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The Ecology of the Sea Birds of Aldabra

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The ecology of the sea birds of Aldabra

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1. Introduction

This paper summarizes the results of investigations into the numbers, distribution, breeding and moulting seasons and food of all the species of sea bird known to breed on Aldabra, and briefly records the non-breeding species seen. This is a preliminary progress report only; a fuller treatment of the ecology of the sea bird community is in preparation. The work reported here was carried out from September 1967 to late March 1968 on the Royal Society Expedition to Aldabra; later work, from March to September 1969, will be referred to only in passing.

Counts of breeding species are given in table 1, and the locations of colonies of frigate birds, boobies and colonial terns are shown in figures 1 and 2. Place names mentioned in the text will be found on the place name map in this volume, Stoddart, p. 632.

Table 1. Census results and population estimates

species	census result	units	time of count	category counted	estimated population: breeding pairs	estimated population: total birds
Phaethon rubricauda	870	occupied nests	half breeding season only	breeding pairs	1800	?
P. lepturus	1380	occupied nests	half breeding season only	breeding pairs	2000	?
Sula sula	3800	occupied nests	part breeding season only	incubating birds	5000	12 000
Fregata minor	3850	all fledged birds	nesting peak	birds on trees in colony	?	30 000
F. ariel	6700	all fledged birds	nesting peak	birds on trees in colony	?	
Hydroprogne caspia†	9	breeding pairs	nesting peak	breeding adults	10	25
Sterna sumatrana	50	occupied nests	nesting peak	breeding adults	70	160
Thalasseus bergii†	54	occupied nests	nesting peak	breeding adults	60	150
Anous stolidus	823	occupied nests	nesting peak	breeding adults	1500	3500
Gygis alba	—	—	nesting peak	breeding pairs	300	750

† Census made in 1969 season.

2. Breeding species

Audubon's Shearwater

Audubon's Shearwater *Puffinus lherminieri* has not previously been recorded from Aldabra or its immediate area. The five specimens collected in 1967–8 show plumage characters identical with the population nesting in the Seychelles, but their bill measurements are in the zone of overlap between Seychelles birds and the Mascarene population (*P. l. bailloni*) (C. Jouanin, personal communication).

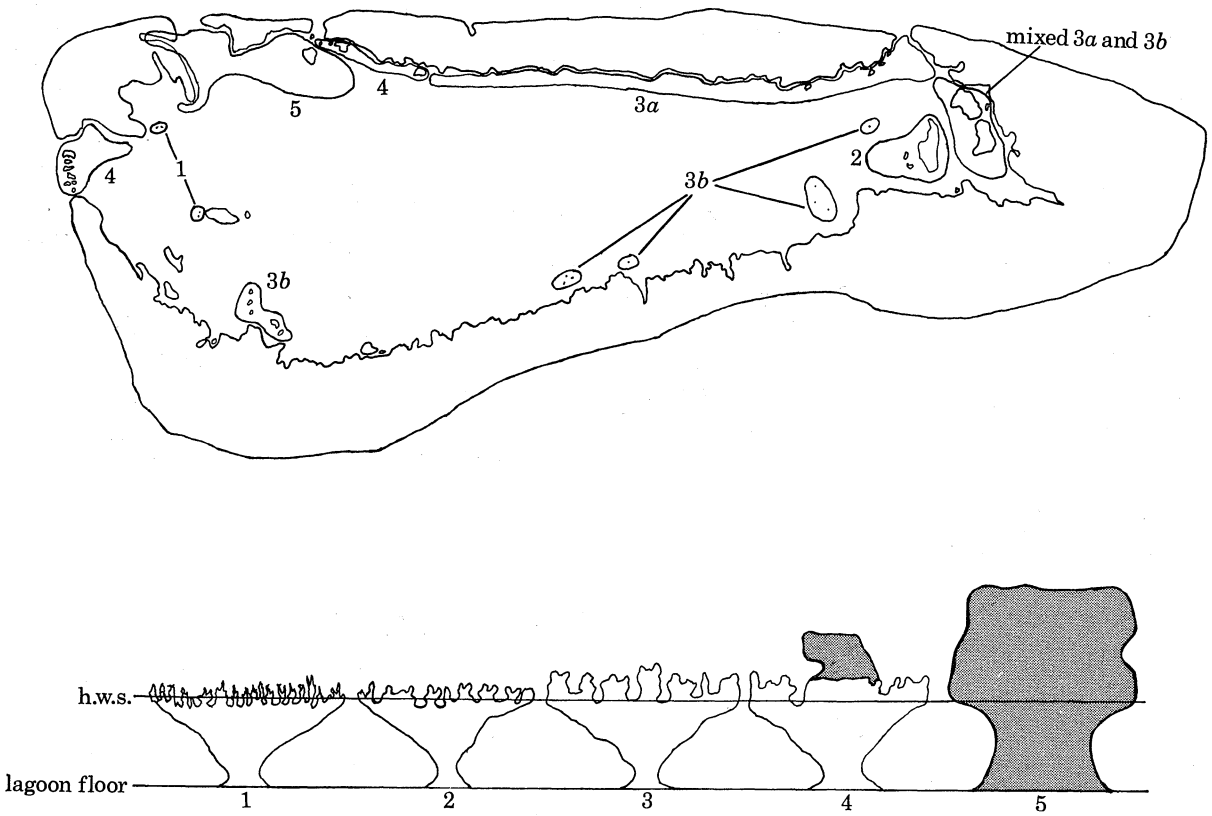

Figure 1. Diagram of islet types with sketch map of their distribution.
□, reef limestone 'champignon'; ▦, poorly consolidated coral debris.

Nests were found on islets in Passe Femme, Passe Gionnet and near East Channel; the species is probably abundant on Aldabra, nesting on islets throughout the lagoon, but very few nests could be reached because they were situated in very small solution holes. An egg and a nearly fledged chick were found in October, two young chicks in December, and a fresh egg in March, so laying is evidently widely spread. The stomach contents of the birds collected consisted entirely of very small squid beaks; birds were seen near the atoll only at dusk and dawn so they presumably feed out of sight of land.

Tropic birds

Distribution and numbers

The Red-tailed Tropic Bird, *Phaethon rubricauda*, and the White-tailed or Yellow-billed, *P. lepturus*, both nested on small islets in the lagoon; their apparent absence from the main islands of the land rim may be due to the presence of rats on the larger islands.

Although the two species overlapped considerably in their choice of nest site, the larger species, *rubricauda*, preferred to nest on flat ground under bushes, while *lepturus* usually occupied solution holes below the rock surface. The lagoon islets could be classified into three major and two minor types, on the basis of their rock structure, each type offering different proportions of the two kinds of nest site. These islet types are illustrated diagrammatically in figure 1, which also shows their distribution. Type 1 consists of low-level, extremely dissected 'champignon' limestone islets of very restricted distribution, and no tropic bird nests were found on islets of this type. Islets of type 2, found only in the area extending about 2 km west of Ile Michel, are more massive and less dissected, but still of sufficiently low level (relative to high-water springs) to endanger the nests even of surface-nesting birds (e.g. Brown Noddy, *Anous stolidus*) so, not surprisingly, very few tropic birds nested on these islets. Most islets are of type 3, composed of relatively thick champignon, occasionally with a flatter platin-like surface; the islets along the north coast of South Island tend to rise rather higher above h.w.s. than those along the Middle Island shore and are separated as type 3*b*. Type 4 islets have a basal layer of champignon capped with remnants of an upper layer of poorly consolidated limestone composed largely of coral debris; the islets south of Passe Gionnet are composed entirely of this latter rock type, frequently capped by solution pans and rising to 1.5 or 1.8 m above h.w.s. (type 5).

Some islets of each of the three major types (3 to 5) were visited at approximately monthly intervals to follow the progress of marked tropic bird nest-sites. Type 5 islets were found to be favoured by *rubricauda*, types 3 and 4 by *lepturus*; on type 4 the junction between the two rock types is frequently undercut and was a favourite nest site for *lepturus*.

By assessing the number of islets of each type in the lagoon, and the average number of nest sites occupied by each species on each islet type, it was possible to estimate the number of each species nesting on the atoll; this method gave about 1380 *lepturus* and 870 *rubricauda* sites. Few sites were used by more than one pair, so these figures are more or less equivalent to the numbers of breeding pairs; however, they are both underestimates, partly because not all sites could be found on each islet searched, and partly because only half the year was covered although both species nest all the year round. Minimum figures for the number of *pairs* nesting in one year are likely to be about 2000 *lepturus* and 1800 *rubricauda*.

Breeding season

The regular monthly visits to marked nests showed that there was no obvious peak of nesting by either species during the period under study. All the birds handled were examined for moult, and only one bird of each species (of 83 *lepturus* and 42 *rubricauda* handled) showed any primary moult while breeding; further observations in 1969 suggested that moult usually alternates with breeding in both species but, where moult and breeding *do* overlap, they do so at the start of the breeding period in *lepturus* but at the end of the breeding period in *rubricauda*.

Food

Regurgitated samples of food were collected from nine adult and ten pullus *rubricauda*, and from twelve adult and two pullus *lepturus*. While both species took mostly flying-fish Exocoetidae and squid Ommastrephidae, *lepturus* took relatively more squid, and smaller specimens of both fish and squid. *P. rubricauda* took larger fish than any other sea bird, and was also unusual in providing three specimens of the pelagic octopod *Tremoctopus violaceus* and shells of several small gastropods characteristic of sandy bottoms in shallow water; these last may have been taken

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by a fish that the bird subsequently ate, as tropic birds generally feed by diving just below the surface, out at sea, and were never seen feeding in sight of land.

Red-footed Booby

Red-footed Boobies *Sula sula* occur in several colour morphs in different parts of their range; some of these morphs are described by Nelson (1968, 1969). All the adults seen on Aldabra were of the white morph, except for one brown morph seen at Gionnet in 1967 and one seen, and later caught, near East Channel in 1969; this latter bird was intermediate between Nelson's 'BPS' and 'I' morphs, in being brown with a white tail and rump and prominent white scapulars.

Distribution and numbers

Boobies nested in mangrove trees, frequently among frigate birds but also apart from them; the largest numbers were in Main Colony (between Ile Vert and East Channel), in Bras Takamaka (including Bras Cinq Cases and Bras l'Eglise) and Passe Gionnet; smaller numbers nested at Camp Frigate, Bras Grand Poche (West Island), Gros Ilot Cavalier and Ile aux Cèdres. The mangrove *Avicennia marina* was avoided but all the other common species were used.

Smaller colonies were counted completely, but Main Colony was sampled by counting the birds in randomly chosen counting strips of 200 m of coastline covering altogether two-fifths of the colony. The number of nests was not counted directly, because this required a close approach which would have caused great disturbance among the frigate birds which commonly nested among the boobies, but was estimated as follows; all the boobies visible on the trees were counted, followed by a count of those birds that could clearly be seen to be on a nest plus those that were clearly *not* on a nest. This ratio of nesting to not-incubating birds was then applied to the total count of adults to estimate the number of birds on nests at the time of the count. The number of incubating birds was thus estimated at 3800, out of a total of 6000 adults and 900 immatures. This is an underestimate of the number of pairs, as chicks were not included in the count; the number of pairs nesting between September 1967 and March 1968 was probably between four and five thousand.

Breeding season

Two nesting colonies (in Bras Takamaka and Main Colony) were counted once in October/November 1967 and again in January/February 1968; on each occasion the number of nests was also estimated as described above. In addition, chicks in both colonies were measured and their age estimated from the bill length; using both these methods in each colony, it appeared that there were three laying peaks in Main Colony in early November, early January and mid-March, and at least one laying peak in Bras Takamaka, in August/September 1967.

Of 58 breeding adults examined for moult, 44 were in active primary moult showing that although primary moult may slow down during breeding it does not cease altogether.

Food

Regurgitated food was collected from eight pullus and 17 adult boobies; the species composition and size of the food items were very similar to those of the two species of frigate bird although the boobies took rather more small squid than the frigates.

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Frigate birds

Distribution and numbers

Two species, the Great Frigate Bird, *Fregata minor*, and the Lesser, *F. ariel*, breed on Aldabra, in four major colonies; a mixed colony of *F. minor* (about 3300 birds) and *F. ariel* (5800 birds) on the SE coast of Middle Island between East Channel and Ile Vert ('Main Colony'), two colonies of *F. minor* at Gionnet (*ca.* 350) and Camp Frigate (*ca.* 200) and one of *F. ariel* (*ca.* 900) in Bras Takamaka. In the smaller colonies, a total count was made; Main Colony was sampled by counting randomly chosen 200 m strips of coastline covering two fifths of the colony, as described for Red-footed Boobies.

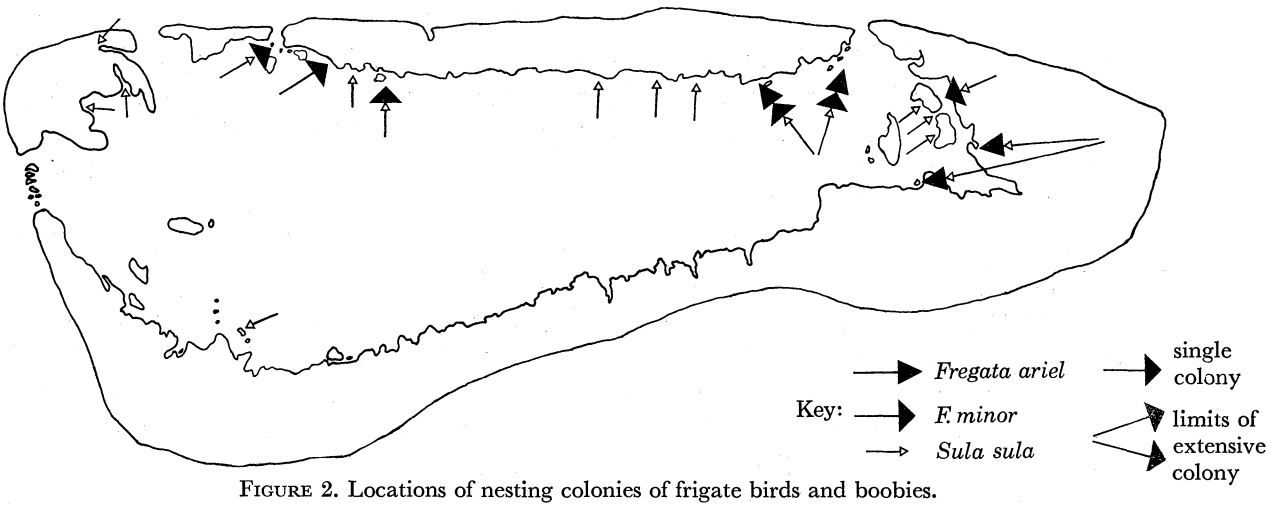

FIGURE 2. Locations of nesting colonies of frigate birds and boobies.

These counts include only those birds sitting on the trees in the colony at the time of the count; they do not include the birds soaring over the colony, as large numbers do in the early part of the season, or birds which were away from the colony at the time of the count. Birds soaring over one part of the Main Colony were photographed and later counted from the negatives; in this particular area, in late October, the total number of birds was about 1.7 times the number of birds on the trees. If this factor is applied to all the colonies it gives a figure of about 19000 birds present in the nesting areas in October; the number of birds still not included in this figure—adults feeding at sea or soaring over other parts of the atoll, and immature birds dispersed at sea—can only be guessed at, but the total population of the atoll probably exceeds 30000 birds. (This 'grand total' is necessarily speculative but is justified by the general interest aroused in the number of frigate birds by the proposal to build an airfield on Aldabra; such a large population of frigate birds would clearly have been a hazard to these aircraft had this proposal been carried through.)

Breeding season

Both species were displaying and laying in large numbers in September 1967; observations later that year, and in 1969, showed that laying extends from June to December but is concentrated between August and October. The long incubation and fledging periods, and the protracted period for which the parents continue to feed their young after they have fledged, mean that the parents are occupied for a year or more in rearing their young: moult alternates with

breeding (none of the breeding adults handled were in primary moult), so that birds which succeed in raising a chick in one season cannot complete their moult in time to breed again in the next but must wait until the next season but one. Attempts to establish this point with marked birds were unsuccessful, due partly to loss of the plastic wing-tags used and partly to desertion by some of the marked birds.

The marked drop in the numbers of birds present in the colonies between November and July indicates that non-breeding birds and failed breeders probably leave the atoll then. Young birds of all ages are seen around the colonies throughout the year, but there is probably a considerable dispersal of immatures after they have been abandoned by their parents.

Food

Frigate birds have been widely accused of obtaining most of their food by robbing other species, particularly boobies. Such behaviour is extremely conspicuous around breeding colonies but cannot be regarded as providing a major source of food for the Aldabra population, if only because frigates far outnumber boobies. Also such attacks are rarely successful; of 55 attacks whose result could be clearly seen, only ten resulted in a frigate bird taking in food released by its victim. Most of the attackers were females, usually *F. minor* (49 out of 82 birds identified). Frigates would also attack each other, but only for nest material; males, which collected most of the nest material in both species, were usually responsible for these attacks.

All these observations were made on the atoll, mostly at East or West Channels, and it is of course possible that frigates are much more successful when attacking boobies over the open sea; however the larger population of frigate birds still argues against such piracy providing a major source of food for the Aldabra population as a whole.

Food samples were collected, by regurgitation, from 16 *F. minor* pulli, and from 19 adult and 33 pullus *F. ariel*; flying-fish, Exocoetidae, and squid, Ommastrephidae, made up the bulk of these samples, with occasional stomatopod crustacea (*Squilla investigatoria*) and small gastropods (*Ianthina* sp). Despite the great difference in size of the two species of frigate bird, the food samples obtained from them were very similar in both the species composition and the size of the food items.

In all aspects of these species' ecology which were investigated—choice of nest site, breeding season, and feeding—they were remarkably similar, and further work in 1969 confirmed most of the similarities without revealing any major differences.

Caspian Tern

Caspian Terns, *Hydroprogne caspia*, did not nest during this study, but were found nesting on Iles Esprit and Moustique in July 1968 by J. Frazier and R. N. Hughes (personal communications). In 1969 eight pairs nested, one on Ile Esprit and seven on Ile Moustique, between April and August, and a further pair made several nest scrapes on Ile Michel. This species was previously known in this area only from sight records on Astove and Cosmoledo (Benson 1967), but probably also breeds on Astove (J. Frazier, personal communication, and personal observation).

Black-naped Tern

Distribution and numbers

Black-naped Terns, *Sterna sumatrana*, nested on small islets in all parts of the lagoon (but most densely in West Channels), usually singly but occasionally in groups of two or three pairs

on the same small islet. This was the only species which regularly laid more than one egg; of the 28 nests found, 10 contained two eggs or young and the rest one only. The total breeding population of 50 pairs was estimated, as for tropic birds, by islet type choice; the total is probably higher than this but is unlikely to exceed 70 pairs.

Breeding season

Laying was concentrated between mid-January and early February; Gaymer's (1967) record of an egg in November, and my own observations in 1969, indicate that laying was unusually concentrated in 1968 and may more often be spread throughout the wet season (November to March). One adult caught on an egg was moulting one primary in each wing, as were two others collected at a roost during the peak laying period.

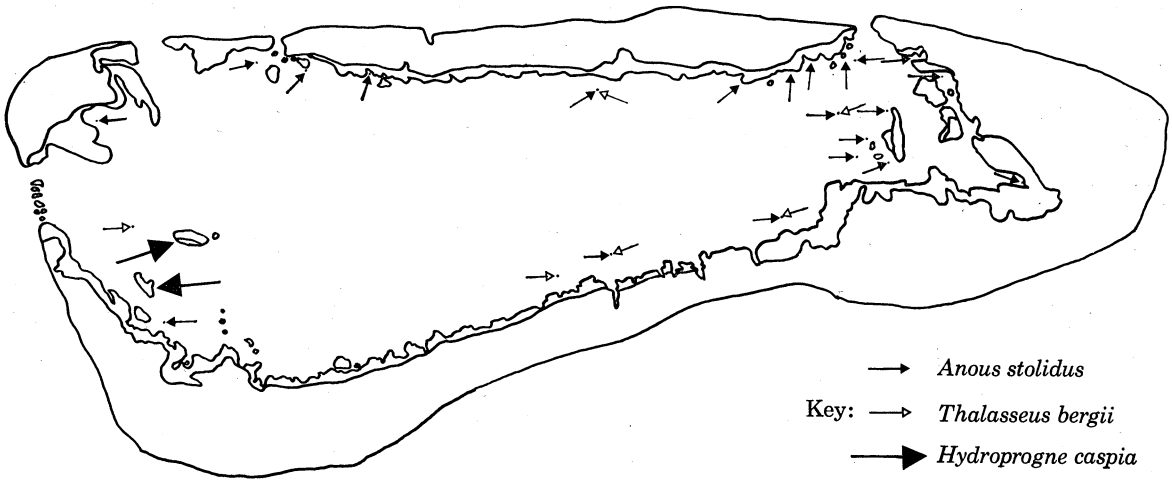

FIGURE 3. Locations of nesting colonies of terns.

Food

Black-naped Terns were seen feeding in the lagoon and over the seaward reef-front (see also under Crested Tern), invariably taking small silver fish about 3 to 6 cm long. Chicks did not regurgitate, but one adult disturbed on its nest brought up four fish, 3 to 6 cm long, on one occasion, and three of 3.5 to 4 cm length on another.

Crested Tern

Distribution and numbers

Crested Terns, *Thalasseus bergii*, were commonly seen roosting, on sand flats at low tide and lagoon islets or pebble beaches at high tide, throughout this study; assuming that birds do not move between roosts the numbers were estimated at 80 to 100 birds. A breeding census in 1969 found about 54 pairs nesting.

Breeding season

Two chicks were found on Iles Chalen in February 1968, from eggs laid in mid-January; however, R. S. Lowery and J. Frazier (personal communications) found 16 nests on Table Ronde in July 1968. My own observations in 1969 confirmed that laying was concentrated in

July, on Mentor, Champignon des Os, Table Ronde, Cézanne and a small islet near Ilot Deder. Whether the two pairs which laid on Iles Chalen in January 1968 were simply aberrant in laying out of season, or whether laying is commonly at 6-month intervals, is not clear; Gaymer (1967) records a local rumour that young were commonly taken from Iles Chalen for food, so wet-season laying may be a regular occurrence.

Food

Crested Terns fed almost exclusively in shallow water, usually over beds of the grasses *Thalassia* and *Cymodocea* on reef-flats but occasionally over mud on the south shore of the lagoon. On several occasions up to 10 *T. bergii* and 30 to 40 *S. sumatrana* were seen feeding in the lagoon around East Channel on a rapidly falling tide, but the two species were clearly feeding in different zones; *T. bergii* in the shallow water over the *Thalassia*/*Cymodocea* beds and *S. sumatrana* in deeper water over coral between the grass beds and the steep edge of the channel itself.

Two samples collected by regurgitation from *T. bergii* chicks in 1968, and further observations in 1969, showed that the fish taken were reef or lagoon species and were much larger than those taken by *S. sumatrana*, i.e. up to 12 cm in length.

Brown Noddy

Distribution and numbers

Brown Noddies, *Anous stolidus*, nested on small islets throughout the lagoon but, unlike the two tropic birds and the Black-naped Tern, were not dispersed over the available islets but were highly aggregated into dense, conspicuous colonies. The nesting colonies were usually on low champignon islets; these were often barer than most islets of the type but several showed a strong growth of *Achyranthes* sp. that was probably promoted by the birds' guano.

The census was made not by sampling the different islet types but by making a specific search for colonies and counting the number of occupied nest sites at least once at each colony. The maximum counts at 20 colonies added up to 823 occupied nests; allowing both for a few small colonies being overlooked, and for the fact that a single count will not include all the birds that nested at the colony during the season, 1000 pairs seems a reasonable figure for the population. This is about half the number of birds counted at the main roost on the island, on Polymnie, in September 1967; my observations in 1969 suggested that there were more birds nesting than in 1967–8, so the breeding population may reach 1500 pairs.

Both during and outside the nesting season, many birds roosted away from the colonies; the major roosts were on Polymnie, in southern West Channels, and on islets around Passe Gionnet and Ile Michel.

Breeding season

A very few eggs were found between September and November 1967, but the main peaks of laying were between early December and early March, different colonies showing slightly different peaks. Some of the later laying peaks were undoubtedly due to relaying after the loss of the first egg; many eggs were lost to high spring tides backed by strong winds, and perhaps also to human predation.

Most birds began their primary moult while still breeding, and appeared to complete it in the roosts after the breeding season; Dorward & Ashmole (1963) and M. P. Harris (personal communication) also found that Brown Noddies began to moult while still nesting, on Ascension and in the Galapagos respectively.

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Food

Noddies were occasionally seen feeding among breakers over the reef edge, and quite often a mile or so out to sea in mixed flocks with boobies, frigates, White and Sooty Terns. Very few food samples were obtained by regurgitation from chicks, but a few small fish and squid were collected.

White Tern

White or Fairy Terns, *Gygis alba*, nested solitarily in mangroves in many parts of the atoll. Favoured areas were the Main Colony around East Channel, and Ile Esprit; they were not found in Bras Takamaka or along the south shore of the lagoon. Only one area, in Main Colony, was searched intensively for White Terns, which were found to be nesting at a density of about 20 pairs per kilometre of coastline. This was the highest density found and, if maintained all along the coast of Middle Island, would give a population of about 340 pairs there. Allowing for perhaps 30 pairs on Ile Esprit and a few known to nest in *Casuarina* trees on the north coast, would give about 400 pairs on the atoll; however the 340 pairs on Middle Island is known to be an over-estimate so the total population is unlikely to exceed 300 pairs.

Breeding season

A few eggs were found between September and November 1967, but most were laid in December and January. Very few were found in 1969, and those at the beginning of the visit, so it is safe to conclude that laying is concentrated in December and January with little activity outside those months. White Terns were conspicuous in all months and probably do not leave the atoll outside the breeding season.

Seven nesting adults were examined but none were moulting, indicating that moult alternates with breeding as it does on Christmas Island (Ashmole 1968) and Ascension (Dorward 1963).

Food

White Terns were very rarely seen feeding, and then only outside the reef at sea, although birds were commonly seen carrying small silver fish across the lagoon; no chicks or adults regurgitated when handled.

3. Non-breeding species

Blue-faced Booby (Sula dactylatra)

A single adult was seen in the lagoon on 3 January 1968, by P. Grubb. Immatures of this species can be confused with immatures of *S. leucogaster* and may possibly have been overlooked. Morris (1964), in a list of birds seen at Aldabra in January and February 1962, describes this species without further comment. The nearest breeding station is probably Cosmoledo; Blue-faced Boobies used to breed on Assumption (Nicoll 1906), but that island has since been devastated by guano diggers and is probably no longer suitable (Vesey-Fitzgerald 1941).

Brown Booby (Sula leucogaster)

Single adults were seen regularly between September 1967 and July 1968, usually off the seaward coast but also on three occasions among the mangroves near Middle Camp. The only previous record is of one seen in March 1964 (Bourne 1966), but this species is clearly a regular visitor. An adult, apparently overladen with fish, was caught at sea off Middle Island on

28 January 1968; the wing length of 425 mm is longer than any male and all but one of the females measured by Gibson-Hill (1950) on Cocos-Keeling Island and so the bird was presumably a female. It was nearing the end of primary wing moult and was in mid tail moult. It is not possible to be certain whether or not this bird was breeding; Dorward (1962) found that Brown Boobies on Ascension Island usually stayed away from the island outside the breeding season but that active moult was not restricted to the non-breeding period. The nearest known breeding station is on Desnoeufs Island in the Amirantes.

Great Skua (Catharcta skua)

On 8 March 1968, P. Grubb found the body of a Great Skua washed up on the beach near Settlement. This is the first record of the species for Aldabra, but it has been recorded on the Seychelles where it is 'very rare' (Ridley & Percy 1958). Bailey (1968) recorded it six times between 20° S and the equator, and notes that most previous records are from the northwestern Arabian Sea and off southern India in the period March to December inclusive.

Little Tern (Sterna albifrons)

Flocks were commonly seen between early January and the end of March 1968, usually roosting on sand flats at low tide. Up to 200 birds were probably on the atoll at one time, many of them in immature plumage. It is unlikely that this species would have been overlooked before January if it had been present in similar numbers, but Gaymer (1967) records 100 seen in November. Gaymer also quotes local reports that Little Terns bred on the atoll; while this possibility cannot be excluded such reports can be given little weight because the Creole name 'Diament' covers three species of small to medium-sized pale terns including the Roseate Tern *Sterna dougalli* and the Black-naped *S. sumatrana*, the latter breeding commonly and unlikely to be distinguished from the Little. These birds are more probably migrants spending the non-breeding period on the atoll, but their race is in doubt. The palaearctic *S. a. albifrons* is said to winter south to the Seychelles and Aldabra (Witherby, Jourdain, Ticehurst & Tucker 1940) and has the rump grey, the tail white and the legs yellow. *S. a. saundersi* breeds from the Red Sea and East Africa to the Seychelles, Madagascar and the Mascarenes (Alexander 1955), and has the rump and tail grey and brownish-yellow legs. The few birds examined closely in the field on Aldabra had the rump grey, the tail white and yellow legs, so were more probably *S. a. albifrons*, but specimens are needed to confirm this.

Sooty Tern (Sterna fuscata)

In September 1967, flocks of Sooty Terns were commonly seen off the south and west coasts, often with Brown Noddies which appeared to be feeding. J. Frazier (personal communication) recorded them passing over Dune Jean-Louis at night during May, June and July 1968 and saw large movements at Middle Camp on 10 January and 19 May 1968. The nearest breeding colonies are on Cosmoledo and in the Amirantes; the breeding season in the Amirantes is closely tied to the onset of the SE Trades between mid-April and early May (Ridley & Percy 1958) and this is probably also true on Cosmoledo. Sooty Terns were certainly seen at Aldabra more frequently during the Trade Wind period than during the calm season.

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Lesser Crested Tern (Thalasseus bengalensis)

This species was recorded regularly between early January and early April 1968 although, like the Little Tern, small numbers may have been overlooked before this. They were most commonly seen roosting on Ile Esprit (in mangrove trees at high tide and on sandflats at low tide), or on reef flats at low tide; C. W. Benson (personal communication) saw them on the exposed flats north of Dune Jean-Louis in March 1968. They were also seen feeding, singly and in loose flocks, both in the lagoon and outside the reef. There are no certain previous records on Aldabra; the description given by Morris (1964) is equally applicable to the Crested Tern *T. bergii*. The nearest breeding grounds are on the coast of East Africa, where eggs are laid in June and July (Alexander 1955); the birds seen on Aldabra were in off-season dress, with the forehead streaked white, and so were presumably 'wintering' on the atoll.

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