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A CENSUS OF SEABIRDS OF FRÉGATE ISLAND, SEYCHELLES

BY

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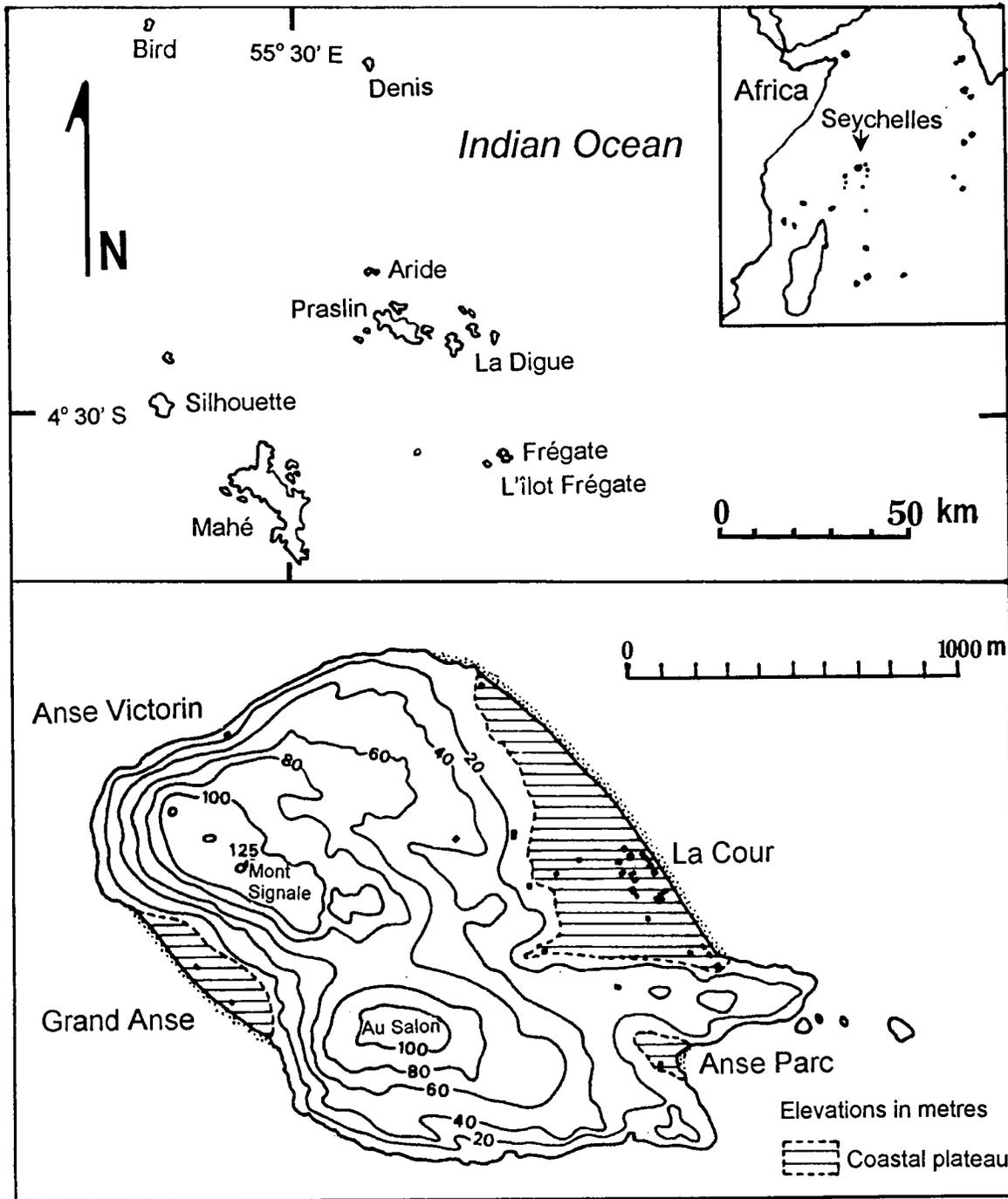


FIGURE 1. Index map showing the location of Frégate Island, Republic of Seychelles. The lower map shows the topography of Frégate Island, based on Robertson and Todd (1983).

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ALAN E. BURGER^{1,2} and ANDREA D. LAWRENCE¹

ABSTRACT

We censused seabirds on Frégate Island, Seychelles, from 4 to 8 August 1999, to monitor changes expected from forest restoration and rat eradication. Lesser Noddies (*Anous tenuirostris*) nested in mixed woodland, scattered alien and native trees among plantations and in four clumps of banyan trees (*Ficus benghalensis*). Our count of 7,300 Lesser Noddy nests (95% confidence limit $\pm 1,550$) was almost three times higher than a previous estimate of 2,700 pairs. The actual total in 1999 was probably more than 8,000 nests because some nests had already fallen from trees by the time we did our census. White (Fairy) Terns (*Gygis alba*) were more widespread, nesting principally in mixed exotic woodland, scattered trees among buildings and plantations, sang-dragon (*Pterocarpus indicus*) woodland, and in banyan trees. Our estimate for White Terns was 3,030 nests (95% CL: ± 980 nests), and the year-round breeding population was several times higher. Frégate thus supports one of the largest populations of White Terns in the Seychelles. We found only two nests of White-tailed Tropicbirds (*Phaethon lepturus*) and estimated the total breeding population at less than 20 pairs. A search was made by day and at night for shearwaters, but there was no evidence of their breeding. No other seabirds appear to be breeding on Frégate. We recommend regular monitoring of the noddy and tern populations. Shearwaters and other ground-nesting seabirds are likely to re-colonize Frégate if rats are eradicated.

INTRODUCTION

Frégate Island is generally not considered among the most important seabird colonies in the granitic Seychelles, although there were once large numbers of seabirds breeding there (Rocamora and Skerrett, In Press). Breeding seabirds have been severely affected by over a century of human habitation, removal of indigenous forest, the presence of feral cats and, more recently, rats. The current owner of the island is attempting to restore some of the indigenous forest and a rat eradication program was initiated in 2000. With these changes Frégate might once again become one of the larger

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seabird colonies in the Seychelles. Our study provides baseline data to monitor these changes and to help understand the restoration of tropical seabird colonies.

Three seabird species were known to breed in 1997: an estimated 2,700 pairs of Lesser Noddy (*Anous tenuirostris*), “thousands of pairs” of White (Fairy) Terns (*Gygis alba*), and an unknown number of White-tailed Tropicbirds (*Phaethon lepturus*) (Rocamora and Skerrett, In Press). The small satellite island, L’îlot Frégate, which we did not visit in 1999, supports breeding populations of Sooty Tern (*Sterna fuscata*), Bridled Tern (*S. anaethetus*) and Brown Noddy (*Anous stolidus*). We counted seabirds on Frégate Island over five days, 4-8 August 1999. Although incomplete, our census provides the most detailed account of present seabird populations for this island. We show that Frégate is an important colony for White Terns and appears to have a growing population of Lesser Noddies.

STUDY AREA AND HABITAT DIVISIONS

Frégate Island (4°35' S, 55°56' E) is 202 ha in area, most of which is gently sloping hillside with two hills reaching 125 and 100 m elevation (Fig. 1). The island’s topography, history and vegetation are described by Robertson and Todd (1983), McCulloch (1994, 1996) and Rocamora and Skerrett (In Press). Virtually all of the indigenous forest was removed over the past 100 years and replaced by alien trees, including coconut (*Cocos nucifera*), cinnamon (*Cinnamomum zeylandicum*), cashew (*Anacardium occidentale*), breadfruit (*Artocarpus altilis*), sang-dragon (*Pterocarpus indicus*) planted to support vanilla vines, citrus and other fruit trees. Several huge multi-stemmed banyan (*Ficus benghalensis*) trees grow in the hillside forest and as isolated clumps on the northeast plateau and southwest coast. Thickets of coco-plum (*Chrysobalanus icaco*) shrubs cover most of the open woodland and unforested hillside.

The present owner is reestablishing native trees in parts of the forest, but nearly all the forest remains dominated by alien crop trees. Most of the lowland coastal plateau is used for agriculture, buildings, roads and service areas, but many large trees in this area support nesting terns and noddies. Feral cats (*Felis catus*) almost certainly affected seabirds on Frégate, especially ground-nesting species, before they were eradicated in 1982 (Watson et al. 1992). Norway rats (*Rattus norvegicus*), which were accidentally introduced to Frégate in 1994, likely had similar impacts. Rats were widespread and abundant in 1999, but a program to eradicate them was underway in mid-2000.

We used the coarse-scale habitat map made by McCulloch (1996) modified by our own measurements and field observations (Fig. 2). We could not accurately map or estimate the areas of the various habitat patches due to the absence of aerial photographs. When better estimates of habitat patch size are possible from a high-quality aerial photograph, our estimates of nest density can be reapplied to give more accurate measures of seabird populations. Our preliminary inspection, along with the experience of James Millett, the resident biologist on Frégate, suggested that very few or no seabirds nested in the large areas of scrub/grassland or the riverine bamboo. White Terns nested in very low densities in the disused coconut plantation but we did not have time to sample

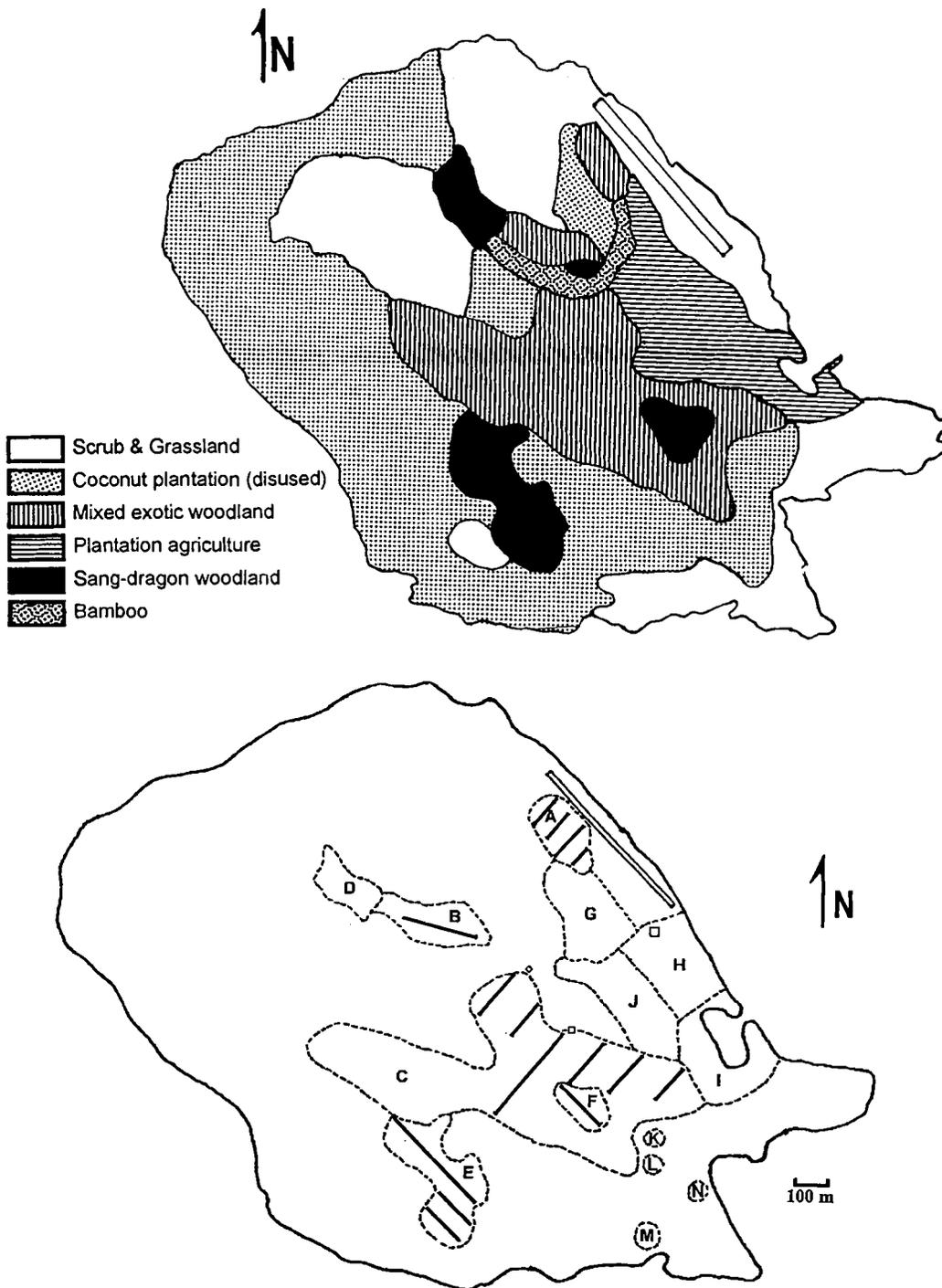


FIGURE 2. The upper map shows the distribution of the major habitat types on Frégate Island (modified after McCulloch 1996). The lower map shows the blocks of habitat sampled for seabirds in August 1999, including mixed exotic woodland (areas A-C), sang-dragon woodland (areas D-F), plantation, hotel and service areas on the plateau (areas G, H, I and J); and isolated clumps of banyan trees (areas K, L, M and N). Transect lines used for locating sample plots in woodland habitats are also shown.

this widespread habitat. Likewise, we were unable to check all the scattered albizia (*Albizia falcata*) trees, in which a few White-tailed Tropicbirds nested.

We used stratified sampling, focusing on four habitat types: mixed exotic woodland (Fig. 2, areas A, B, C); sang-dragon woodland (areas D, E and F); plantation, hotel and service areas on the plateau (areas G, H, I and J); and isolated clumps of banyan trees (areas K, L, M and N). McCulloch (1996) classified the woodland near the airstrip (Fig. 2: area A) as sang-dragon woodland, but our sample plots here included a diversity of tree species and so we classified this as mixed exotic woodland. The density of White Terns was higher here than on the hill slopes and so was treated separately.

SAMPLING METHODS

Census units – For Lesser Noddy we counted all nests, whether occupied or not. At the time of our census some noddies had already lost eggs or chicks and it was impossible to determine the original number of active nests. Most noddy nests were high in trees making it impossible to see their contents. For White Terns we counted chicks and incubating adults (evidence of the egg was usually obvious from the hunched, immobile posture of the adult and the pouching of the breast feathers over the egg) to get the number of active pairs.

Census Methods Used for Terns and Noddies.

Plot sampling – This method was used in the mixed exotic woodland and sang-dragon woodland. We estimated the density of nests within representative sample plots and then applied the mean density to larger areas of habitat to estimate the total number of nests. All nests were counted within 300 m² circular plots (radius 9.77 m) with the plot centers randomly spaced along transect lines. The first plot was placed 10-30 m from the habitat edge to ensure that it was entirely within the sampled habitat. To avoid overlap, the subsequent plots were placed 20-40 m apart. The actual distances between plots were determined by computer-generated random numbers within these intervals. Transect lines followed fixed compass bearings (NE to SW, or NW to SE) and were 50 m apart in exotic woodland area A and in sang-dragon woodland areas E and F, but 100 m apart in the larger exotic woodland area C (Fig. 2). To sample the narrow strip of mixed woodland in area B, we followed the path from the ridge crest to the lower road, with plots placed 20-40 m apart along the path and 10-30 m perpendicular to the path on alternating sides (left or right) of the path.

Direct counts – Plot sampling was not suitable for counting nests in the scattered trees in the plantation/hotel area (Fig. 2, areas G-J) nor in the banyan clumps (areas K-N). Here we counted the nests in each individual tree.

RESULTS

Lesser Noddy – Lesser Noddy nests were found in three areas: within the mixed exotic woodland bordering the airstrip (Fig. 2, area A); on scattered trees on the NE plateau among the buildings and service areas (areas G-J), particularly around the marina; and in four clumps of very large banyan trees and nearby *Pisonia grandis* trees (areas K-N). No

noddy nests were seen in the mixed exotic woodland, sang-dragon woodland or the disused coconut plantation on the hillside.

A total of 7,302 nests of Lesser Noddies were found (Table 1). Most nests were from direct counts involving no confidence limits, but the small area of woodland sampled had 95% confidence limits of $\pm 1,545$ nests (858.3 nests per ha \times 1.8 ha). The estimated population (rounded to the nearest 10) was thus $7,300 \pm 1,550$ nests.

White Tern – White Terns were more widespread than the Lesser Noddies (Table 1), occurring in the mixed exotic woodland (1,601 nests), sang-dragon woodland (793 nests), plantation/hotel area (564 nests) and banyan clumps (68 nests). Overall, a total of 3,026 nests were counted. The combined 95% confidence limit for the three habitats in which plot samples were used (plateau mixed woodland, hillside mixed woodland and sang-dragon woodland) was calculated from the standard deviations in each habitat, using the habitat areas for weighting and the method outlined in Sutherland (1996:101-105). The resulting 95% confidence limit was ± 977 nests. There were no confidence limits for the direct counts in the plantation/hotel area and banyan clumps. The rounded estimate of White Tern nests in the areas surveyed was thus $3,030 \pm 980$ nests. Since White Terns breed all year round, the current breeding population represents only a portion, likely less than half, of the total year-round breeding population. This total is thus likely to exceed 6,000 pairs.

White-tailed Tropicbird - We saw two tropicbird nests. One was 3 m high in a cavity on top of a large stump at the edge of vegetable gardens on the northeast plateau. The second was in a cavity 4 m high in a large red sandalwood (*Adenanthera pavonina*) tree, on the ridge in area B (Fig. 2). Both nests were found only because the adults' tails were visible. Other nests, especially those with chicks, would not be as readily visible and there were probably some in the large banyan trees. Judging by the number of nests found, the availability of suitable nest sites and the numbers of adults flying over the island, we estimate that the total breeding population is less than 20 pairs. After our visit one pair attempted nesting on the ground among the hotel buildings but failed (J. Millett, pers. comm.). Widespread ground nesting, as used by the majority of tropicbirds in the Seychelles, is unlikely until rats are removed from Frégate.

Shearwaters and other seabirds – We made intensive searches of the grassy slopes and rocky areas of both peninsulas on the southeast end of the island and on the hilltop at Mont Signale (Fig. 1). These are habitats in which Wedge-tailed Shearwaters (*Puffinus pacificus*) and Audubon's Shearwaters (*P. lherminieri*) might nest. We also searched the peninsulas at night using head lamps and listened for calls. We found no signs of nesting shearwaters. There were signs of burrowing beneath some large boulders and in a few grassy spots but these were obviously made by rats and not shearwaters (evidence of rat droppings, no distinctive shearwater smell, and no response to imitated shearwater calls). A few Wedge-tailed Shearwaters were seen by day flying past the island. In November and December 1999, during the northwest monsoon breeding season, J. Millett heard Wedge-tailed Shearwaters calling over the forest at night and found several on the ground, but no nests.

Table 1. Estimated number of Lesser Noddy and White Tern nests in census areas on Frégate Island in August 1999. See Fig. 2 for habitat areas.

Map	Habitat area	Location	Habitat area (ha)	Lesser Noddy		White Tern	
				Nest density (Nests/ha)	Total nests	Nest density (Nests/ha)	Total nests
Mixed exotic woodland							
A		Plateau at airport	1.8	770.8	1387	175.0	315
B		Slope near staff housing	2.5	0	0	55.9	140
C		Slope above garden fields	20.5	0	0	55.9	1146
Total mixed exotic woodland			24.8	-	1387	286.8	1601
Sang-dragon woodland							
D		Slope above new hotel	1.6	0	0	111.7	179
E		Slope near Au Salon	4.3	0	0	111.7	480
F		Slope near Anse Parc	1.2	0	0	111.7	134
Total sang-dragon woodland			7.1	-	0	335.1	793
Hotel/Plantation							
G		NW of Plantation house	-	-	443	-	111
H		Plantation house to marina	-	-	415	-	196
I		Marina area	-	-	2530	-	177
J		Trees around fields	-	-	428	-	80
Total hotel/plantation			-	-	3816	-	564
Banyan clumps							
K		Pirate's Wall	-	-	579	-	3
L		Near Pirate's Wall	-	-	116	-	4
M		Anse Coup de Poing	-	-	1069	-	33
N		Anse Parc	-	-	335	-	28
Total banyan clumps			-	-	2099	-	68
TOTAL ALL AREAS					7302	3026	
± 95% confidence limits (see text)					1545	977	

There was no evidence that any other seabirds nested on the island. Brown Noddies and Sooty Terns were seen on a few occasions passing near the island but these were likely from L'îlot Frégate or some other colony.

DISCUSSION

Our five-day visit was insufficient to make a detailed inventory of the seabirds on Frégate, but our survey included all of the Lesser Noddy nesting areas and most of those of White Terns. We were unlikely to have missed any concentrations of nesting seabirds. The disused coconut plantation, which we did not sample, supported some tern nests, but based on our observations of the habitat and the number of terns seen in and over that habitat, the total there was less than 200 pairs. We almost certainly missed some White-tailed Tropicbird nests because those high in the trees would be very difficult to see but, based on the numbers of adults seen flying overhead, the total population seems likely to be around 20 pairs at most. Other seabird species appeared to be absent from Frégate.

Our results show that Frégate has a more important seabird colony than previously expected. Our count of Lesser Noddy nests ($7,300 \pm 1,550$) is almost three times higher than a previous estimate of 2,700 pairs (Rocamora and Skerrett, In Press). This estimate seems to be based on unpublished counts of nests made by C. Murray and M. Nicoll in late August to early September 1997 (Frégate Island unpublished data). Their count was made several weeks later than ours and this partly explains the lower count in 1997. Lesser Noddies nest synchronously in Seychelles and there is very little replacement of lost eggs or fallen nests. It is not possible to determine from Murray and Nicoll's notes whether they covered the same areas as we did. Our census was made when many noddy nests had already fallen off the trees so the maximum count in 1999 was likely more than 8,000 nests. This was considerably less than the large Lesser Noddy colonies elsewhere in the Seychelles, on Aride Island (108,000-166,000 pairs in 1996-1998; Betts 1998, Bowler and Hunter 1999), Cousin Island (82,000 pairs in 1999; Burger and Lawrence, unpublished) and Cousine Island (60,000 pairs in 1999; G. Wright, pers. comm.). Nevertheless, our data show that the Frégate colony is worth monitoring. There is no shortage of nesting habitat on Frégate and the colony could easily increase manyfold.

Frégate is even more important as a colony for White Terns. A comparison of the number of nests per census on Frégate and other colonies on the granitic Seychelles is given in Table 2. Comparisons of White Tern populations are difficult because the species nests year-round in Seychelles, and hence the total breeding population is much larger than a count made at any one time. The proportion breeding at any single point in time is unknown. Comparing these "snapshot" counts is a more precise way to compare islands than using extrapolations of such counts to year-round populations. This comparison shows that Frégate has a population of White Terns similar to that of Aride, and larger than the populations on Cousin and Cousine Islands. Clearly, Frégate must be included in any consideration of the White Terns in Seychelles. Our census should be repeated at other times of the year to get a better idea of the year-round breeding density.

Our impression, having observed White Terns on several of the Seychelles islands, is that chicks on Frégate were more frequently fed large prey items (usually a single flying fish or other species) than on these other islands. Frégate is the easternmost of the granitic islands and the White Terns there might be exploiting different prey stocks than those from the more central islands. We were also surprised at the high density of White Tern nests in localized areas on Frégate, particularly in breadfruit and other trees among the buildings and the plantation on the northeast plateau. Several dozen nests

were often visible from one point. Clearly this would make an excellent study site for this species.

Table 2. Comparison of populations of White Terns on four granitic islands in the Seychelles. Each count is the breeding population at the time of the census and not the year-round total of breeders.

Island	Year	Month	No. of nests	95% confidence limits	Source
Frégate	1999	Aug	3030	980	This study
Aride	1996	Jan/Feb	6795	1424	Betts 1998
Aride	1996	Jun	1945	536	Betts 1998
Aride	1997	Jan	5040	1371	Betts 1998
Aride	1997	Jun	1686	561	Betts 1998
Aride	1998	Jan/Feb	3204	797	Bowler and Hunter 1999
Aride	1998	Jun	1664	539	Bowler and Hunter 1999
Mean for Aride			3389		
Cousin	1989	Mar/Apr	2512	-	Braat et al (1989)*
Cousin	1990	Feb	1751	-	Den Boer and Geelhoed (1990)*
Cousin	1999	May	1079	242	Burger and Lawrence (unpubl.)
Cousin	1999	Jun/Jul	1405	251	Burger and Lawrence (unpubl.)
Cousin	2000	Feb	3606	709	Burger and Lawrence (unpubl.)
Mean for Cousin			2071		
Cousine	1999	Jul	1278	282	G. Wright and K. Passmore (unpubl.)

*The means for Cousin in 1989 and 1990 were recalculated from the raw data in these two reports, and not using the erroneous methods used by the authors.

There are few previous data on the seabirds of Frégate. Stoddart (1984) and Diamond (1994), respectively, refer to 24,000 and 15,000 pairs of Brown Noddy nesting on Frégate in 1955, but these figures almost certainly refer to the population on nearby L'îlot Frégate, where Rocamora and Skerrett (In Press) give the combined total of Brown Noddies and Sooty Terns as more than 25,000 pairs.

CONCLUSIONS AND FUTURE WORK

Our brief visit showed that Frégate supports significant breeding populations of Lesser Noddies and, especially, White Terns. Frégate should no longer be ignored as a

seabird colony in the granitic Seychelles. If the habitat management at Frégate proceeds as planned, with eradication of rats and reforestation with indigenous trees, then Frégate will become more suitable for these and other seabirds. Ground- or burrow-nesting species, such as Brown Noddy, Bridled Tern, Sooty Tern, Wedge-tailed Shearwater and Audubon's Shearwater are likely to colonize the island and tropicbirds will increase. We recommend regular monitoring of the existing seabird populations plus continued searching for evidence of other seabirds. L'îlot Frégate should be included in future censusing and monitoring. Monitoring the changes in seabird populations caused by habitat restoration or the removal of alien predators is important in evaluating the benefits of these procedures and in understanding the losses caused by earlier human interference.

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