DISCOVERY OF TWO MAJOR SEABIRD COLONIES IN MADAGASCAR

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SUMMARY

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This paper reports the discovery of the two most important breeding places for seabirds in Madagascar. Nosy Manampaho (east coast, 60 km south east of Antsiranana) holds the largest Sooty Tern *Onychoprion fuscata* colony in Madagascar (21 800 pairs). The colony is intensively harvested (eggs only), but some regulation occurs. Egg harvest generates important income for the local community, and this revenue is used to employ wardens and authorized egg collectors. As a consequence, the island and its seabird colony are better protected than most seabird places in the country. Nosy Foty (west coast, 30 km to the west of Antsiranana) is in the core area of the Marine National Park of Nosy Hara. It holds an important colony of Crested Terns *Thalasseus bergii.* Although heavily harvested in the past, the colony is now protected and has increased from fewer than 1000 pairs in July 1997 to 10 840 in July 2008. This colony of Crested Terns is now the most important of Madagascar and of the all Western Indian Ocean. Although ecotourism is not developed yet in the region, such an impressive seabird colony may be used by local authorities to promote the National Park and to increase the number of visitors in the region. Access to the colony should be strictly regulated, however. Our findings are discussed in the context of sustainable use of biodiversity in poverty alleviation in Madagascar.

Key words: Crested Tern, Sooty Tern, *Thalasseus bergii, Onychoprion fuscata,* conservation, egg harvest, ecosystem services, ecotourism

INTRODUCTION

Compared to remote oceanic islands of the Western Indian Ocean, the continental islets off the coasts of Madagascar hold few seabird colonies, most of which are reduced and declining (Le Corre & Jaquemet 2005, Bemanaja & Le Corre in prep.). Less than 0.5% of the 3 million pairs of seabirds that breed in the Mozambique Channel breed in Madagascar (Le Corre & Jaquemet 2005). Although some islands are traditionally protected, most are still heavily harvested as a protein source (egg harvest, chicks or adult poaching), leading to a constant decline in populations. Furthermore, most remote islands are seldom visited by ornithologists, and updated data are urgently needed on population size, trends and threats. Seabird colonies are spectacular and highly attractive for ecotourism. Because such tourism can generate benefits for local populations, with no or few detrimental effects on seabirds (if well managed), ecotourism is a sustainable alternative to egg harvest or poaching of seabirds. However, seabird ecotourism is virtually non-existent in Madagascar, although it could benefit both coastal villagers and biodiversity.

As part of a three-year regional project (Conservation and Ecosystem Services of Seabirds in the Western Indian Ocean) funded by the French Institute for Biodiversity, we visited several islets in the north of Antsiranana Province in July 2008. In this note, we report our main findings on seabird colonies, conservation issues, local uses of seabirds by coastal villagers, and perspectives.

MATERIAL AND METHODS

Field work was conducted from 6 to 15 July 2008. We visited Nosy Manampaho, on the eastern edge of the Nosy Ankao Archipelago on 8 and 9 July (Fig. 1). Then from 11 to 13 July, we moved to the west to the proposed Marine National Park of Nosy Hara, visiting Nosy Foty, Nosy Vaha, and Nosy Bamaho. Finally, on 14 July, we visited Nosy Antaly-Bé, in the northeast of the Bay of Diego-Suarez (Fig. 1).

Our goals were to census breeding seabirds, to conduct enquiries to determine the traditional uses of seabirds by coastal villagers, and to assess the conservation status of the colonies. The enquiries concerning Nosy Manampaho were conducted at Manampaho, at Nosy Ankao, and in a small coastal village named Beampingo near Ambolobozobé. The enquiries concerning the islets of the Marine National Park of Nosy Hara were conducted at Ampasindava, a coastal village at the limit of the Park. Finally, the enquiries concerning Nosy Antaly-Bé and adjacent islets were made at Orangéa.

To census the tern colonies, the colony area was mapped using a GPS (giving the exact area of the colony), then the number of nests were counted in circular plots of 10 m^2 chosen randomly within the colony. Assuming a regular distribution of nests within the colony (see "Results and Discussion"), we estimated the total number of breeding pairs in the colony using the mean density found in the 10-m^2 plots. The nests of other seabird species (White-tailed Tropicbirds *Phaethon lepturus*) were also counted and mapped, but with no attempt to extrapolate population size to the complete island.

The nomenclature used for terns is the one proposed by Bridge *et al.* (2005).

RESULTS AND DISCUSSION

Census

We identified seven species of seabirds, among which five were breeding or about to breed (Table 1). The most surprising result was the discovery of two large colonies of terns, one at Nosy Manampaho (21 800 pairs of Sooty Tern *Onychoprion fuscata*, see Table 1 and Fig. 2) and one at Nosy Foty (10 840 pairs of Crested Terns *Thalasseus bergii*, Table 1 and Fig. 2). To the best of our knowledge, these two colonies are the two largest seabird colonies at Madagascar (see Table 2 for comparison).

Sooty Terns were known to breed at Nosy Manampaho (ZICOMA 2001), but with no precision on population size. All other Sooty Tern colonies at Madagascar consist of fewer than 6000 pairs (see Table 2 and Feare *et al.* 2007), although these data need to be updated. All observed nests were occupied by an egg, and no chicks

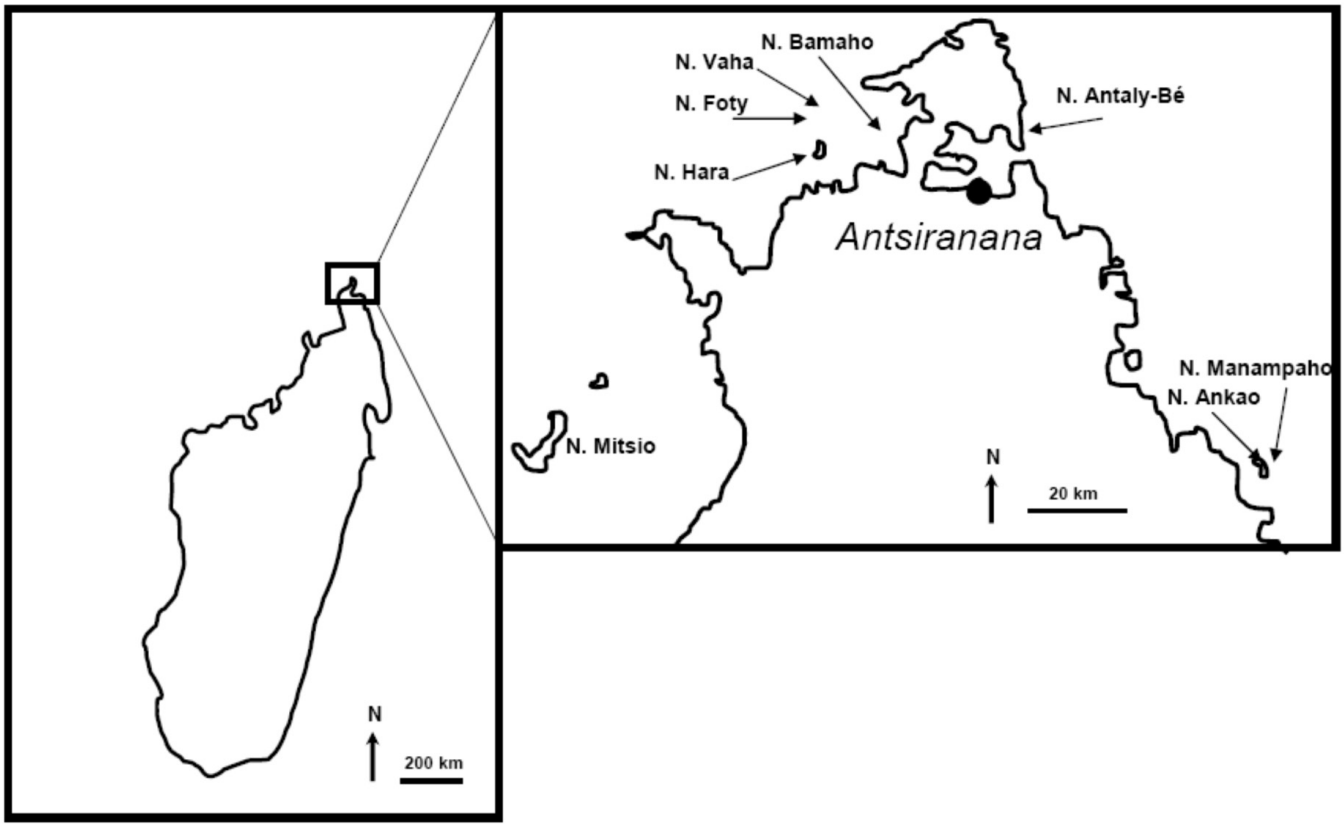

Fig. 1. Map showing the location of sites mentioned in the text.

TABLE 1
Counts of seabirds[a] in northern Madagascar in July 2008

	Sooty Tern *Onychoprion fuscata*	Crested Tern *Thalasseus bergii*	Caspian Tern *Hydroprogne caspia*	Roseate Tern *Sterna dougallii*	Brown Noddy *Anous stolidus*	Lesser Noddy *Anous tenuirostris*	White-tailed Tropicbird *Phaethon lepturus*
Nosy Manampaho	21 800±4 790 pairs	3 birds[b]	2 birds[b]	135 birds[b]	5 birds	5 birds	0
Nosy Foty	5 birds	10 840±2 970 pairs	22 pairs	3 birds	0	0	3 pairs
Nosy Vaha	0	0	1 pair	0	0	0	10 pairs
Nosy Bamaho	0	0	1 pair	0	0	0	2 pairs
Nosy Antaly-Bé	0	0	0	0	0	0	1 pair

[a] Numbers indicated in pairs imply that the birds were breeding; numbers indicated in "birds" imply that they were not breeding.
[b] Birds observed in breeding plumage.

were observed in the colony, suggesting a synchronous laying season in June or July (but later discussion). We also observed 135 Roseate Terns *Sterna dougallii* in breeding plumage on Nosy Manampaho, but they were not on nests. According to the warden and egg collectors who live there, Roseate Terns lay in August.

The Crested Tern population of Nosy Foty, in the proposed Marine National Park of Nosy Hara, was much larger than the previous census found in July 1997: a total population size for the archipelago of 3200 pairs (ZICOMA 2001). We did not visit the 12 islets of the archipelago, just three of them, and we found breeding Crested Terns on only one (Nosy Foty). This colony is by far the largest Crested Tern colony in Madagascar and in the whole Western Indian Ocean. Indeed, other known breeding colonies of Crested Terns in the region all consist of fewer than 1000 pairs (Table 3). The presence of large numbers of Crested Terns in the archipelago was already known, but all previous estimates were well below our census, indicating that the species has increased in numbers substantially in the last 10 years.

Fig. 2. The two major tern colonies of Madagascar: Crested Terns *Thalasseus bergii* at Nosy Foty (left) and Sooty Terns *Onychoprion fuscata* at Nosy Manampaho (right).

TABLE 2
Synthesis of published data[a] (present study not included) on seabirds in Madagascar[a]

	Wedge-tailed Shearwater ***Puffinus pacificus***	**Lesser Frigatebird** ***Fregata ariel***	**Great Frigatebird** ***Fregata minor***	**White-tailed Tropicbird** ***Phaethon lepturus***	**Red-tailed Tropicbird** ***Phaethon rubricauda***	**Brown Booby** ***Sula leucogaster***	**Lesser Crested Tern** ***Thalasseus bengalensis***	**Greater Crested Tern** ***Thalasseus bergii***	**Roseate Tern** ***Sterna dougallii***	**Sooty Tern** ***Onychoprion fuscata***	**Caspian Tern** ***Hydroprogne caspia***	**Bridled Tern** ***Onychoprion anaethetus***	**Brown Noddy** ***Anous stolidus***	**Total**
Cape Anorontany Archipelago							?[c] (350)	3 200	500	2 000	50			6 100
East Coast of Antsiranana				50				160		?[c]	65			?
Islets off Toamasina								60	50	5 500	20		100	5 730
Nosy Manitra and other islets									4 000	100		100		4 200
Nosy Vé					250									250
Islets off Morombé	125													125
Nosy Barren									1 480			100		1 580
Nosy Bé and satellites				15		30								45
Mitsio archipelago		?[c]	?[c]	5		250								405
TOTAL	125	?[c]	?[c]	70	250	280	?[c] (350)	3 420	6 030	?	135	200	100	20 710

[a] Figures shown are pairs of breeding birds.
[b] From Appert 1965; Cooke & Randriamanindry 1996; Le Corre & Bemanaja 2007; Milon 1946, 1948, 1950; Polunin 1979; Salvan 1971; ZICOMA 2001.
[c] May breed, but numbers are unknown.

The reasons for such an increase are discussed shortly. Of the nests counted in the circular plots, 86% (n = 542 nests in 10 plots) held one or two eggs; the remaining 14% had downy chicks of less than five days. This finding suggests a synchronous laying period in mid-June 2008. At least 20 pairs of Caspian Terns *Hydroprogne caspia* were also breeding in the fringe of the Crested Tern colony.

Another interesting finding was the presence in the National Park of the White-tailed Tropicbird as a breeding species. This species was present on the three islets visited, with at least 10 pairs on Nosy Vaha. This figure is probably well below the real population, because we stayed only one full day on this island and did not have time to check all potential breeding sites. To our knowledge, this species had not been documented in the National Park previously, and the nearest known breeding place is in the Mitsio Archipelago (ZICOMA 2001). The White-tailed Tropicbird is also known to breed on islets and cliffs in the East of the Bay of Antsiranana (Milon 1946), but we found only one occupied nest and five displaying adults on Nosy Antaly-Bé. This island is well known by coastal villagers as a breeding place for White-tailed Tropicbirds, where they go to poach eggs, chicks and adults.

Uses of seabirds by coastal villagers

The two main places visited (Nosy Manampaho and Nosy Foty) contrast markedly in term of uses of seabirds by coastal villagers. On Nosy Manampaho, eggs are intensively harvested. All the information that follows is based on enquiries with the warden, egg collectors and fishermen. The island is well known by local people as an important seabird colony, and unregulated egg harvest and poaching have occurred here for a long time. In 1997, the community at Ampisikinana that uses the island decided to protect the resource and to regulate the harvest. They decided to settle wardens, authorized egg collectors and their families each year during the Sooty Tern breeding season (May to October) to protect the island from poachers.

Since then, from the beginning of the laying period (May) to mid-June, the entire colony has been harvested, taking up to 5000 eggs per day. From mid-June to the end of the laying period (July), approximately one third of the colony is reprieved, and the adults are allowed to incubate their eggs and rear their chicks. The other two thirds of the colony are harvested until the end of the laying period. During this period, the harvest rate is approximately 800 eggs per day. According to the warden, no adults or chicks are taken. No previous attempt was made to census the colony, and according to the warden, the number of birds has not changed significantly in the last 10 years. However, the structure of the vegetation of the island suggests that all the central part of the island may have been occupied by Sooty Terns in the past. The colony now occupies only 0.5 ha or 1.7% of the island.

The eggs collected each day are stored in a house on the island for one week before a boat comes from Ampisikinana to take them. The eggs are then transported by road to the markets of Antsiranana, where they are sold for 250 ariary (€0.10) each. Thus, during the first part of the laying season, the colony generates an income for the community of 1 250 000 ariary (€500) per day. During the first month, the incomes generated may thus reach €15 000. By comparison, the average monthly wage in the agricultural sector in Madagascar is 100 000 ariary (€40). Hence, the presence of the Sooty Tern colony at Manampaho represents a considerable source of wealth for the community. This situation probably explains the decision to manage and protect the colony by settling a seasonal warden and authorized collectors. No study has been made to assess the impact of this rate of harvest for the population dynamics of the terns, but a modelling study conducted in the Seychelles suggested that a harvest rate of 30% per year should be sustainable (M. Le Corre & C.J. Feare unpub. obs.). We do not know whether the collectors on Mananpaho harvest more than 30% of the eggs, but a higher percentage is likely. Further studies should be conducted there to assess the sustainability of this harvest.

The island of Nosy Foty, on the other hand, is in the core area of the Marine National Park of Nosy Hara. Although the Park had not, at the time of our visit in 2008, been declared officially, poaching had been banished, and warden patrols were being conducted regularly (Agence National pour la Gestion des Aires Protégées pers. comm.). According to local villagers, intensive egg harvesting previously occurred on all islands of the archipelago, but

TABLE 3
Synthesis on the Crested Tern *Thalasseus bergii* colonies in the western Indian Ocean (including east Africa)

Islands	Population size (pairs)	Trends	Threats	Source
Tanzania (Latham Is.)	320	?	?	Crawford et al. 2006
Madagascar (Nosy Foty)	10 840	Increasing	None	Present study
Madagascar (east coast of Antsiranana)	250	?	?	Milon 1950
Madagascar (ilets of Toamasina)	60	?	?	Salvan 1971
BIOT (Chagos)	52			McGowan et al. 2008
Somalia (Jasiira Ceebaad, Jasiira Sacaada Diin)	<1 000	?	?	Anonymous 2001
Seychelles (Aldabra)	60–100	?	?	Rocamora & Skerret 2001
Seychelles (Cosmoledo)	100–500	?	?	Rocamora & Skerret 2001
Seychelles (African Banks)	6	Decreasing (extinct?)	Poaching	Rocamora & Skerret 2001
France (Juan de Nova)	250	?	Predation by cats	Le Corre & Jaquemet 2005, Peck *et al.* 2008

this harvest stopped in 2001. Poaching and egg harvesting is now forbidden and probably very little occurs in the archipelago. We did not see any people while on the islands, nor any evidence of recent human settlements or poaching.

The Crested Tern population of Nosy Foty has increased from 1000 pairs in July 1997 (ZICOMA 2001) to 10 840 pairs in July 2008. Crested Terns are known to move colony locations within islands and archipelagos (e.g. Dunlop 1987) and even between regions (e.g. Crawford 2003) if a shift occurs in prey populations. There are no data on the variation in the abundance of coastal fish in the Marine Park of Nosy Hara, and so we cannot assess whether the increase by a factor of 10 in the Crested Tern colony is a result of the complete protection of the area or of a change in prey density. However, the positive effect of the cessation of the poaching is very likely, because Malagasy poachers usually collect both eggs and adults when they visit an island. Protection may also explain the presence and relative abundance of the White-tailed Tropicbird in the national park. Indeed this species is quite rare in Madagascar and is heavily poached at most places where it still breeds (Milon 1946, authors pers. obs.).

Trends, conservation issues and perspectives

The islands that we surveyed are rarely visited by ornithologists, and one of them (Nosy Manampaho) had never previously been surveyed, preventing any temporal analysis of population changes. The only clear trend that we can identify is the increase by a factor of 10 in the Crested Tern colony of Nosy Foty after the complete stop of egg harvest and poaching in 2001. This spectacular recovery is a true conservation success for the Marine National Park, which also holds an important number of breeding Green Turtles *Chelonia mydas* and some of the very few pairs of the endemic and endangered Madagascar Fish-eagle *Haliaeetus vociferoides*. Efforts should be conducted to complete the seabird census on the other islets of the park.

The situation is dramatically different in Nosy Manampaho, where egg harvest is still very important. Although regulated, the harvest rate is probably beyond the sustainable threshold and may lead to decline of the colony. However, as a long-lived species, the Sooty Tern is not very sensitive to additive mortality at egg or chick stages, so that such a decline, if it occurs, should be slow. By comparison, a minor human-induced decrease of adult survival would have a very important and quick negative effect on the population. Adults are not caught at Nosy Manampaho, which probably explains the persistence of this large colony despite an important egg harvest.

Egg harvest is known to occur at most tern colonies in Madagascar, but to our knowledge, this is the first case of a regulated and managed harvesting activity. At most other places, egg harvest is not regulated, and poachers collect all what they can, including chicks and adults (Bemanaja *et al.* in unpublished). This case holds particularly true in the Barren Archipelago and at Nosy Manitra and Nosy Mborono in the southwest of Madagascar (Bemanaja *et al.* unpublished). At such places, tern colonies are small and declining and can hardly produce a single chick.

Although it is difficult to assess the sustainability of the egg harvest conducted at Nosy Manampaho, the situation there is much better than a non-regulated situation, because adults are not killed, and some chicks are produced each year. Furthermore, the presence of a warden and authorized collectors also benefit other wildlife, especially Green Turtles that breed at Nosy Manampaho and that are no longer poached. Because egg harvest generates important incomes for the community, local villagers are highly motivated to protect their colony against poachers and to harvest sustainably. An alternative way to give seabirds an economic value is to develop ecotourism. Seabird colonies are spectacular, and numerous seabird sites are managed as nature reserves, where at least a part of the island is open to visitors. There is no tourism at all at Nosy Manampaho, nor in the whole archipelago, although the area is pristine and holds numerous ecotourism attractions (coral reef, beaches, typical villages, nice islands, seabirds, marine turtles, and so on). The main reason for the absence of tourism is the difficulty of reaching the place from Antsiranana or from Vohémar (the nearest towns of the region) and the lack of local infrastructure, but these difficulties are quite general in Madagascar.

The north tip of Madagascar holds numerous islets where seabirds breed or bred, but few updated data are available. It would be particularly important to complete the census on the other islands of the Marine National Park of Nosy Hara to complete the assessment of the conservation measures taken in 2001 in this park.

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