

# Diurnal seabird movements at Cabo Carvoeiro (Peniche, Portugal): observations in early October 2012

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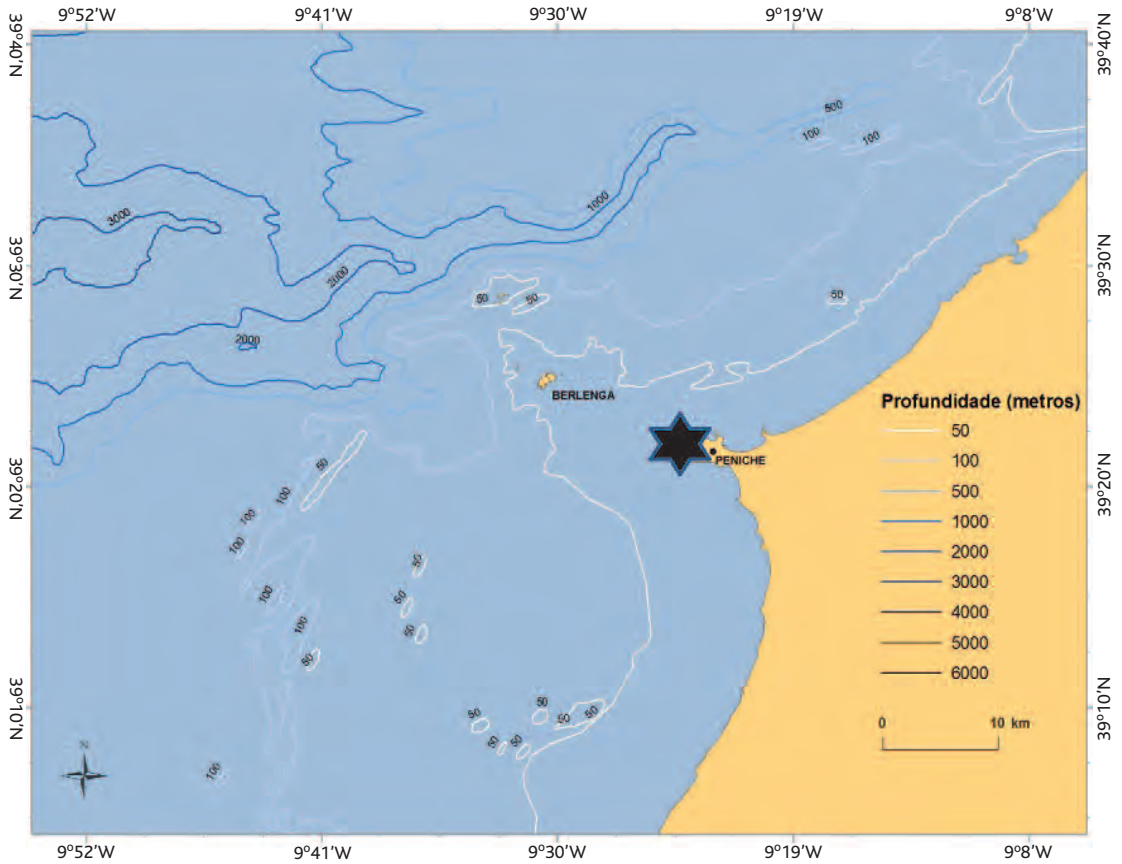
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## Abstract

The ecology and movements of seabirds are still inadequately understood, mainly because they can rarely be studied efficiently from land. The potential of Cabo Carvoeiro (Peniche, Portugal) for monitoring seabird movements from land is poorly known internationally, as few results from this site have been published in English. Here we present data from standardised counts in October 2012 and draw attention to recent organised seabird counts in Portugal. Despite unfavourable weather conditions for concentrating seabirds towards land, we observed a strong passage of Northern Gannet *Morus bassanus*, Cory's Shearwater *Calonectris diomedea*, Great Skua *Stercorarius skua*, and Balearic Shearwater *Puffinus mauretanicus* (mean morning passage of 252, 99, 19, and 21 birds / hour, respectively). Manx Shearwater *Puffinus puffinus*, Sooty Shearwater *P. griseus* and Great Shearwater *P. gravis* occurred regularly in low numbers. Extrapolation indicates that thousands of seabirds passed daily within a few kilometres from land. The high counts of some species and the fairly high species diversity observed by us and in the RAM (*Rede de observação de Aves e Mamíferos marinhos*) initiative show that Cabo Carvoeiro is an outstanding site for monitoring and studying seabirds in the eastern Atlantic, as it is also located further south in the flyway than most other seawatch points. We hope this note will inspire ornithologists from other countries to participate in standardised seabird counts at Cabo Carvoeiro and other Portuguese sites.

## Introduction

The ecology and movements of seabirds remain much less well understood than those of landbirds, mainly because most seabird movements, including their often spectacular migration, cannot be seen from land. Despite recent advances in satellite telemetry and geo-locator technology there is no technique available to monitor seabird migration at sea quantitatively. The scarcity of information about migration movements and numbers makes seabirds vulnerable in an era of global change and fisheries impacting ever more of the marine environment. Indeed, the list of conservation concerns related to seabirds is alarmingly long. In a North Atlantic perspective, it is urgent to gain a better understanding of their movements in time and space. Specifically, on-shore monitoring of sites further south in the East Atlantic seabird



**Figure 1.** Cabo Carvoeiro (star) is situated in the western part of the city of Peniche on the Portuguese Atlantic coast 75 km NNW of Lisbon. "Profundidade" is depth in meters. Map courtesy of City of Peniche.

flyway would add value by including more species and populations, compared with established count sites further north (e.g. in the UK, Ireland and France).

Examining a map of the eastern Atlantic, Cabo Carvoeiro in Portugal promises to provide such information for several reasons (Figure 1). First, central Portugal is within or close to the breeding range of several seabird species occurring in the Mid-Atlantic (Hagemeijer & Blair 1997; Lecoq *et al.* 2011). Secondly, migrants of these and more northern seabird species pass through the region during migration (e.g. Wernham *et al.* 2002; Yésou 2003; Meirinho 2009). Thirdly, protruding into the Atlantic as the westernmost point on the European mainland, Cabo Carvoeiro appears eminently situated for observing passing seabirds that otherwise might not be visible from land.

Although known as a seawatching site by Portuguese ornithologists since at least the 1980s, Cabo Carvoeiro remains more or less unknown outside of the country. Its qualities are barely described in ornithological and birding journals alike, and what little has been published in English (and in Portuguese, until recently)

provides little detail or is biased towards spectacular days with extremely favourable weather conditions and out-of-the-ordinary totals (e.g. Moore *et al.* 1997; Moore 2000). The aim of this article is to increase international awareness of the site, by reporting our own results from early October 2012 and by promoting a recent initiative by Portuguese ornithologists (Sengo *et al.* 2012).

## Methods

We undertook standardised seabird counts at Cabo Carvoeiro on eight occasions during 1–5 October 2012 (Table 1) from the sea cliffs west and north of Remédios (39°21'59"N 9°24'12"W and 39°22'12"N 9°23'49"W, respectively) in the western outskirts of the city of Peniche. Both vantage points offered excellent views over the sea, being backlit in the morning and side-lit in the evening. We conducted five early morning (total 644 min) and three evening counts (total 340 min), each lasting about two hrs. The former started at daybreak and the latter ended at dusk (Table 1). We used 10x binoculars and 20–75x spotting scopes, scanning the sea and the sky back and forth continuously. All counts were made by the authors (2–3 observers on each occasion). Wind data for Peniche were obtained from <http://www.windguru.cz>, and corresponded very well to our own on-site estimates.

## Results

Winds were light to moderate from the NW to NE sector during the study period (Table 1). Night skies preceding the morning counts were clear and visibility was good during all counts except for the last (morning of 5 October), when overnight fog lingered for the first half hour.

Seabird movement was dominated by Cory's Shearwater *Calonectris diomedea* and Northern Gannet *Morus bassanus* (Table 1). Balearic Shearwater *Puffinus mauretanicus* and Great Skua *Stercorarius skua* were also common, and these four species were seen on all counts. Great Shearwater *Puffinus gravis*, Sooty Shearwater *P. griseus* and Manx Shearwater *P. puffinus* were scarce but fairly regular, so that five species of shearwater were recorded on four of the eight counts, and never less than three species. Sandwich Tern *Sterna sandvicensis* was also recorded on all counts.

Morning and evening totals by species were not directly comparable, as more time was devoted to morning counts (65%). Patterns emerge, though, if passage is standardised by observation effort (passing birds / hour). Nine out of the 12 species that were seen both in the morning and in the evening had a stronger passage in the morning (individuals / hr; Table 1). The pattern that morning passage was stronger than the evening passage approached statistical significance in Sooty Shearwater, Balearic Shearwater, and Northern Gannet (individuals / hour, Mann-Whitney *U*-test statistic 3.5, 12.0, and 13.0, respectively,  $0.05 < P < 0.20$ ,  $n = 8$ ; only species seen on six or more counts were considered in tests), despite the inherent low power of tests to demonstrate differences for this low sample size (i.e., the number of counts).



Acknowledging the similarly low power of correlation tests to verify patterns based on eight counts, we did pairwise tests of count-level totals of the species that were seen on six counts or more. Accordingly, totals of Great Skua were positively correlated to those of Balearic Shearwater (Spearman rank correlation:  $r_s = 0.64$ ,  $P < 0.05$ ,  $n = 8$  counts) and Great Cormorant *Phalacrocorax carbo* (Spearman rank correlation:  $r_s = 0.82$ ,  $P < 0.05$ ,  $n = 7$  counts), implying a synchrony between these species in passage activity. Our data also suggest that there was a tendency for passage strength to be correlated among species at a more general level (correlation coefficients were positive in all six pairwise tests where  $P < 0.20$ ).

At times the seabird passage was so strong that it was not possible to note the flight direction of all individual birds of the more abundant species. Despite this imperfection in the data, some species-specific patterns were very evident. Determined straight-course southward migrants dominated greatly in Great Shearwater (8 of 9 birds), Sooty Shearwater (all), Northern Gannet (> 90%), Sandwich Tern (> 90%), and Great Skua (all but 2). All three Pomarine Skuas *Stercorarius pomarinus* and the only Arctic Skua *S. parasiticus* seen also flew like determined southward migrants. On the other hand, Cory's, Manx and Balearic Shearwaters, European Shag *Phalacrocorax aristotelis*, and Great Cormorant were all passing north and south in broadly equal numbers, thus providing little evidence for migratory activity in these species.

Although offshore distance and flight altitude were not noted consistently, some patterns were obvious. Among the species in which determined direct southward migration dominated, Northern Gannet, Sandwich Tern, and Great Skua passed on a broad front in the strait between the mainland and the Berlengas Islands. In contrast, all Sooty Shearwaters, Great Shearwaters, Pomarine Skuas and the only Arctic Skua migrated far offshore from the mainland.

## **Discussion**

Our counts took place during a week of settled weather, with winds from rather unfavourable directions for forcing seabirds towards land. However, this allowed us to document the seabird passage during more typical weather conditions instead of extreme. Winds from the north sector predominate in this area for much of the summer and autumn. With this background, the high number of seabird species observed, including the regular occurrence of Sooty and Great Shearwaters, confirms that Cabo Carvoeiro is well located to capture seabird flux along an important migratory flyway (cf. Sengo *et al.* 2012). This is likely just as true for numbers of birds as it is for species richness; the critically endangered Balearic Shearwater, for example, passed in numbers similar to those in sea counts in the summering areas in the Bay of Biscay (Yésou 2003). Hourly passage totals of Northern Gannet and Great Skua were also high when wind conditions are taken into account.

As indicated above, our sample was too limited to demonstrate diurnal patterns. Still, we found a tendency for a stronger passage in the morning than in the evening, but we did not collect any data on passage activity during the rest of the day, nor

at night, making this a tentative but potentially interesting result. We speculate that there is a significant passage of some species also during the hours of darkness at this time of year, as we often spotted migrating Northern Gannets and Great Skuas as soon as daybreak light permitted us to discern birds in flight over the sea.

Our data can be used to speculate about the daily passage total for some species at this time of the year. Assuming that our counts were representative of all daylight hours, daytime totals would have been approximately 1,200 for Cory's Shearwater, 180 for Balearic Shearwater, 2,200 for Northern Gannet, and 120 for Great Skua. To the extent that these species pass also at night, daily (24 h) totals might be correspondingly higher. However, caution is warranted; counts of Northern Gannets at Cape St Vincent, Portugal, suggest that passage activity is indeed strongest in the morning, and that extrapolation of morning count data should be avoided for this species (Walker 1996). Moreover, the extrapolated numbers above refer only to what is visible from land, which in turn depends on several factors, primarily wind, flight altitude, body size and whether a certain species passes on a broad front or not (e.g. Meirinho 2009). For example, from Cabo Carvoeiro it is probably possible to detect the vast majority of Northern Gannets that pass on the inshore side of the Berlengas archipelago, whereas a fairly large proportion of smaller, low-flying species (e.g. Balearic and Manx Shearwaters) might be missed. However, previous studies indicate that Balearic Shearwaters often stay within 15 km of the coast outside the breeding season (Yésou 2003 and references therein), suggesting that a fairly large proportion of those occurring in Portuguese waters might be seen from Cabo Carvoeiro. This suggestion is well in line with recent spatial data from Balearic Shearwaters fitted with geolocators (Guilford *et al.* 2012) as well with count data from Portugal and Galicia (Spain) (Mouriño *et al.* 2003; Poot 2005).

Cory's Shearwater was by far the most common shearwater in our counts. This was expected, as the nearby Berlengas archipelago is an important breeding area for this species (c. 1,000 pairs in 2011; Lecoq *et al.* 2011). We noted Cory's Shearwaters passing north and south in fairly equal numbers, and suggest that most birds were residents merely adapting flight direction to take advantage of local foraging conditions (Paiva *et al.* 2010). It should also be noted that Cory's Shearwater is one of the seabirds exhibiting as yet unexplained so called 'attendance cycles' (Granadeiro *et al.* 2009), which may also affect abundance patterns in counts done from the shore and near breeding colonies.

Our limited study provides a backdrop to Moore's (2000) observations that Cabo Carvoeiro may produce impressive daily totals during favourable wind conditions (e.g. 12,000 Cory's Shearwater, 5,500 Northern Gannet, 820 Sooty Shearwater, 1,250 Manx Shearwater, 3,450 Balearic Shearwater and 1,350 Arctic Skua on either 19 September or 24 October 1999). More importantly, the Portuguese parts of the Iberian Seawatching Network (RAM) initiative point to the outstanding qualities of Cabo Carvoeiro in a report in Portuguese (Sengo *et al.* 2012), based on counts done in 2009–11. We strongly encourage non-Iberian ornithologists to join the Portuguese seabird counts within the RAM initiative, which are now taking place

on a monthly and standardised basis. More information is available (in English) at: <http://www.spea.pt/en/study-and-conservation/birds-census/ram-days/>. Such participation would help in improving the understanding of seabird movements in the eastern Atlantic and provide support for conservation initiatives. This is an important matter, as the waters off Iberia and north-western Africa are subject to intense fishery and serve as a major route for commercial shipping, while hosting significant numbers of widespread and rare endemic seabird species.

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