MIGRATION OF THE SOOTY SHEARWATER *PUFFINUS GRISEUS* OFF GABON

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SUMMARY

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From 1 to 18 October 2007, about 2000 Sooty Shearwaters were observed migrating offshore from Gabon, most in small groups consisting of one to seven birds. The maximum intensity of the migration occurred within 10 days, with a peak centered on 9 October. According to the available data, the Sooty Shearwaters migrating during this period may be even more numerous. These results are in contrast to the expected figure-eight migration pattern followed by the Sooty Shearwater in the Pacific and by Cory's Shearwater in the Atlantic, and also in contrast to the recently discovered energy-saving use of wind corridors by Cory's Shearwater in the Atlantic. The Sooty Shearwaters seen off Gabon may have been young birds that lacked the experience to choose the most favorable migration routes or adults trapped in sub-optimal wind corridors appearing initially to be more energy-saving. More studies are required to determine the migration routes of the South Atlantic breeders, thought to be the bulk of the Sooty Shearwater population wintering in the North Atlantic.

Du 1er au 18 octobre 2007, environ 2000 puffins fuligineux ont été observés en migration au large du Gabon, principalement en petits groupes de un à sept individus. La densité maximale de leur passage a été observée lors d'une dizaine de jours centrés autour du 9 octobre. Selon les données disponibles, les puffins fuligineux ayant migré au large du Gabon durant cette période pourraient être bien plus nombreux. Ces résultats sont en contradiction avec le pattern de migration « en huit » qui a été observé pour le puffin fuligineux dans le Pacifique et pour le puffin cendré dans l'Atlantique, ainsi qu'en contradiction avec les corridors de vent à faible coût énergétique suivis par le puffin cendré dans l'Atlantique. Les puffins fuligineux vus au large du Gabon pourraient être de jeunes oiseaux qui manquent d'expérience pour choisir les routes de migrations les plus favorables, ou bien des individus adultes piégés par des corridors de vents leur demandant initialement peu d'énergie, mais dont le coût énergétique total est plus élevé. Afin de lever ces incertitudes, de nouvelles études devraient être effectuées concernant les routes migratoires des populations nicheuses de l'Atlantique Sud, qui semblent constituer la majorité des puffins fuligineux hivernant dans l'Atlantique Nord.

Key words: migration, Gabon, Sooty Shearwater *Puffinus griseus*, offshore

INTRODUCTION

The Sooty Shearwater *Puffinus griseus* is one of the most numerous seabirds in the world, with an estimated population over 20 million (Reyes-Arriagada *et al*. 2007). Its population is decreasing globally because of the impact of fisheries, harvesting of its young and probably climate change, leading to a "near-threatened" status on the IUCN Red List (Birdlife International 2000). It is a transequatorial migrant from the southern hemisphere, breeding largely on islands around New Zealand and Chile (Reyes-Arriagada *et al*. 2007, Warham *et al*. 1982), continental New Zealand, Australia (Lane and White 1983) and islands in the vicinity of Cape Horn and the Falkland Islands (Reyes-Arriagada *et al*. 2007). From May to September, during the austral winter, it occurs mainly in the northern hemisphere. In the Pacific, the Sooty Shearwater occurs offshore from California, where flocks from 1000 to 20 000 birds were regularly encountered (Briggs and Chu 1986), as well as on the Aleutian Islands and Japan (Shaffer *et al*. 2006). In the North Atlantic, it is found from Newfoundland to the British Isles. Some also winter in the Benguela Current off South Africa, where a few remain during the breeding season (Philips 1962, Cooper *et al*. 1991). This paper reports the sighting in early October 2007 of almost 2000 of these birds from an offshore platform off Gabon, West Central Africa, outside of previously known migration routes for this species.

METHODS

Birds were observed from the helideck of an offshore drilling platform 30 m above the sea level, providing an excellent 300° view within a radius of 3 km around the platform using 10 × 25 Leica binoculars. On this type of platform, the helideck is oriented against the prevailing winds for safety reasons, and is off-centre and higher than the platform body. In this case, the helideck was oriented towards the north, the origin of all the Sooty Shearwaters observed during this period.

The platform used for observation (00°53'S, 08°39'E) was located 15 km away from the nearest coastline, and roughly 20 km south of Cape Lopez, the westernmost point of Gabon (Fig. 1). Sooty Shearwaters were observed for a total of 36 hours, usually from 06h30 to 09h30 daily between 1 October and 18 October 2007. Data were collected every minute and summed in 15 min intervals. Observations were terminated whenever a decline in numbers was noticed during two successive 15 min intervals after 08h30. On 10 and 12 October observations ceased earlier than 08h30. Throughout the observation period, the weather was usually rather calm with a moderate wind and little swell. The wind was stronger on the two first days and on 11 October, whereas the swell increased from 1 m to 2 m during 10–14 October. The sky was generally cloudy and

this, together with early-morning observations, afforded very good visibility owing to the absence of heat haze.

RESULTS

From 1 to 18 October 2007, 1909 Sooty Shearwaters were observed passing the platform. All birds were heading south-southwest to south-southeast. The peak rate of passages was from 7 to 11 October, with >95% of birds passing between 4 and 14 October (Fig. 2). Most were in groups of one to seven birds (maximum 51, Fig. 3), with singles less numerous than those migrating in pairs or groups (Fig. 3). Sooty Shearwater groups mainly travelled in lines, birds following slightly beside the bird ahead.

Sunrise was at about 06h30, and Shearwater passage rose progressively from 06h30 to 07h30 (Fig. 4). The activity of the birds before 07h30 remains unknown, as no birds were seen around the platform at this time of the day. Numbers passing continued to be high up to 09h30; thus, many Sooty Shearwaters probably passed later in the day. Indeed, on several occasions during the period of study, small flocks of five to 10 birds were seen casually at about 17h30, just before sunset. Moreover, on the 11 October 2009, the Sooty Shearwater migration was monitored onshore from the Cape Lopez lighthouse from 07h30 to 11h00, and 27% of the 130 birds were seen after 09h30. Hence, I estimate that a minimum of several thousand Sooty Shearwaters may have been migrating in early October 2007 offshore from Cape Lopez.

In addition to the Sooty Shearwaters, I counted some hundreds of Arctic/Common Terns *Sterna hirundo/paradisea*, five Sabine's Gulls *Larus sabini*, seven Arctic Skuas *Stercorarius parasiticus*, two Lesser Black-backed Gulls *Larus fuscus*, one Brown Booby *Sula leucogaster*, and some other unusual offshore migrants (one Peregrine Falcon *Falco peregrinus*, one Willow Warbler *Phylloscopus trochilus*, one Icterine Warbler *Hippolais icterina* and one House Martin *Delichon urbicum*).

DISCUSSION

There is a general lack of data and knowledge about movements of seabirds off West and Central Africa, except for Senegal, where data have been gathered regularly since 1995 (Dubois *et al*.

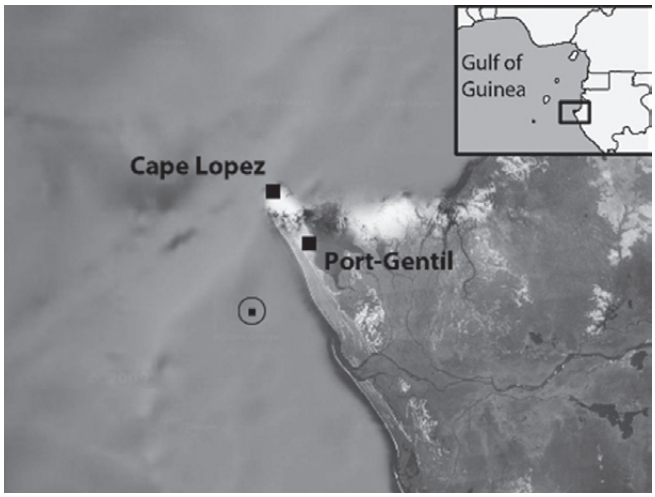

Fig. 1. Location of the observation point (square), with the approximate observation area from that point (circle, 3 km radius) (modified from Google maps 2009).

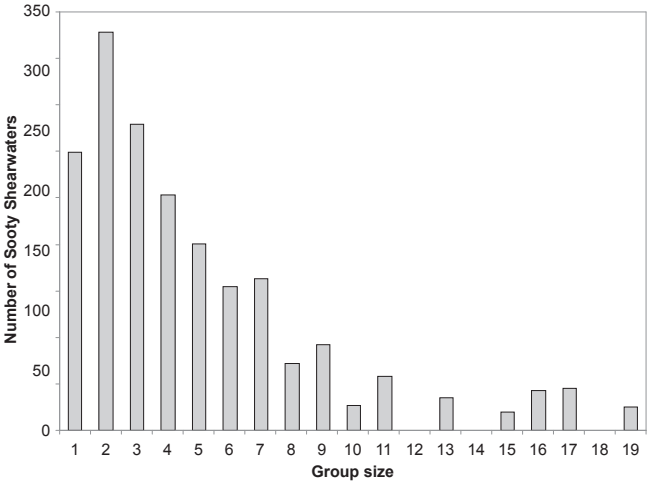

Fig. 3. Number of the Sooty Shearwaters seen, per group size.

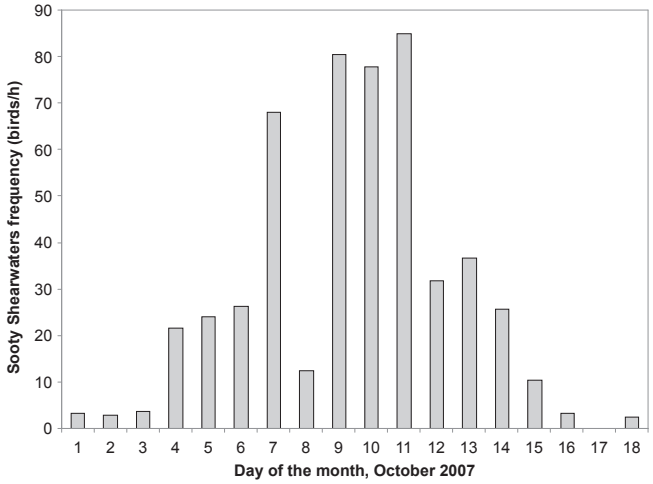

Fig. 2. Migration phenology of the Sooty Shearwater offshore Gabon in October 2007. Because of the irregular duration of daily observations, the hourly frequency of the Sooty Shearwaters was used.

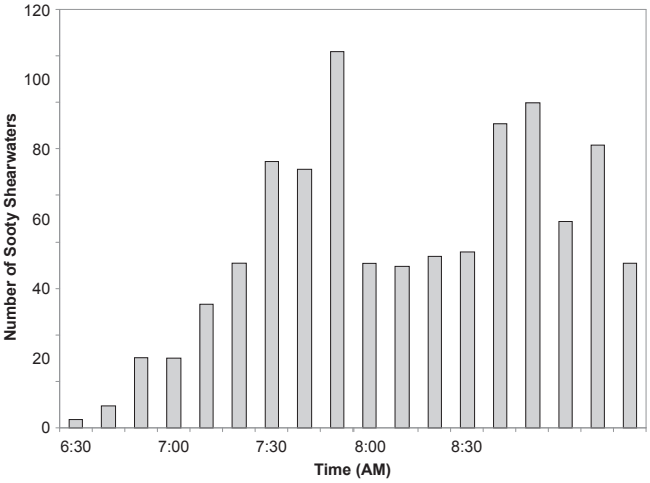

Fig. 4. Number of the Sooty Shearwaters per 10 min interval during the three days when observations were conducted continuously from 06h30 to 09h30.

2009). Indeed, this region is commonly considered to be outside of the migration routes of most pelagic birds (Philips 1962). Bird observers on West African coasts have never been numerous. For instance, in Senegal, the extent of Sooty Shearwater migration was largely underestimated in the 1980s, and the Sooty Shearwater was noted as "apparently uncommon" (Dupuy 1984), but up to 9739 birds were seen recently from 5 to 28 October 2007 (Dubois *et al*. 2009). There have been few sightings elsewhere in Central and West Africa. The first record from the Ivory Coast dates back to 1985 (Cheke 1987). Before this, three years of seabird observations around Lagos, Nigeria, failed to record it (Wallace 1972). The Sooty Shearwater has not been reported from Guinea Bissau to Sierra Leone, Ghana to Benin, Cameroon and Congo, and it is noted as a vagrant in Liberia, Nigeria, Sao Tome, Annobon and Bioko in Equatorial Guinea (Dowsett and Forbes-Watson 1993). In Gabon, it was considered to be regular offshore Cape Lopez, with maxima of 114 individuals on 19 October 1986 and 59 individuals on 28 October 1989 (Alexander-Marrack unpubl. data, available upon request). According to these observations, along with this paper and the observation of 130 birds on 11 October 2009, it seems that the Sooty Shearwater is a regular migrant in good numbers offshore from Gabon in October. Elsewhere in Africa, it is commonly found on the Atlantic coast, with large numbers wintering in the Benguela Current off South Africa, and reduced numbers observed throughout the year (Jackson 1988, Cooper 1991).

The magnitude of this migration off Gabon may have been overlooked previously owing to the lack of regular seabird watchers, the poor observation conditions (due to elevation of <3 m) and the short duration of this migration (most of the birds were seen within 12 days). According to tracking studies using geolocators (Shaffer *et al*. 2006), the majority of the Sooty Shearwaters wintering in the North Pacific cross the Equator within 5 days of 7 October; and they arrive at the breeding grounds on Snares Island, New Zealand, within 6 days of 7 October (Warham *et al*. 1982). However, this relatively short migration period has not been documented in the Atlantic. Although the direction of the Sooty Shearwaters seen from the offshore observation point suggests that most of them should have been visible from Cape Lopez, many of the shearwaters were probably not visible onshore even with the use of a telescope.

The Sooty Shearwater migration off Gabon contrasts with the commonly recognized migration routes in the Atlantic. Indeed, the recent use of geolocators for Sooty Shearwaters in the Pacific (Shaffer *et al*. 2006) and Cory's Shearwaters in the Atlantic (González-Solís *et al*. 2007) showed that the tracked birds follow a figure-eight pattern in each ocean, in the direction of the prevailing winds. They perform a clockwise loop in the northern part of the ocean, and a counter-clockwise loop in the southern hemisphere. In the North Atlantic, field observations tend to confirm the same migration routes for the Sooty Shearwaters. They are almost absent from the southeastern United States all year (Wallace and Whigh 2007), but they appear along northeastern coast of the United States in May, then move north to Newfoundland by June (Philips 1962), to the British Isles by mid-August to mid-September (Wynn & Brereton 2008, 2009) and then south via Spain (Philips 1962) and Senegal (Dubois *et al*. 2009). Meanwhile, the exact migration routes in the Central and South Atlantic are still unknown, although information is now available for the Falkland islands birds (A. Hedd & W.A. Montevecchi unpubl. data). The route followed by the birds seen in Gabon is contrary to the expected direction of this figure-eight migration pattern.

Also, the Sooty Shearwaters migrating offshore Gabon do not seem to follow the most favorable wind corridors in the South Atlantic. The migration routes of the Cory's Shearwaters tracked by geolocators were compared to several alternative routes, whose total energetic cost was calculated using sea surface wind data (Felicisimo *et al*. 2008). Even if the Cory's Shearwater has slightly different flight characteristics and thus different energetic costs, we may suppose that the Sooty Shearwater can also take advantage to a certain extent of these low-cost corridors, since both species have the same "glide–flap" flight style (Spear and Ainley 1997). The studied birds reached the Benguela Current in South Africa via the southern coast of Brazil until they crossed the Atlantic following the prevailing winds. It has been demonstrated that this flight strategy would save a lot of energy because it is aided by the wind, although the distance travelled may be up to 30% longer. All of the calculated low-cost corridors between Senegal and the Benguela Current passed in the vicinity of the southwestern Brazilian coast and none in the vicinity of Gabon or the Gulf of Guinea (Felicisimo *et al*. 2008). Only one tracked Cory's Shearwater out of twenty-two went straight to the South Atlantic without following wind conditions or any apparent energy strategy, but still passed very far away from the Gulf of Guinea (González-Solís *et al*. 2009).

The occurrence of Sooty Shearwaters off Gabon in such high numbers may be due to several factors. First, a small percentage of birds out of the huge number of the Sooty Shearwaters potentially wintering in North Atlantic, roughly estimated at one million (Barrett *et al*. 2006), may not use the prevailing winds as an energy-saving strategy. At least one geolocator-tracked Cory's Shearwater did not follow these low-cost corridors (González-Solís *et al*. 2007), and some young and inexperienced Sooty Shearwaters may not choose the best low-cost corridors. This may be enhanced by the fact that the current studies about migration efficiency are not iterative, but only consider the final cost of the route, whereas a traveling bird can refer to the local weather conditions but not to the weather conditions ahead in choosing its trajectory. Second, the average prevailing winds in West Central Africa south of Gabon head toward the north (Atlas *et al*. 1996), and are against the Sooty Shearwater migration direction. Some birds may thus be "trapped" by corridors with an initial low-cost pattern along the West African Coast from Senegal to Gabon, until they face an energy barrier that greatly increases the final energetic cost of the migration path. Finally, there is a one-month difference between the migration dates of the studied Cory's Shearwater and the Sooty Shearwaters seen offshore Gabon. Apparently, the Cory's Shearwaters wait for the West African westerly winds, also named ITCZ (Intertropical Convergence Zone), to cease before moving to the southern hemisphere in November (Felicisimo *et al*. 2008), but the Sooty Shearwater migration occurs one month earlier. The geographic pattern of the low-cost corridors has not been studied at this time of the year and may be very different.

Sooty Shearwaters banded in the Falkland islands have been recovered in Barbados, West Indies, and off Newfoundland, Canada (Otley 2008), but the exact origin of the birds wintering in either the North, and potentially migrating offshore from Gabon, or South Atlantic is little known. The Atlantic known breeders are located in Cape Horn and the Falkland islands, where the population is estimated at 100 000 pairs, mainly on Kidney Island (Otley 2008). There is little known about the population of the Cape Horn colonies, but they seem to be much greater, with estimates of up to 300 000 individuals on Wollaston islands (Reyes-Arriagada *et*

al. 2007). Nonbreeding birds from Australasia may also be part of the birds wintering in the Atlantic, since it takes an estimated minimum of five years before the Sooty Shearwater reaches sexual maturity (Cooper *et al*. 1991). New Zealand breeders seem to be excluded from the birds observed offshore from Gabon, as 99% of the burrows were occupied by 28 September in Snares Island, New Zealand (Warham *et al*. 1982). On the other hand, breeding starts around the end of October in the Falkland islands, so breeders from the Falkland islands and Cape Horn may be part of the birds migrating offshore from Gabon (Cawkell and Hamilton 1961). More studies, including additional geolocator tracking of the Sooty Shearwaters breeding in South Atlantic and an energetic cost-related analysis would help to assess the migration strategy and the origin of three groups of birds: breeders from South Atlantic, nonbreeders summering in the Benguela Current and Australasian nonbreeders returning to the breeding area.

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