

ILLEGAL EGG HARVESTING AND POPULATION DECLINE IN A KEY PELAGIC SEABIRD COLONY OF THE EASTERN INDIAN OCEAN

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SUMMARY

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We carried out population counts of a nesting colony of terns (*Sternidae*) on Pitti Island, an official seabird sanctuary, on 17 February 2013, 10 March 2013, and 10 February 2014. We also assessed population trends over previous years using data from earlier surveys. We estimated the number of nests and eggs, and recorded loss of eggs by predation, including harvesting by fishermen. Using a structured questionnaire, we interviewed 800 respondents from Kavaratti Island in the Lakshadweep Archipelago to assess the number of people involved in seabird egg harvesting and trade, and to evaluate their attitudes towards seabird conservation. We recorded three species of terns: Sooty Tern *Onychoprion fuscatus*, Brown Noddy *Anous stolidus*, and Greater Crested Tern *Thalasseus bergii*, but only Sooty Terns were nesting during our field visits. Levels of natural predation on this species were low (<1%), whereas fishermen removed 14%–45% of the eggs. Approximately 72% of the 800 respondents interviewed on Kavaratti Island were either directly or indirectly involved in the harvest and local trade of seabird eggs. Respondents involved in egg harvesting were significantly less inclined to support seabird conservation. Although Pitti Island is a protected area, tern numbers have declined since 1963. This key breeding site will likely be lost unless stringent conservation measures are implemented to monitor and protect the nesting colony, and to divert the local people away from the seabird egg trade.

Key words: seabird population decline, illegal egg harvesting, Indian Ocean, pelagic seabird colony, Sooty Terns

INTRODUCTION

Seabirds, which comprise 3% of the world's avifauna, are found in diverse oceanic habitats worldwide. A significant number of these seabirds are globally threatened (Croxall *et al.* 2012). An appreciable amount of research has been conducted on seabirds in tropical areas (Ballance & Pitman 1999), and more recently, important seabird research has been conducted in the Western Indian Ocean (De Monte *et al.* 2012, Mannocci *et al.* 2014, Thiers *et al.* 2014). However, seabirds of the Eastern Indian Ocean have received less attention. Therefore, studies are required to shed light on their population status and the threats they face (Mondreti *et al.* 2013).

Pelagic foraging terns, such as the Sooty Tern *Onychoprion fuscatus*, are widespread in tropical oceans, with a mixed population status depending on the region (BirdLife International 2017). Of the 46 known Sooty Tern colonies in the Western Indian Ocean, 14 have been extirpated and eight have declined in number over the last century (Feare 1984, Feare *et al.* 2007). Similarly, in the Chagos Islands, Carr (2011) reported a decline in Sooty tern populations following the introduction of alien predators. In the Eastern Indian Ocean along the western flank of the Indian subcontinent, colonies of breeding pelagic seabirds are surprisingly rare. Reports of breeding pelagic seabirds have been limited to Pitti Island in Lakshadweep, Vengurla Rocks in Maharashtra (Feare *et al.* 2007), and Sand Island III (Sri Lanka) in Adam's Bridge between India and Sri Lanka (Seneviratne *et al.* 2015).

Earlier surveys reported 31 species of pelagic seabirds and shore birds in the Lakshadweep Islands (Kurup & Zacharias 1994, Robertson 1994), whereas in 2006 only eight pelagic and nine non-pelagic species were recorded (Pande *et al.* 2007). Nesting colonies of Sooty Terns *Onychoprion fuscatus*, Brown Noddies *Anous stolidus*, and Greater Crested Terns *Thalasseus bergii* have been reported on these islands over the past 100 years (Hume 1876, Betts 1939, Kurup & Zacharias 1994, Robertson 1994, Mathew *et al.* 1996). Currently, only Sooty Tern and Brown Noddy colonies have been reported and are localized to the islands of Cherbaniani and Pitti (Pande *et al.* 2007). Former breeding sites such as Tinnakara and Suheli are no longer used by the birds (Kurup & Zacharias 1994, Pande *et al.* 2007). Land use change, especially conversion of nesting habitats to coconut plantations, likely affected nesting colonies during the early days of human occupation (Feare *et al.* 2007). In the Seychelles and across the Western Indian Ocean, egg harvesting for local human consumption has been cited as the main reason for the recent decline in tern populations. Intensive egg harvesting in Lakshadweep has been noted in several surveys (Kurup & Zacharias 1994, Pande *et al.* 2007).

To better understand the situation in Lakshadweep, we carried out a survey of nesting seabirds at Pitti Island. Our aim was to (i) assess the tern population status over time using secondary data, (ii) estimate current tern numbers, and (iii) document the levels of egg harvesting on-site. We also used a structured questionnaire to interview people on Kavaratti Island (the nearest populated island)

to (i) determine the proportion of people involved in egg harvesting and (ii) understand their attitudes towards seabird conservation.

METHODS

Study area

The Lakshadweep Archipelago, an Indian territory, is located between 8°15'–11°45'N and 72°00'–74°00'E, off the coast of Kerala state. It consists of 12 atolls, three reefs, and five submerged banks, ten of which are inhabited by people (Fig. 1). Our study was primarily focused on Pitti (10°46'31.8"N, 72°32'3.4"E), a 1.21 hectare (0.0121 km²) uninhabited barren island located off the coast of Kerala, 24 km from Kavaratti, the capital of Lakshadweep. Pitti Island is well known for its breeding colonies of seabirds (Hume 1876, Betts 1939, Mathew *et al.* 1996). It was declared a bird sanctuary under the provisions of the Wild Life (Protection) Act of India, 1972. However, the effects of this protection on seabird colonies are unknown. Field studies on Pitti Island are extremely challenging because landing is only possible by swimming ashore across the breakers, and there is no fresh water to support an overnight stay (Mathew *et al.* 1991, Pande *et al.* 2007).

Population data acquisition

Trips to Pitti Island were made on local fishing vessels. Due to logistical constraints, observations were limited to three days: 17 February and 10 March 2013, and 10 February 2014.

We recorded the outline of the seabird breeding area using a handheld Garmin eTrex10 GPS, and calculated the area (m²) of the nesting colony. During each field visit, we estimated the total number of terns in the colony, and counted eggs using direct counts (Bibby *et al.* 1992, Walsh *et al.* 1995). All observations were made by two independent observers from elevated ground using a spotting scope (Leica 25-50x wide angle), at a maximum distance of 20 m from the colony. We compared the percentage of eggs lost to natural predation with those harvested by the fishermen. Eggs destroyed by Ruddy Turnstones *Arenaria interpres* and Hermit crabs *Pagurus* sp. were considered lost due to natural predation, whereas eggs collected by humans were considered lost due to egg harvesting. Pitti Island is uninhabited, including by rats and cats, and is devoid of any vegetation. The number of eggs harvested during all three field visits was directly estimated by following fishermen as they collected eggs; the percentage of eggs harvested was calculated as the number of eggs harvested divided by the total number of eggs in the colony.

Our population counts during the three field visits were compared with those of earlier surveys (Hume 1876, Betts 1939, Kurup & Zacharias 1994, Robertson 1994, Mathew *et al.* 1996, Pande *et al.* 2007) and unpublished information. Sooty Terns were found to be the dominant species in all past estimates of seabird populations. Similar to Sooty Terns in the Chagos Islands (Carr 2011), breeding of Sooty Terns on Pitti Island occurs during most months of the year, suggesting that they have a non-annual breeding cycle (Hume 1876, Betts 1939, Mathew *et al.* 1996). Outliers, such as data reported by Pande *et al.* (2007), were also

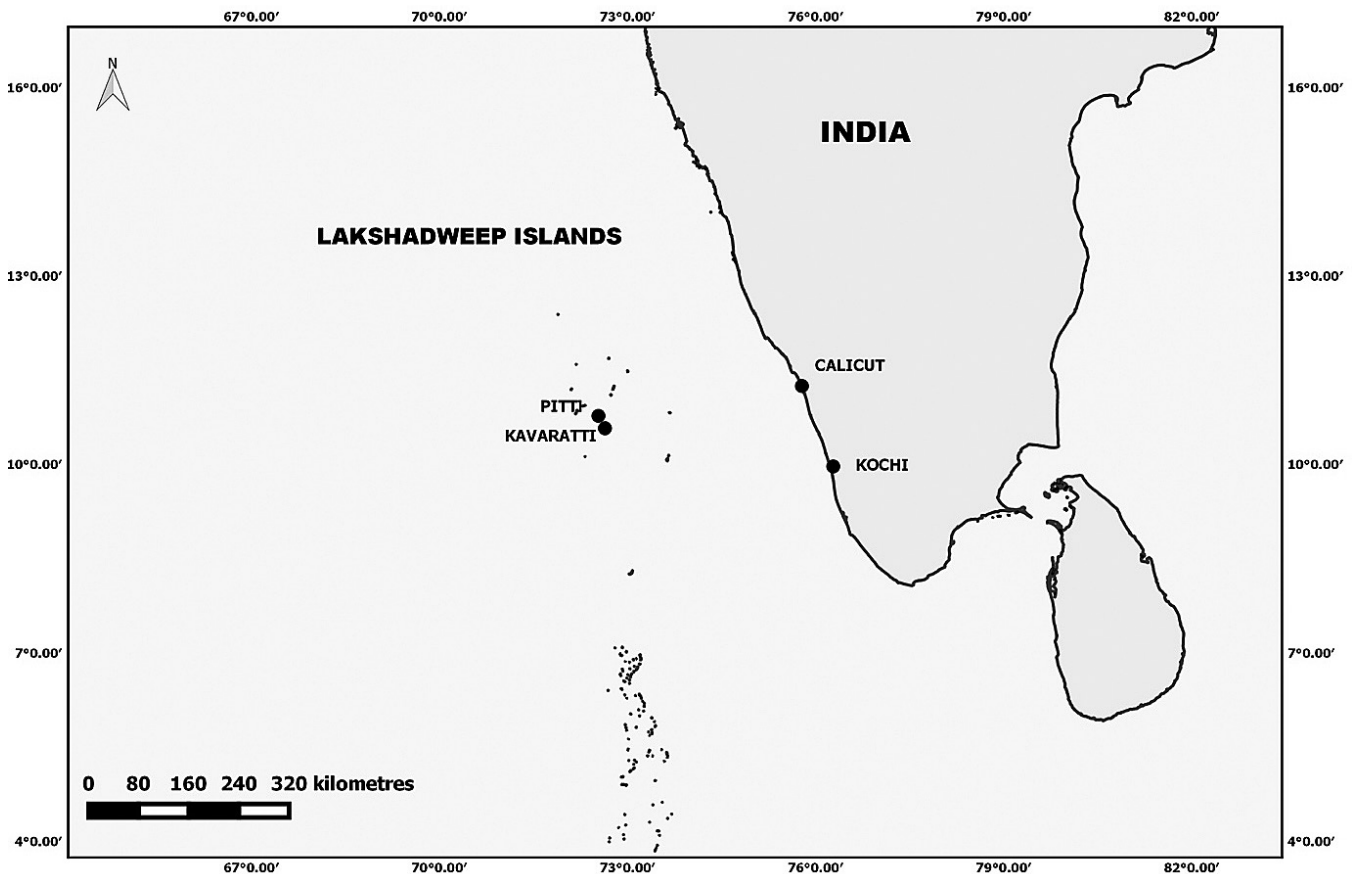


Fig. 1. Study area showing location of Pitti Island within the Lakshadweep Archipelago (India).

included in our review. However, these rough counts were made from a boat and are not comparable to observations made after landing on the island.

A survey questionnaire was carried out in Kavaratti (the nearest inhabited island, located 24 km from Pitti Island) to assess the extent of seabird egg collection by the local people. The island was divided into 5 grids, and individuals in each grid were chosen based on their willingness to participate in the survey. We reduced bias by employing a local person to serve as a translator and to participate in the interview process. The number of individuals in each grid ranged from 136 to 195, with an average of 160 people per grid. A total of 800 individuals, both men and women between the ages of 14 and 80, were interviewed in Malayalam, and their age, gender, and occupation were recorded. Survey participants were asked two questions: (i) Do you harvest or sell seabird eggs; and (ii) Is it important to conserve seabirds? Positive responses were recorded as “Yes”; negative or ambivalent (not sure) responses were recorded as “No”. A chi-square test was carried out to test whether there was a correlation between the respondents’ involvement in seabird egg harvest or trade and their support of seabird conservation.

RESULTS

In February and March of 2013/14, we observed Sooty Terns, Brown Noddies, and Great Crested Terns at Pitti Island, but only Sooty Terns were nesting. Natural predation of eggs by turnstones and crabs was low, but fishermen removed 14%–45% of all eggs on each occasion (Table 1; see appendix Table A1 for population estimates).

At Pitti Island, the tern population (all Sternidae) has declined from 20 000 birds in 1963 to 970 in our February 2014 survey (Fig. 2, Table A1).

A total of 573 (72%) respondents were involved in egg harvesting and/or the local trade of seabird eggs in Kavaratti. Those involved in seabird egg harvesting and trade were less likely to support the conservation of seabirds ($\chi^2=56.62$, $df=1$, $p<0.0001$; Table 2).

DISCUSSION

Our study indicates that the breeding colony of Sooty Terns at Pitti Island in the Eastern Indian Ocean could be in danger of disappearing due to the intensive harvesting of eggs by local people. Overall, 72% of the respondents to our survey admitted involvement in the harvesting or trade of seabird eggs, both of which can provide supplementary income to respondent households. The local people consider seabird eggs to be of medicinal value (RM pers. obs.). This dependency of the local people on eggs from the seabird colony, which is already small, could easily continue to reduce the colony’s size and drive it to extinction.

Intensive egg harvesting on Pitti Island has been documented by Kurup & Zacharias (1994) and Pande *et al.* (2007), who also reported the poaching of adult seabirds. In the Seychelles, seabird eggs have been commercially exploited at least since the beginning of the 20th century (Feare *et al.* 2007). However, in the Seychelles, collectors are legally allowed to remove all eggs on a daily basis from parts of the colonies to make sure

TABLE 1
Population estimates and records of egg loss to humans and natural predators on Pitti Island, Lakshadweep, India

Date of observation	Area of colony (m ²)	Number of Sooty Terns recorded	Number of eggs	Human harvested eggs (% of eggs)	Predation by crabs, turnstones (%)
17 February 2013	90	970	430	60 (14)	2 (0.5)
10 March 2013	20	580	310	85 (27)	2 (0.7)
10 February 2014	12	335	55	25 (45)	0

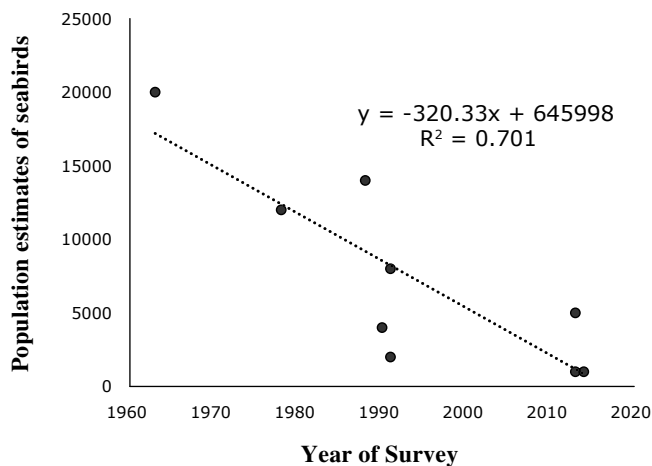


Fig. 2. Declining seabird populations on Pitti Island (1963–2014). The x-axis represents the observation or survey year, and the y-axis represents the population estimate.

TABLE 2
Association between involvement in seabird egg trade and support for seabird conservation among 800 respondents on Kavaratti Island^a

Seabird egg trade	% support for seabird conservation (n)		% involved in egg trade (n)
	Yes	No	
Yes	55 (238)	92 (335)	72 (573)
No	45 (196)	8 (31)	28 (227)
% support for conservation	55 (434)	92 (366)	800

^a($\chi^2=56.62$, $df=1$, $p<0.0001$)

the eggs are fresh (Feare *et al.* 2007). In contrast, at Pitti Island, collectors were observed to illegally remove a small portion of the eggs, which could prevent replacement clutches. Eggs might be replaced by a second clutch whose quality is lower than that of the first clutch. For instance, Feare (1976) found that replacement eggs were much less successful in producing fledged chicks than first eggs.

Egg harvesting can be sustainable if regulated (Feare *et al.* 2007), but in a small colony with unregulated access, such as that found on Pitti Island, egg harvesting is driving the population to extinction. Especially in areas with limited breeding habitat/islands, many seabirds show high philopatry (Gaston & Donaldson 1996), and this trait makes them particularly vulnerable to threats such as poaching and egg harvesting. Accordingly, losses of seabirds and breeding colonies have been dramatic in the Lakshadweep Archipelago (Kurup & Zacharias 1994, Robertson 1994, Pande *et al.* 2007).

Our sociological survey indicates that the dependence on seabird egg harvesting as a source of livelihood for the local population reduces support for conservation. The association between resource interest in a protected area and lack of local support for conservation has been documented in other cases (Holmes 2003, Arjunan *et al.* 2006). Pitti Island has been declared a bird sanctuary, but its status is not currently enforced; there is no monitoring, and poaching carries on unabated, which will likely result in the loss of this nesting site for seabirds.

Therefore, conservation action should focus on (i) improving patrolling and monitoring of the nesting seabird populations on Pitti Island, a seabird sanctuary, (ii) providing incentives to the local population to reduce their dependency on seabird eggs as a source of income, and (iii) promoting wildlife tourism to increase the value of the Pitti Island seabirds to the local people.

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