

Foraging strategies of a small seabird across an oceanic landscape

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Introduction

Seabirds are exposed to multiple threats while foraging at sea. Understanding how extrinsic and intrinsic factors may modulate the foraging strategies and trophic ecology of seabirds is crucial for their conservation, but this information is still scarce for small oceanic seabirds.

The current miniaturization of GPS devices allows to determine the foraging areas of small oceanic seabirds with high accuracy [1, 2]. This information, combined with stable isotope analyses, give us insides about their trophic ecology and their main foraging grounds [3].

AIM: To assess the variability of foraging strategies and trophic ecology among colonies, breeding stages, and sexes of the Bulwer's petrel (*Bulweria bulwerii*) (Fig. 1 & 2), a small oceanic seabird.



Figure 1: *Bulweria bulwerii*; picture taken by Tomás Andrade



Figure 2: *Bulweria bulwerii* with a GPS; picture taken by Marta Cruz-Flores

Methods

Foraging strategies: ~500 GPS devices recovered from breeding adults during incubation or chick-rearing periods from 2017 until 2021, in four islets: Montaña Clara (Canary Islands, Spain), Cima, Rabo-de-Junco, and Raso (Cabo Verde) (Fig. 3). **Trophic ecology** was inferred based on the carbon and nitrogen isotope values of plasma samples collected at GPS recovery on Montaña Clara and Cima Islet.

Linear Mixed Models (LMM) were conducted to compare data from different colonies during different breeding stages and sex (fixed factors), while assuming ring and year to be random factors.

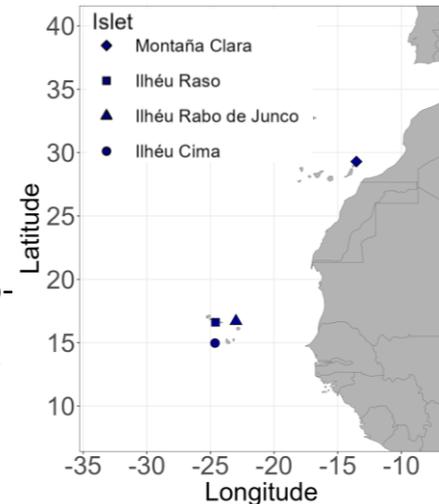
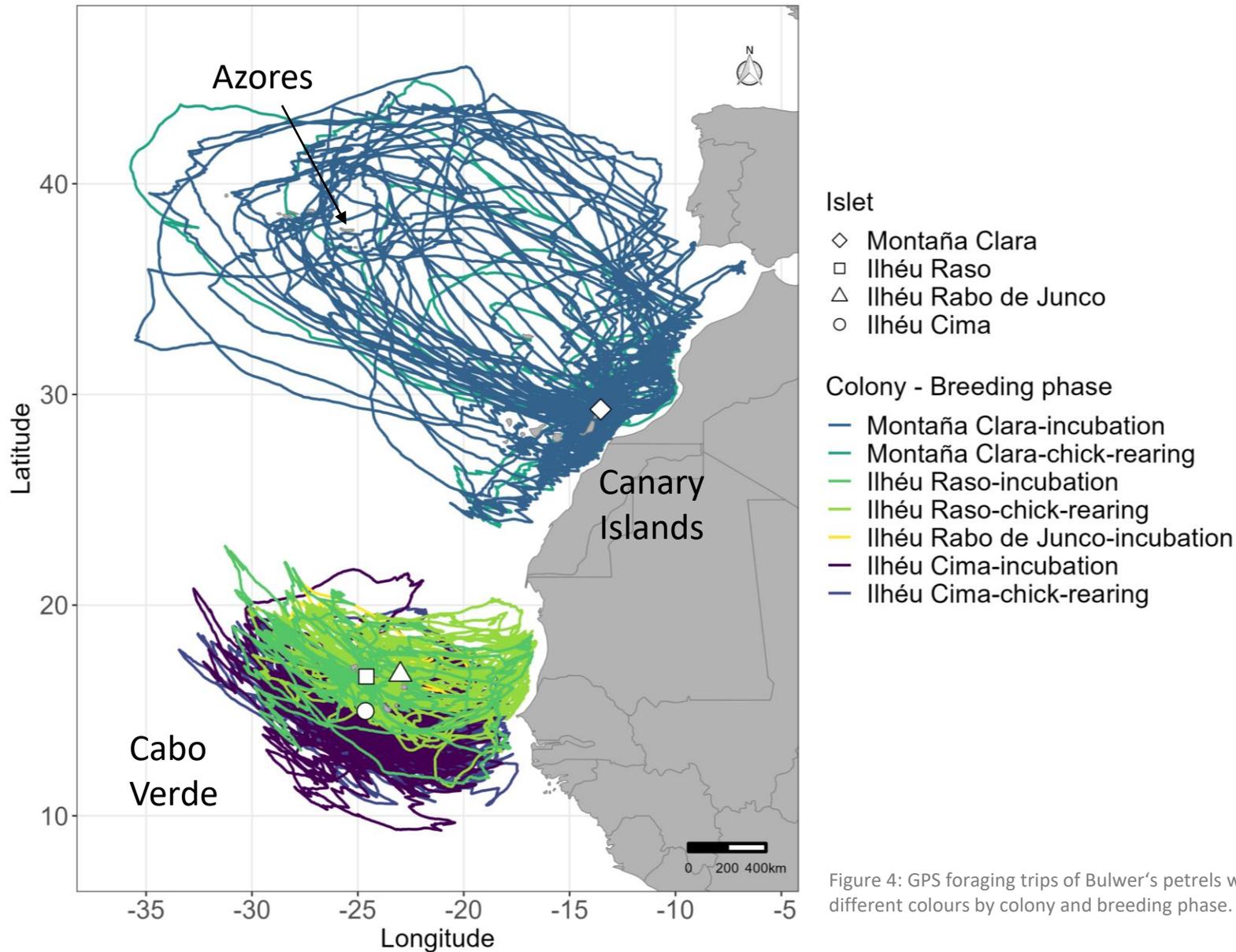


Figure 3: Map of study areas on the west coast of Africa

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Results – Foraging ecology

Based on the 1502 complete foraging trips, Bulwer's petrels foraged mainly on oceanic waters.

There was a clear spatial segregation in the foraging areas between petrels from different archipelagos, with petrels breeding in Canary Islands foraging as far as Azores, while those of Cabo Verde foraged in areas around this archipelago (Fig. 4).

There was also a smaller degree of spatial segregation in the foraging areas of petrels from different colonies within the Cabo Verde archipelago (Fig. 4).

Figure 4: GPS foraging trips of Bulwer's petrels with different colours by colony and breeding phase.

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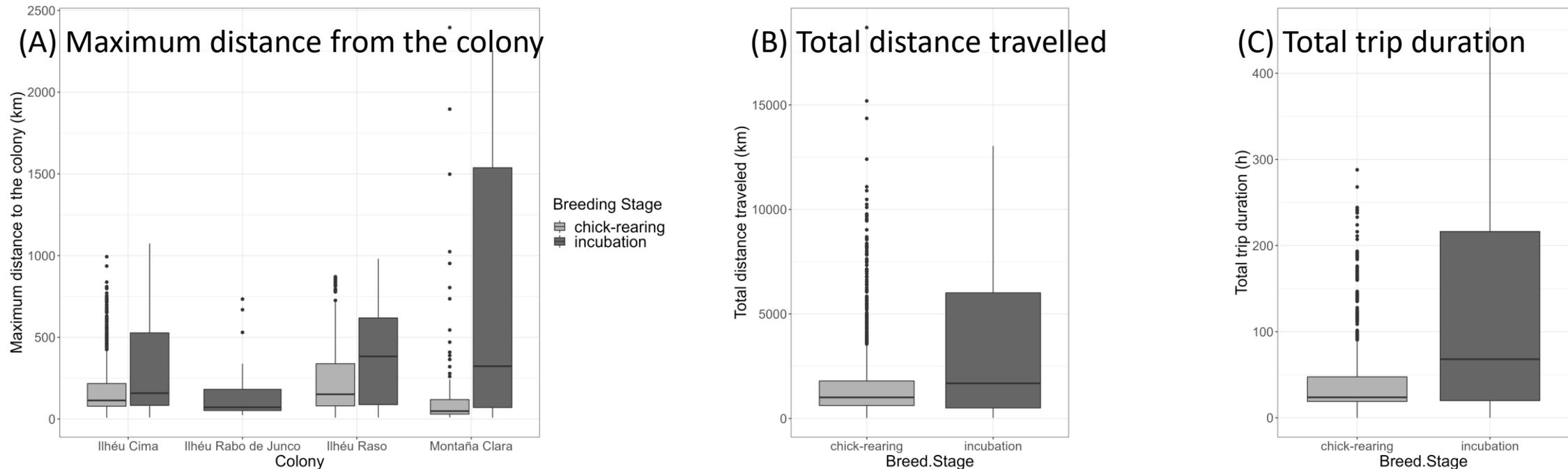


Figure 5: Boxplots of the (A) the maximum distance traveled from the colony (km), (B) the total distance travelled (km) during a complete foraging trip, and (C) the total trip duration (h) of a complete foraging trip separated by colonies and breeding stages.

Results – Foraging ecology

Petrels breeding in Montaña Clara travelled further from the colony than those of Cabo Verde (LMM p-value < 0.001, Fig. 5A), but no difference was found on total distance travelled nor in total trip duration between colonies (LMM p-values >0.05, Figs. 5B & 5C).

Foraging trips were longer in maximum distance from the colony, total distance travelled and total trip duration during incubation than during chick-rearing in all colonies (LMM p-values <0.05).

No sex-specific differences were found in the duration, in the maximum distance from the colony nor in the total distance travelled between colonies nor between breeding stages (LMM all p-values >0.05).

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Results – Trophic ecology

Petrels from Montaña Clara showed lower $\delta^{15}\text{N}$ and $\delta^{13}\text{C}$ values than those from Cima Islet.

We found significantly lower $\delta^{15}\text{N}$ values during incubation in Montaña Clara than in Cima Islet as well as a significant difference in $\delta^{15}\text{N}$ values between the incubation and the chick-rearing periods in Montaña Clara (LMM p-values < 0.05).

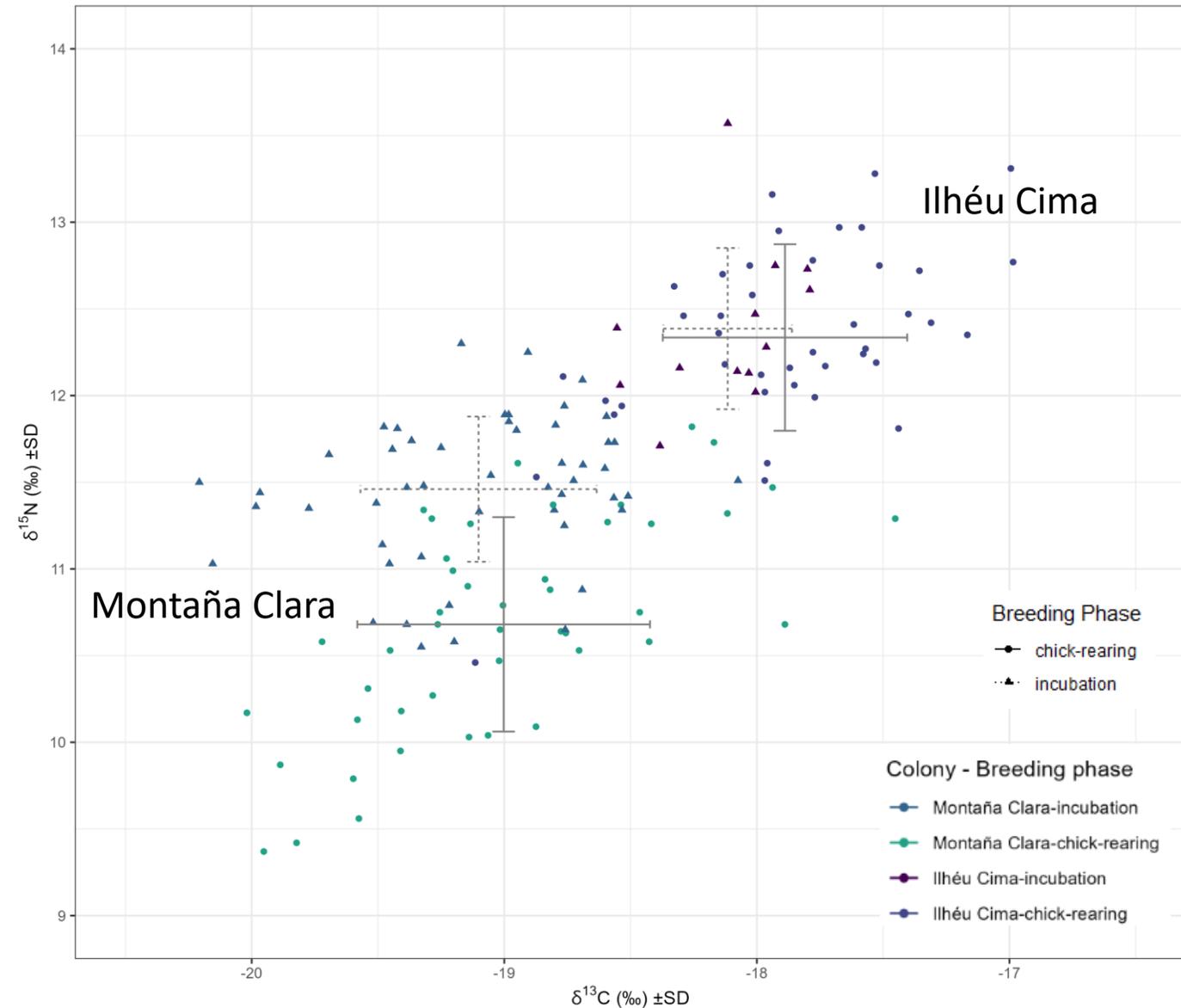


Figure 6: Differences in $\delta^{15}\text{N}$ and $\delta^{13}\text{C}$ values from plasma samples from two breeding colonies of Bulwer's petrels.

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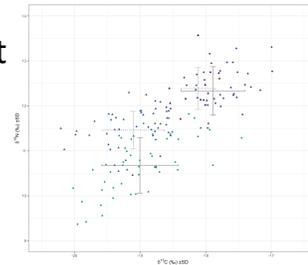
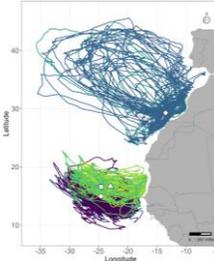
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Discussion

Spatial segregation on Bulwer's petrel foraging areas possibly reflects different environmental conditions and prey availability in the two study regions.

The **lack of sex-specific differences** in the foraging trips could be explained by the fact that males and females share their parental duties equally.

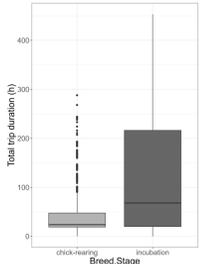
The **lower $\delta^{13}\text{C}$ values** of petrels from Montaña Clara reflect a more **oceanic diet** than those from Cabo Verde, which agrees with the GPS data. While their lower $\delta^{15}\text{N}$ values may indicate that these individuals are relying on prey of lower trophic level than those of Cabo Verde.



The **shorter foraging trips** (in duration and distance) during the **chick-rearing** reflects the need to feed the chick regularly.

Our study reinforces the importance of multi-colony assessment of foraging strategies to accurately identify the **marine important areas** used by different populations.

Further studies based on the identification of prey from regurgitates and **DNA metabarcoding** of faeces will help to interpret the isotopic results.



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