoscope) to reveal the inside of the burrows and categorize it accordingly (Figure 4). Data collected were dates, number of nests and description of what was observed in each nest (egg, chick, dead chick, egg shells and feathers).



Figure 3 and 4. Laje Branca islet showing the nests (black holes) of the white-faced storm petrel (*Pelagodroma marina*). Drone picture by local photographer Dany Évora. Right: white-faced storm petrel chick still inside the nest. Picture by FMB staff using a burrowscope.

4.3. Capture, ring and data collection on morphometrics, blood and feathers

The petrels were captured by using mist nets (Figure 5) with the leadership and support of the Director of the Natural Park of Fogo's Island. The Director was a Park technician for 10 years

and has a vast experience working and handling seabirds, along with the University of Barcelona. Thanks to a collaboration between FMB, the Natural Park of Fogo and the University of Barcelona, the Director came to Maio for 3 days to train, support and supervise 4 team members' work in capture using mist nets, ringing and data collection whilst handling the birds (Figure 6). Capture of birds occurred throughout the nights of 2nd and 3rd of June 2017. The methodology used during this part of the work was those used by the Natural Park of Fogo and the University of Barcelona that have been using for other seabird studies in Cape Verde. Metal rings provided by University of Barcelona were used for ringing. The data collected included population, locality, date, species, time, sampler name, whether it was a new bird or recapture, whether it had a wind bars, their number and on which feather they occurred; stage of the brood patch, number of ring; the length of tarsus, total bill depth, bill depth at nostril, total head length, wing, culmen (all in millilitres), using rulers to the nearest 1 millilitres for the wing length and Vernier calipers to the nearest 0.1 millilitres for all the other lengths), identification number of feathers collected, weight (grams, using a spring balance) and blood sample (millilitres).

The feathers collected were S8 (secondary) and R6 (retrace) from the right wing, P1 (primary) and S1 (secondary) from the left wing and a few breast feathers were additionally collected. Blood samples were taken from the brachial vein using insulin syringues (0.25 ml) and were then transferred to a vial containing ethanol.

If a bird was highly stressed from being captured, it was promptly released back to the colony and no further data collection was done with that bird.



Figure 5. Setting up of 2 mist nets on the east side of the islet.

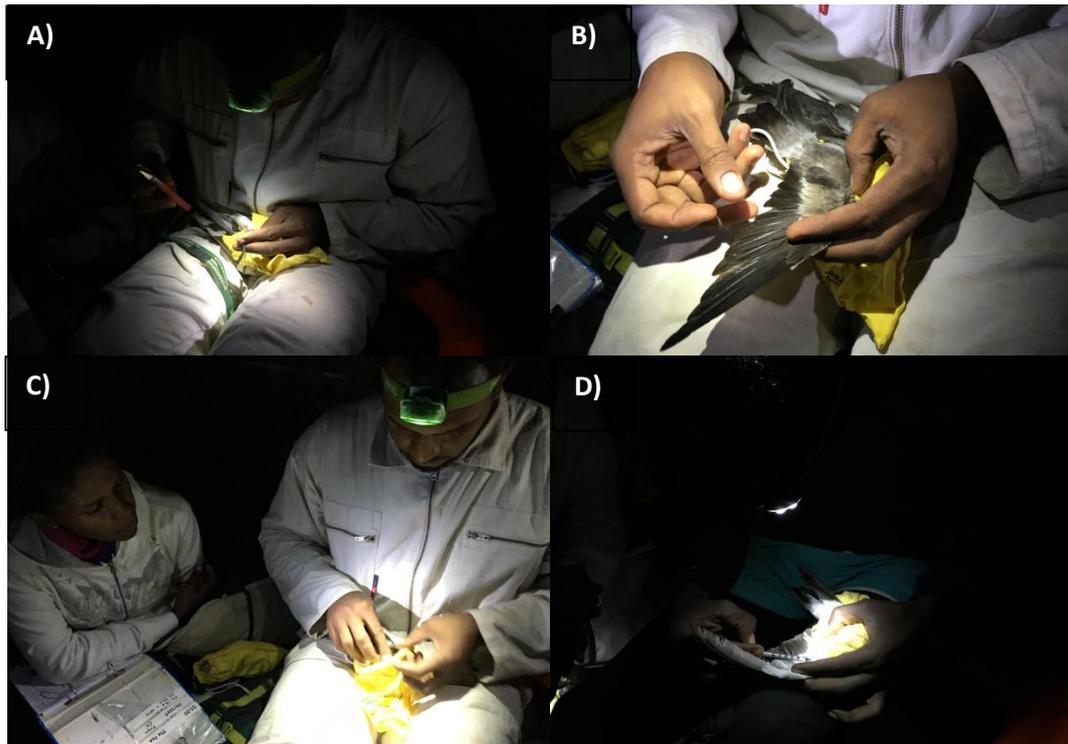


Figure 6. Photos A and B show Director Herculano teaching the team how to ring (A), which feathers to collect (B); photo C shows a team member paying attention to Director Herculano's explanations, photo D shows a team member applying what he learnt under Director Herculano's supervision.

4.4. Quadrats

Due to the "Population Activity" method not being accurate for population estimates, an experimental method was trialed in February of 2017. This method consisted in choosing 5 different fixed spots, spread at the edge of the colony to conduct quadrat surveys. Markers were used in order to mark where the quadrats (2x1m) would be positioned and the distance between each quadrat to the pole holding the trap camera (Bushnell and Reconyx) was also noted. The pole had 1.5 m height and the camera was attached to the top of it. Due to the constant strong winds in the islet, the pole was introduced into a bucket with cement to aid in stabilising it (see pictures below).



Figure 7. Team setting up new quadrat methodology using both quadrats and trap cameras.



Figure 8. New quadrat methodology ready to be trialed at night.

Two trap cameras were set to take pictures of at 1 minute interval for 1 hour each before deploying them on the next plot (each camera was set to a different quadrat). They were set up from 20h to 4h. One of the issues we found was that if the setup of the plot in relation to

the camera was not precise, the camera wouldn't be able to capture the whole quadrat in the pictures (see example Figure 9).



Figure 9. Left picture: good quadrat position in relation to the camera. Right picture: bad quadrat position in relation to camera's position.

This method proved not good because it barely caught any birds landing during the 1 minute that the camera took the picture. Then, we changed the method to have one camera taking pictures at 1 min interval and the other camera filming for as long as possible, as well as move it to the next plot every 1 hour. This proved slightly better but still not a good method for this species as the birds are constantly flying and only land for a few seconds before flying again. The idea was to identify which nests were active and then estimate the density of nests (using a Geographic Information System to get the area) in the whole colony and multiply it by 2 to get the number of reproductive adults, and get the total number of breeders for the reproductive season. However, both these methods were not appropriate because it did not allow the team to properly identify which nests were active, and thus both methods were interrupted since then.

4.5. Population count

A Masters (MSc) student, Gemma Charles, from the University of Bath in collaboration with FMB developed her final project in "Population viability analysis of a white-faced storm petrel (*Pelagodroma marina*) population breeding in Cabo Verde" at Laje Branca, 2017. Part of her study was to estimate population count, where the active burrow percentage was determined by selecting 150 random burrows within 2m of the edge of the colony using a random number generator to select each subsequent burrow. Burrows were inspected using an endoscope (CrazyFire, Digital Video Recording Endoscope) to reveal the inside of the burrows; they were determined as 'active' if they contained a chick, egg, or recent eggshells. Burrow density for

the colony was calculated using 30 x 2m² quadrats to find the average number of burrows per quadrat, multiplied by the area of the colony to find the total number of burrows. Total number of burrows was then multiplied by the active burrow percentage to find the total number of active burrows. Colony area was determined using QGIS (QGIS Development Team 2017), as the boundaries of the colony are very clear due to the nature of the sandy soil habitat (Gemma Charles 2017 Master thesis). This part of fieldwork was done over a three-week period, one day per week.

4.6. Presence of invasive mammals

From 2016 onwards, FMB had occasionally checked for the presence of invasive mammals that are known to cause extinctions in seabird colonies. We used mice metal box traps with pieces of food as bait before in the islet and had never found a mouse in it. As part of the study of the Master student's project mentioned above, another methodology was developed to double the presence of invasive mammals. Between May and June 2017, the student placed 4 detection tunnels (Black Trakkatm, Gotcha Trapz NZ) in different locations at the edge of the colony, with inked cards in the centre baited with peanut butter. Additionally, 2 more were placed at locations 50m apart on the shoreline of Maio. These were retrieved, checked and replaced every couple of days to avoid having the footprints covered by dust. Any animal that would cross the inked card would leave its footprints that were used to identify species. Mice have front and hind footprints; front footprints are semi-circular, with 4 toes and a central pad, whereas hind feet have five toes and a split central pad (Agnew 2017; Gemma Charles 2017 Master thesis).

5. Results

5.1. Population activity

In 2016, the surveys started on the 25th of February 2016 and finished on the 9th of June. Eleven surveys were carried out, an equivalent of 75 hours and 8 minutes. It was possible to see the activity level increasing gradually from January until the first week of May where it reached a peak, and then started to decrease until no further birds were observed at the beginning of June (Figure 10).

In 2017, the surveys started on the 19th of January and were run until the 12th of June. A total of nineteen surveys were carried out, accounting a total of 63 hours and 10 minutes of

monitoring. The data showed the same activity pattern than in 2016 reflecting variation through the breeding season. The activity of *P. marina* seems to increase from January to the beginning of March. From March onwards, there was a sharp decrease and increased again at the beginning of May (Figure 11).

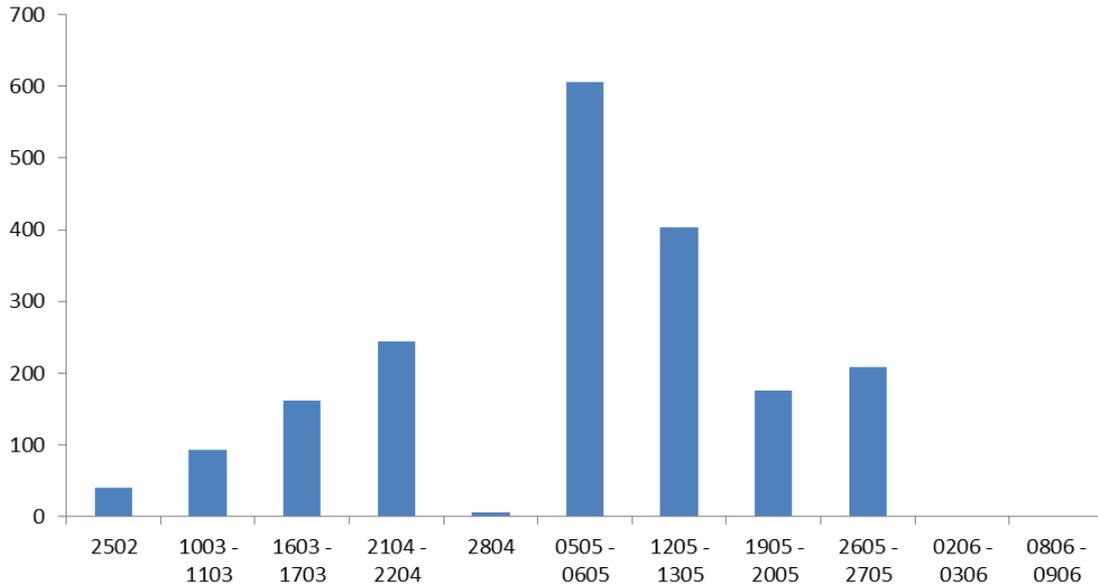


Figure 10. Activity level (number of times that birds passed by the observer) showed throughout the reproductive season of *P. marina* in 2016. Dates showed as DDMM in which the first 2 digits reflect the day and the last 2 reflect the month (i.e. 2502 refers to the 25th of February).

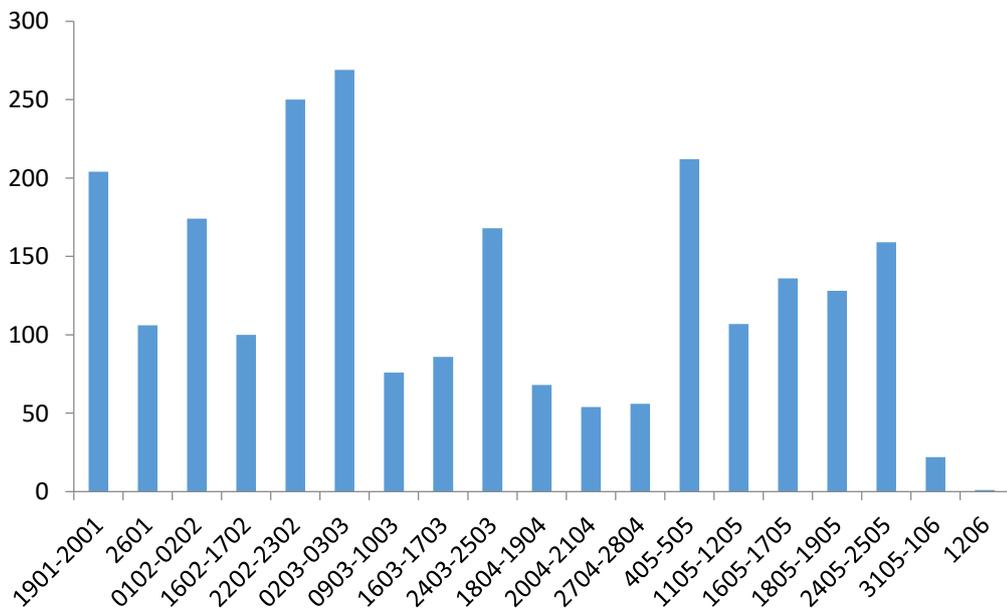


Figure 11. Activity level (number of times that birds passed by the observer) showed throughout the reproductive season of *P. marina* in 2017. Dates showed as DDMM in which the first 2 digits reflect the day and the last 2 reflect the month (i.e. 2502 refers to the 25th of February).

These variations in activity level observed in 2017 may be explained by the fact that the adults may leave their nests unattended for several days in a row. Additionally, from the 18th April, a new methodology was applied in which the effort was much reduced and such a change could also explain why the pick season showed relatively low activity during 2017. Further research about intraseasonal variability will be done next year.

5.2. Monitoring of the nests and chicks

In 2016, we monitored a total of 20 active nests where 8 eggs and 10 chicks were found. In 2017, a wider study was possible and 100 nests were monitored. According to our observations, the egg laying happens in the middle of March until the end of May. Only a total of 14 chicks were found spite the increase of nests monitored. One of the chicks was found dead. Additionally, another 6 chicks belonging to non-monitored nests were found also dead. However, the causes were not identified.

5.3. Capture, ring and data collection on morphometrics, blood and feathers

In 2016, it was not possible to capture any birds due to the lack of response from the Government about our application to obtain the permit to handle the species. In 2017, it was possible to capture individuals and during 2 nights 53 birds were ringed. See morphometric data below in Table 1.

Table 1. Average morphometrics (\pm SD) from the 53 captured birds during 2 nights in Laje Branca, 2017.

N	Tarsus (mm)	Culmen (mm)	Bill height (mm)	Nostril height (mm)	Head - bill (mm)	Wing length (mm)	Weight (g)
53	44.9 \pm 2.3	19.1 \pm 1.6	6.3 \pm 0.5	4.6 \pm 0.3	45.1 \pm 1.0	15.9 \pm 0.5	51.6 \pm 4.2

There was a total of 44 blood samples taken in which whenever it was possible, 2 samples were collected from each bird (one for FMB, one for University of Barcelona and Parque Natural do Fogo); 26 samples of feathers cut (included P1 left, S8 right, S1 right, and R6 right) of each feather sampled bird; 52 samples of a few body feathers taken per individual.

5.4. Quadrats

In February, there were 3 days of survey using the quadrats methodology (9th, 16th and 22th), which resulted in more than 2900 pictures and 501 videos. There were 32 occasions when

white-faced storm petrels were seen. Only 11 were seen landing inside the quadrats. All the remaining were flying. In one occasion, one petrel was seen leaving the nest (Figure below).



Figure 12. Adult white-faced storm petrel leaving a nest.

Since petrels were only seen in less than 1% of the total amount of pictures and videos, this method has been proved not to be efficient for population estimates and was cancelled after those trials.

5.5. Population count

Gemma Charles (2017 Master thesis) estimated that Laje Branca's population size hold 648 breeding pairs, with a burrow occupancy rate of 11.1% and a carrying capacity of 8102 breeding pairs (16205 individuals). The total area of the colony is 3610 m².

5.6. Presence of invasive mammals

Mouse footprints were identified in all ink cards placed on Maio mainland (n=8) but not in any of the ink cards placed in Laje Branca (n=16) (Figure 13). Whilst lizard footprints were detected in both Laje Branca and Maio mainland (100% of the 8 cards placed in Maio mainland, and in

81.3% of the 16 ink cards placed in Laje Branca) (Gemma Charles 2017 Master thesis). These lizards were also seen entering and leaving the petrels' burrows.

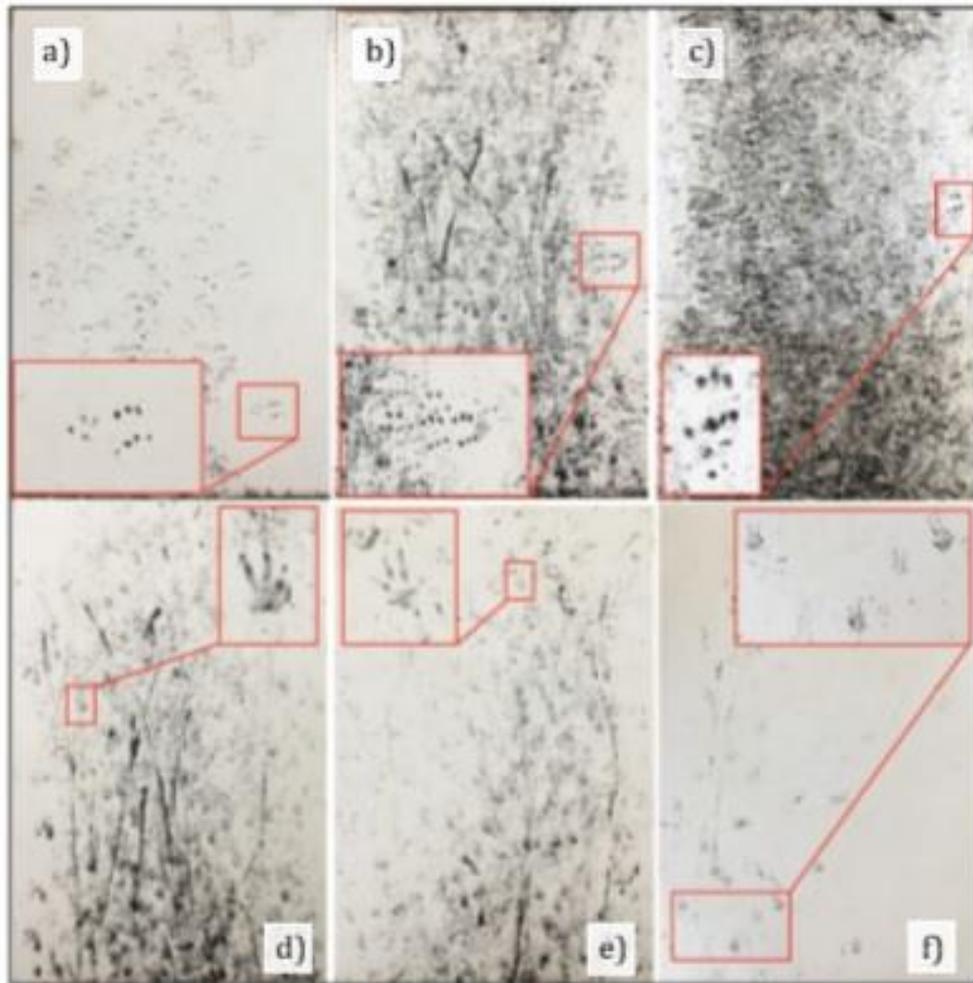


Figure 13. Mouse footprints seen in ink cards from Maio mainland (a, b, c) and lizard footprints detected on both Maio mainland and Laje Branca (d, e, f). From Gemma Charles 2017 Master thesis.

6. Discussion

Before the Seabird Group supported this project, only few visits to the islet (i.e. Hazevoet 1995) were done and no study had been conducted. Thus, this has been the first study about the population of white-faced storm petrel breeding in Laje Branca.

The results showed that the activity level builds up during the season and reaches a peak at the beginning of May. According to 2017 observations, the egg laying happens in the middle of March until the end of May. However, since the laying period was not studied in 2016 and few chicks were also seen at the end of April of 2017, further research is needed for a better understanding of its breeding ecology. On the other hand, 53 birds were ringed over 2 nights at the end of 2017 season and all the ringed individuals seemed to have a good health condition. Since the total population estimated is 1296 breeding individuals, capturing, ringing and collecting morphometric data during the next years it is essential to have a proper knowledge of the population trend. Quadrats were used as an experiment to estimate population count however this methodology did not work well due to the low likelihood of them landing inside a plot whenever the camera triggered. Gemma Charles's methodology was a much more suitable technique for this species. She found that there are 648 breeding pairs, that the island has a capacity of 8102 pairs, and that the burrow occupancy rate was of ~11%. Gemma's method to detect the presence of invasive mammals using ink cards also worked very well, it is not expensive and it is very easy to use. Thus, it also should be applied to keep monitoring the presence of invasive species. Since a first estimation of 5000-10000 pairs of white-faced storm petrel was done in Cape Verde (Hazevoet, 1995; Vasconcelos *et al.* 2015), it is this important to continue the recapture programme we have begun in this project to accurately confirm the number of breeding pairs in order to understand the importance of this colony at national level too.

In addition, the project provided a unique opportunity to develop and improve their skills and capacity of local conservationists to continue carry on their ornithological field studies, with training in captures, ringing, mist netting.

Overall, it must be highlighted the important information and goals has been achieved thanks to this project and the support of the Seabird Group. We have now a better estimation of the breeding population size, the most suitable methodologies and of the main threats to the

colony. From now on, we can focus on the new strategies for the next few years in order to keep and improve the conservation of the white-faced storm petrel that can potentially be expanded to other islets in Cabo Verde and worldwide where the species occur.

7. Next steps

- Accurately determine the nesting periods in the islets.
- Create a contingency plan for eradication of invasive species, particularly rodents.
- Check whether eggs and chicks are being predated by lizards inhabiting the islet.
- Study species biology to determine the dynamics of the population, including the reproductive cycle, incubation and breeding period, adult and juvenile survival rate, age of the first breeding and longevity of the species.
- Site fidelity to the colony (through capture/recapture programme).
- Assess the impact of by-catch.
- Determine feeding sites during nesting and spatial dispersion during the non-productive season.

8. Recommendations

Due to Laje's Branca proximity to Maio's mainland and fishermen that work intensively around that area during at least 5 months of the year, some of which overlap with the reproductive season, we suggest the development of a contingency plan as soon as possible in order to control any rat/mice invasion and show it to local stakeholders so that in case of an invasion everyone can participate and aid with its eradication. Further studies should be carried out in order to refine these first monitoring results. Another suggestion would be to create fixed paths that would cross the islet, outside the breeding season, so that population estimates become more accurate because the white-faced storm petrels might not be using the burrows from the periphery equally to those in the centre of the islet.

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10. Annex – Financial section

Below are the details of how the Seabird Group Grant has been invested during this project.

Category/Budget Item	Budget (GBP)	Amount (CVE)	Spent TOTAL (CVE)
Car rent for transportation from Cidade do Porto Ingles to Laje Branca*	0	0	0
Gasoline for Car from Cidade do Porto Ingles to laje Branca beach vice versa	36	5,034	4,000
Boat rent to Laje branca islet**	156	21,813	1,800
Gasoline for boat to Laja branca islet**	36	5,034	0
Equipment for surveys (telescopes, binoculars, handheld GPS, bird identification booklet)	0	0	0
Ringling and sampling materials	36	5,034	760
Train tourist/bird guides	67	9,368	6,800
Office cost and internet	35	4,894	8,518
Food for 2 field assistants	84	11,745	15,335
Workshops with fishermans and school activities	43	6,012	31,381
Totals	493	68,934	68,594
Actuals		68,430	68,594

*There was no need to rent a car as FMB provided a car.

**There was no need to rent boats and thus using fuel for boats because the equipment was taken within a kayak whilst swimming.