

Pitti

Island

Lakshadweep

AN ORNITHOLOGICAL STUDY



PITTI ISLAND, LAKSHADWEEP

An Ornithological Study

MADRAS NATURALISTS' SOCIETY (Regd.)

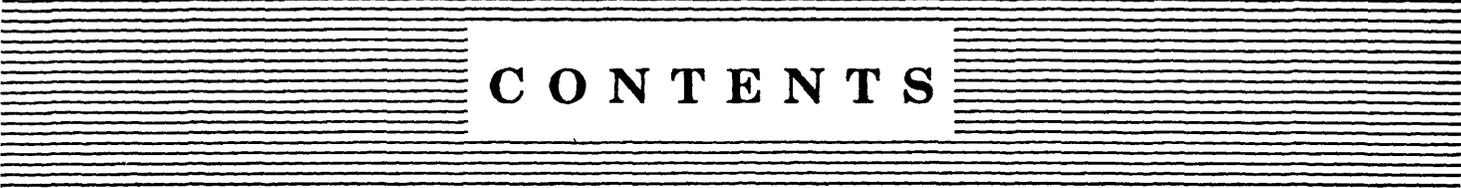
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Dedicated to the memory of Dr.Sálim Ali - pathfinder of field ornithology.

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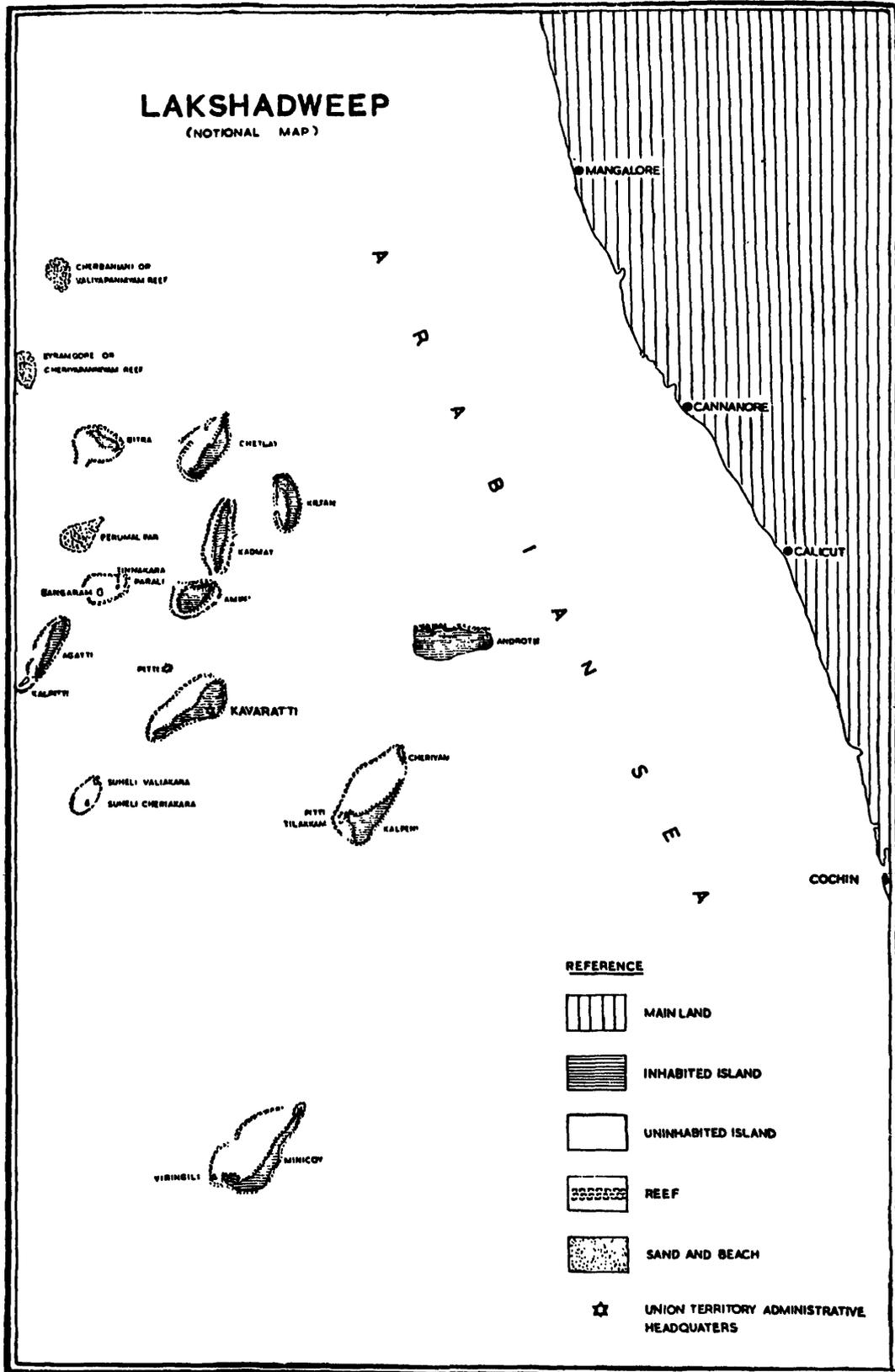


Fig.1
Courtesy - Gazetteer

INTRODUCTION

The Lakshadweep Islands lie about 220-440 km. off the coast of Kerala in the Arabian sea between 08°.00' - 12°.30' N latitude and 71°.00 - 74°.00 E longitude. There are, in all, thirty six islands and a number of sunken banks, open reefs and sand banks. These islands are irregularly scattered in the sea and only ten are inhabited. The total land area of all the islands is 32 sq. kms.

Though the word 'Lakshadweep', by its common use, may appear to mean, 'one hundred thousand islands' the word 'Laksha' in Sanskrit, as well as in Malayalam, has many connotations. The word itself having derived from the root 'lag', a mark or sign especially a mark to aim at. Lying in the trade route between Africa and Malabar, these islands were a landmark for navigation during the days of sailing ships and that was probably why they were known as Lakshadweep.

The islands are formed by the accumulation of coral sand in the form of sandbank with the action of the wind, waves and current. They are flat and only a few metres above sea level. The Lakshadweep atolls like the other coral atolls elsewhere have two important mineral deposits. The phosphate deposits on the islands and the Calcium Carbonate deposits in the lagoons. The phosphate deposits occur on all the islands and these were formed by the birds' excreta or guano long before man had colonised Lakshadweep. Guano deposits are still being actively formed in the Pitti Islands and some soil samples collected there contain 11-15% P₂O₅. The lagoons contain large quantities of almost pure Calcium Carbonate sands. The islands ranging in area from 1 ha. to nearly 440 ha. are little specks in the Indian ocean. They are beautiful, idyllic and strategically located from the point of view of economic and defence considerations of India. Being oceanic islands, the continental shelf around them is limited to about 4336 sq.kms. But considering the lagoon area of about 4200 sq.kms, 20,000 sq.kms. of oceanic zone, and about 4 Lakh sq.kms of economic zone, Lakshadweep is one of the largest territories of India.

There are no rivers, mountains or hills. The soil being very porous, there are no marked vegetation zones, or cultivated fields. The most important commercial crop of the islands is the coconut tree. Thousands of coconut palms grow on every island (except Pitti) and form a major source of income. Very few vegetables are grown except the bread fruit (*Artocarpus incisa*), drumstick (*Moringa oleifera*), wild almond (*Terminalia catappa*) papaya (*carica papaya*), cucumber

(*Cucumis sativus*), and banana (*Musa paradisiaca*). The lagoons of most of the islands have seagrass *Cymodocea* *sps.* growing near the beaches. These grasses are useful in prevention of sea erosion. *Thalassia hemprichii* and *Cymodocea isoifolia* are common, the former being the major food for turtles. There are no snakes, though there are frogs everywhere. Rats are very common and are a major pest, causing heavy damage to the coconuts. Among birds the white eye is frequently seen. (A list of birds of Lakshadweep is in Appendix-II).

The sea abounds with fish. About 601 varieties of fish are reported from the sea around, of which tuna is the most important, and its fishing is a major source of income for the people. About 300 species are ornamental fishes (Jones and Kumaran 1980).

The population according to the 1991 census is 51,681 of which 26,582 are males and 25,099 are females (provisional figures).

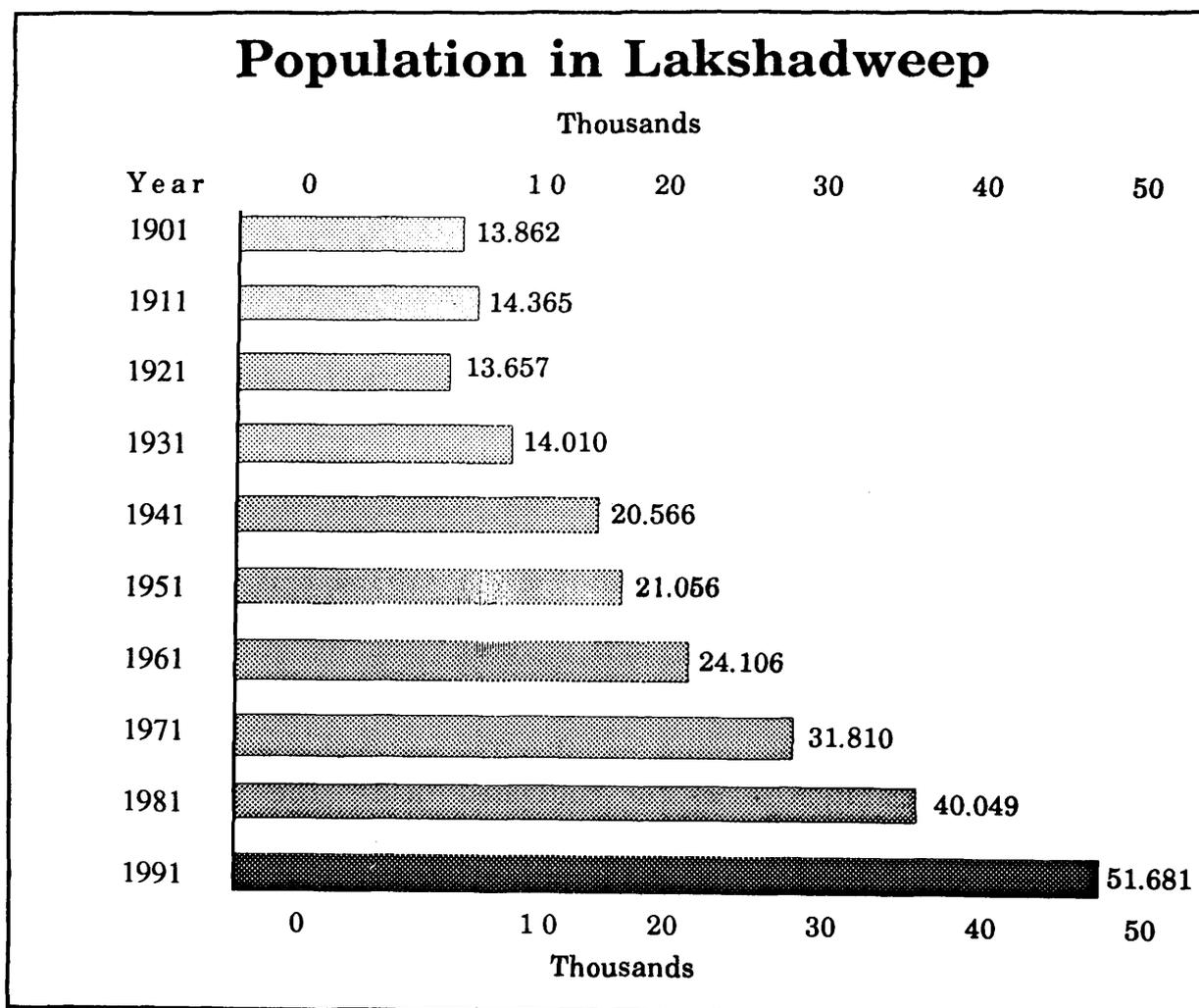


Fig.2

Over 95% of the population is Muslim and are treated as scheduled tribes. Malayalam is the predominant language spoken except in Minicoy where Mahl is spoken. Fish, fish products, coconuts and coir are the main commercial items produced and exported. Weather and rainfall reports for long periods are available for Minicoy and Amini islands only. They may be taken as the average for the other islands. These islands have a warm, humid, tropical climate. The average rainfall is about 1640 mm for Minicoy and 1504 for Amini. Heavy rains occur between June and September. The maximum temperature is between 35°C to 38°C, while the minimum ranges between 17°C and 18°C. Humidity ranges between 73 and 84 per cent (Amini).

PITTI ISLAND

The Pitti island which was our main study area lies about 24 kms north-west of Kavaratti, the administrative headquarters of Lakshadweep. Pitti is a completely barren, desolate, square bit of reef with a sand bank at its southern end. It is about 1.21 hectares in area and has no lagoon surrounding it. The entire island is made up of coarse sand, mostly broken coral that has been pounded to rough sand-like consistency with the constant action of powerful breakers. This is in sharp contrast to the beaches of the other islands where the sand is extraordinarily fine and powdery, almost becoming clayey in consistency in the shallow waters of the lagoons. There is no vegetation of any kind on Pitti, where large boulders and loose stones are the only physical features. The island is a low plateau rising about two metres above sea level at high tide with sloping beaches all around.

Being a tiny island in the middle of the deep ocean, it is constantly battered by powerful breakers and strong swirling currents that are known to be dangerous for people attempting to land on it. During mild weather the sea is incredibly calm with a rich variety of underwater life clearly visible below the surface. Apart from the birds that nest here, a few migratory waders such as curlew, turnstone and sand plover can be seen here. Turtles also seem to be nesting on the sandy beach. A number of hermit crabs appear to be the only other form of life on the island. With the constant washing of the waves, the edges of the landmass have eroded, to form overhanging projections in some places. The central area is in fact slightly sunken into a shallow crater and it was here that terns used to nest in thousands earlier. Pitti is a breeding ground for four species of terns, which are fish eating sea birds with colonial nesting habits. This island is of great importance since such breeding colonies are very rare in the Indian territory. Records of observations made by various workers during the past 30 years indicate that there has been a marked decline in the bird population of Pitti.

Though some migrant waders such as the turnstone are seen on Pitti, terns are the only breeding birds of the island, and the species found here are typical pelagic terns that can be seen even far out in the deep sea. All terns are gull-like birds that are found in inland or coastal waters, they are slimmer and daintier than gulls, with narrow pointed wings, slim, long bills, and usually with deeply forked tails. Some of the terns are winter visitors to the Indian sub-continent with breeding grounds as far north as Ladakh. This makes the breeding colony at Pitti very significant. The tern species described below, that nest and feed on Pitti island are among the few resident terns in our country.

Sooty Tern : *Sterna fuscata*

This black and white tern is about the size of a house crow, with very long, pointed wings and a deeply forked tail. The breast and throat are white, while the abdomen is greyish, and the entire upper parts from the top of the head, down the back to the tail is entirely sooty black.

The Sooty Tern breeds in Lakshadweep, on the Vengurla rocks near Ratnagiri, and probably in Maldives, Andaman and Nicobar islands, but its non-breeding range is not sufficiently known.

They are very active both during the day and in the night time, and flocks are sometimes attracted to well-lit passing ships. It gets its popular name "Wideawake Tern" from its habit of night time activity, and from its peculiar call.

The food of the sooty tern is mostly fish and squids. (Ali and Ripley, 1969). The bird usually flies high above the water in search of fish, and plunges from a height to capture it. The fish is then tossed into the air and caught lengthwise, and swallowed whole, head first. Flying fish are also caught in the air.

The breeding season extends over a long period in summer and during the monsoon, and a second season could be at the end of the year. This leads to the assumption that unsuccessful parents may breed again at an interval of less than 12 months. A single white or pinkish white egg, blotched all over with violet or brown is laid on a bare soil or in a shallow depression, in closely-packed colonies. The yolk is orange coloured.

Noddy Tern : *Anous stolidus*

This is a smoky-brown coloured tern, smaller than a house crow in size, with a white forehead. The wing tips and tail are darker.

Noddy terns do not plunge into the water to catch fish like other terns, but fly low over the water and pick up small fish as they come to the surface. Flocks of noddies can be seen following schools of fish, and like the sooty terns, they feed actively on moonlit nights. They settle to rest on the water's surface like gulls. Their call is a low croaking "graak".

They nest in closely-packed colonies on the bare ground, and are also known to nest on *Pandanus* bushes and coconut palms. A single egg is laid, which is fawn coloured with dark markings, more prominent on the broad end. The yolk is yellow.

Noddy terns are found in the Maldivian islands, Lakshadweep, Andaman and Nicobar Islands, and on scattered islets along the Western coast. The nesting colony at Pitti is the noddy terns' only breeding ground in Indian territory, apart from a possible breeding site in the Andaman and Nicobar islands.

Large Crested Tern : *Sterna bergii*

This is a large tern almost the size of a pariah kite, with a black crown, prominent crest at the back of its neck with yellow bill and black legs. The large crested tern is found on the western as well as eastern coast in the off-shore waters, and usually far out in the open sea, a considerable distance from the shore. While looking for prey, they fly a few metres above the water with the bill pointing downwards, scanning the sea for fish. On sighting the prey, they plunge into the water at an angle to capture it. They feed in flocks, often dropping one after the other into the water. Their food is mostly fish and prawns (Ali & Ripley, 1969). Sand banks and buoys serve as resting places.

The nests are shallow scrapes on the sandy or rocky ground, set very close together. One or two eggs are laid, usually coloured pinkish or mauve with reddish brown blotches and scrawls all over.

Brown winged Tern : *Sterna anaethetus*

A medium sized sea tern, smaller than a house crow, with greyish-brown upper parts, wings and tail. The outer feathers of its long swallow-like tail are mostly white. In flight the white edge of the upper wing is clearly visible. The under parts are entirely white, and the face too is mostly white with a thick black band across the eyes, on account of which it is appropriately called "Bridled Tern".

This wide ranging pelagic tern is found dispersed over the Arabian Sea, the coasts of Western India, Sri Lanka and Andaman and Nicobar islands, but breeds only along the Indian coast on islands off the Maharashtra coast, Vengurla Rocks off Ratnagiri and Lakshadweep islands, and possibly on the Maldiv Islands. This species does not nest on Pitti, but on other islands in Lakshadweep. It however feeds near Pitti.

Flocks of brown winged terns are usually found off-shore but are often seen far out at sea. They follow shoals of fish in the ocean, plunging down from a height to capture the prey. The fish are first held cross-wise in the bird's bill, and then flipped lengthwise to be swallowed whole, head first. Their food is mainly fish (Ali & Ripley, 1969). The breeding season is June-July, sometimes going up to September. They nest in mixed colonies, sometimes with large crested terns and others, and each nest is just a shallow scrape in the sand. A single egg is laid, which is creamish coloured with reddish or lilac markings.

Previous Work :

Although the breeding colony of terns on the island of Pitti was known to ornithologists from the times of Allan Octavian Hume (1876), no attempt appears to have been made so far to carry out a long term study of the birds of Pitti or to study the ecology of the terns. Very little is known of the population, breeding biology and role of the terns in the marine ecosystem of Lakshadweep. Hume (1876) was the first ornithologist to observe the birds of Lakshadweep. Since then Alcock (1902), Betts (1938), Ramunni (1962), Mathew and Ambedkar (1964), Livingston (1987), Lal Mohan (1989) have all published some information about the bird life of Lakshadweep. Two very important recent publications on the resources of Lakshadweep must be mentioned here :

- (1) Marine Fisheries Information Service, Special Issue on Lakshadweep No.68, July 1986.
- (2) CMFRI Bulletin 43, Marine living resources of the Union Territory of Lakshadweep, April 1989.



An aerial view of Pitti



Pitti Island from Boat



Sooty Terns at nest in Pitti



Sooty Terns at nest in Pitti



Noddy Terns in Pitti



Noddy Tern



A Sooty Tern in flight over Pitti



An egg collection in Pitti

AIMS OF THE STUDY

In order to formulate a proper conservation policy for protecting the nesting colony which has been badly affected by human interference and natural causes, the Administration of the UT of Lakshadweep sanctioned a one-year research project during 1990-1991, for data collecting on several aspects of the bird life and ecology of the Pitti island. The project was conducted by a research team from the Madras Naturalists' Society, and in this report we have attempted to set down and analyse the results of our study.

Though a comprehensive study of the entire biology and requirements of the terns of Pitti was highly desirable and overdue, the time available to us in the project was limited and accessibility of Pitti was subject to the unpredictable vagaries of the sea. Even from our first visit, it was clear that the terns of Pitti were highly endangered. We therefore gave priority to the study of the nesting colony from the point of view of conservation, and decided to confine ourselves to the following aspects :

- (1) The time of nesting of the different terns of Pitti.
- (2) Estimation of the number of terns breeding in Pitti.
- (3) Observing species composition.
- (4) The factors threatening the survival of the terns of Pitti.
- (5) Chemical aspects of the contribution of terns to nutrient cycling in the area.
- (6) Updating the checklist of birds of Lakshadweep.

Methods of Study :

We observed the behaviour of terns in their breeding colony in Pitti and foraging areas near Kavaratti, Agatti, Kalpitti, Bangaram, Thinnakara and Pareli and on the newly formed sand banks near the above islands. We visited these locations in the course of four visits, each of over one week's duration, both in the breeding and non-breeding seasons of the terns, between May 1990 and April 1991. We also made aerial observations of the island whenever we had the opportunity to fly low over Pitti by aeroplane or helicopter.

We counted birds at Pitti using direct counts and block method (Howes and Bakewell 1989). All counts were made after landing on the island. During our last visit, we collected soil samples from different islands for analysis of the inorganic phosphate content of the soil. For this, soil samples were collected from the islands at random and extract of each sample was prepared in 2.5% acetic acid. The phosphate content of the extract was analysed by APHA colorimetric method.

We held discussions with scientists of the Central Marine Fisheries Research Institute (CMFRI) Cochin, as well as with the experienced fishermen of Kavaratti and Agatti. We collected information from published literature on sea terns in India, as well as on tern breeding colonies on tropical islands in the Indian Ocean and in other parts of the world. We have integrated data gathered from our own observations with the material from published literature, to give an insight into the working of a part of the marine ecosystem around Pitti, stressing the activities of the organisms which are more directly connected to the ecology of terns.



Eggs of Sooty Tern & Noddy Tern



A view of the Sooty Tern Colony on Pitti



Erosion - Pitti Island



A typical view of a Lakshadweep Island - Kavaratti



Bangaram (Tourist) Island



A white eye in Kavaratti



Dredging in Kavaratti Lagoon



Hermit Crabs

OBSERVATIONS

Species composition :

Three species of terns and three migrant wader species were recorded on Pitti island during the course of our one-year study :-

Sooty Tern (*Sterna fuscata*)
 Noddy Tern (*Anous stolidus*)
 Large Crested Tern (*Sterna bergii*)
 Turnstone (*Arenaria interpres*)
 Curlew (*Numenius arquata*)
 Lesser sand plover (*Charadrius mongolus*)

Turnstones were generally seen among the rocks along the sea coast in small groups of 10 - 15 individuals, while only a single curlew and sand plover were seen standing on a rock during our visit in Jan/Feb 1991. All these are migratory species found only in the winter months, while the terns are all resident birds that are found throughout the year on Pitti. Though brown winged terns are known to occur in the vicinity, we did not observe them either during the breeding season or during the off-season on Pitti island. They have been seen nearer to the northern group of islands close to Birta and Chetlat (Mathew and Ambedkar 1964).

Breeding :

In early May 1990 both the sooty and the noddy terns were breeding at the time of our visit. There were no chicks as all the eggs laid till then appeared to have been harvested by the islanders. At the time of our second visit in October 1990 we could not land in Pitti due to a very turbulent sea and could not determine if breeding activity was going on. In the course of our visit in January- February 1991 we observed Pitti very closely three times and landed there once. Breeding activity had not started yet. On our last visit in April 1991 both Sooty and Noddy terns were breeding. In spite of the regular poaching of eggs, there were about 500 eggs of Sooty Terns on Pitti. Incubation was in progress and courtship and copulation were observed in the Sooty terns. About 5000 Sooty terns were arrayed in neat rows on the ground, each bird within a free space of about 12 x 18 inches (30 x 45 cm). There were frequent conflicts between some of the neighbouring birds. Each bird was incubating a single egg. The Sooty terns occupied an area of about 1250 sq.m. in the north western margin of Pitti.

The Noddy terns appeared to have just started egg laying in late March 1991. We counted about 3000 noddies on the island. We found that the eggs of this species were also being collected, and on our return, we saw some boats

proceeding in the direction of Pitti. There were about 50 Large Crested terns but none of them appeared to have started nesting. Small numbers of Large crested terns were observed close to Pitti on all the four visits we made but we could not see them breeding. We were told by the islanders that their breeding season starts later. The islanders were of the view that they could collect all the eggs laid early in the season (i.e. April - May) as these eggs would not hatch, but according to the former Director of Fisheries this was not true. Few eggs remained on the island till the rains made Pitti inaccessible to human beings (Varghese Pers. Comm).

Food of the Young :

We could not see any tern chicks during our visits in the 1990-91 period in Pitti and hence could not observe the food given to them, though juveniles of sooty terns were observed in flight. Mathew (unpublished) observed the chicks of both Sooty and Noddy Terns being given fish caught from the sea close to Pitti in 1978. In Seychelles, Foure (1976), has recorded three families of squid and nine of fish including the flying fish in the food of sooty terns. Most of the families of fish taken by the Seychelles sooty terns were represented in the Lakshadweep seas. The names of the fish are appended. (App.I)

Mortality :

From our observations and discussions with islanders, it was clear that almost all the eggs laid were being harvested by fishermen till Pitti became inaccessible due to heavy monsoon. On our visit in May 1990 we saw a large number of adult terns also being collected by the islanders. Mathew (unpublished) observed hermit crabs feeding on broken eggs in February 1978. In Seychelles, Feare (op.cit) found that Turnstones were predators of eggs of sooty terns but this did not occur on Pitti during our study. According to the local fishermen, crabs predate on some of the live chicks also, and both eggs and chicks are sometimes washed away by the rain. In short, mortality of eggs, chicks and adults of the terns breeding on Pitti is very high, and much of it is caused by humans. There is no threat from common predators found on other islands such as rats, cats or birds of prey, since these predators do not occur on Pitti. It must be recorded that in 1991 May, we saw one fresh egg with small holes drilled on one side. This could have been the work of a bird, another tern or a turnstone.

Population size of Terns around Pitti :

There is no mention of the precise numbers of terns in any of the publications on Pitti. As the population of terns have been consistently subjected to disturbances by human beings in recent years, it is almost impossible to know the exact numbers. The number recorded by any observer will be related to the time elapsed between that observation and the last visit of a human predator.

However, during the breeding season the birds which have nests and eggs try to stay close to the nest and a more meaningful estimate of the population can be made. The estimates made by various observers during the last three decades are listed below :

Year	Observers	Estimates of the total of (all terns in Pitti)	Remarks
1963 October	Mathew and Ambedkar (Unpublished)	20,000	Nesting activity in progress collections strictly prohibited.
1978 February	Mathew (Unpublished)	12,000	Nesting in progress both adults and eggs collected by humans
1988* December	Deepakumar	13,000 to 15,000	Found no chicks but about 400 eggs.
1990 May	Mathew, Rajan	4,000	Egg laying in progress Eggs and birds collected by humans.
1991 February	Tara Gandhi Mathew, Santharam G.Mathew	2,000	No nesting activity
1991 April	Mathew, Santharam G.Mathew, Rajan	8,000	Both Sooty & Noddy Terns nesting. No chicks. All the eggs laid collected by humans.

* Lal Mohan (1989) has counted about 15,000 terns in Agathy Bangaram and Bitra.

In the present survey we counted the number of terns encountered on a boat journey from Kavaratti to Pitti to serve as some kind of an index. The results are given in table 2.

Table-2 : No. of birds observed between Kavaratti & Pitti

Date	Total	Noddy	Sooty	Large Crested	Unidentified	Remarks
27.10.90	63	60	-	3	-	
30.01.91	63	38	24	1	-	Outward trip
30.01.91	130	118	12	-	-	Inward trip
31.01.91	150	120	30	-	-	
25.04.91	145	47	33	17	48	

The number varied between 60 and 150. We never came across any feeding gatherings of more than 100 terns during these boat journeys of about 2 hours. Both in February and April 1991 we searched the islands, sandbanks and coral reefs between Agatti and Pareli for birds. The maximum number of terns (mostly large crested terns) we could see on the sandbanks close to Pareli and Thinnakkara was about 400. We never saw any large flocks of terns during the helicopter flights between Kavaratti and Agatti, and on a special reconnaissance boat trip we made from Kavaratti to Agatti. The Pitti colony (where no observer has recorded over 50,000 birds), is relatively small as compared to the tern colonies in the western parts of the Indian Ocean (Feare Op.Cit) that contain hundreds of thousands of birds.

Feeding behaviour :

While feeding, noddy terns skim the surface of the ocean, while sooties fly high overhead, and sometimes also hover at the crest of breakers. sooty terns are said to feed even during the night, sometimes taking deep sea fishes which come to the surface only during the night. Ali and Ripley (1983) quote the interesting case of six recently swallowed deep sea fishes *Vinciguera lucetia* regurgitated by sooty terns which had landed shipboard in the Pacific, three hours after sunset. The various kinds of fish observed in the diet of sooty terns in Seychelles (Feare Op. Cit) are appended (App.I). The large crested terns were observed feeding, following the breakers. They were invariably found in the coral reefs close to Kavaratti and Agatti, feeding and resting during the day time.

Terns as indicators of Tuna :

Almost all authors who have written about tuna fishing in Lakshadweep have referred to the function of terns as indicators of Tuna. Both terns and tuna are attracted by the small fishes in the ocean which are an important food resource that they share. Small fishes such as *Spratelloides japonicus*, and *Spratelloides delicatulus* commonly called "sprats", and other similar fish varieties are the chief food of the tuna. Wherever shoals of these little fishes occur, tuna congregate in large numbers to feed on them.

Sprats are surface shoaling fishes that are found in the lagoons as well as in the open sea, and are also an important food source for sea terns. Flocks of terns follow these shoals and are frequently seen feeding and hovering around areas where they have come to the surface. Fishermen look out for feeding tern flocks in the open sea and carry out their fishing operations in the same area, knowing that tuna also gather there to feed on the sprats. Local fisherfolk are keenly aware of this phenomenon, and in fact we first learnt of this indicator function performed by the terns from the fishermen we met. The breeding terns of Pitti are therefore highly beneficial to the fishing industry in Lakshadweep on account of the fact that fisherfolk save time, energy and fuel by the simple

method of locating feeding tern flocks that lead them to an assured, rich fish catch.

Terns recorded in other areas :

Hundreds of Large Crested Terns were invariably seen resting for long periods on the newly exposed sandbanks close to Bangaram, Thinnakara and Pareli. Besides the terns small numbers of about 10 species of shore birds also rested for long hours on the sandbanks. The recorded species are listed in the Annexure-II. The coral reef close to the aerodrome in Agatti attracted Large Crested terns, and more than 50 were observed during some of our visits. Whimbrels and herons rested occasionally on the numerous fence posts and coconut trees around the air strip. Whimbrels were very often found feeding on the grass-covered areas on land. Whether this will pose a danger to aircraft has to be studied.

Other marine forms observed :

The rich variety of marine life around the island is clearly evident from the number of marine creatures we saw during our various boat surveys between and around the islands. A small school of dolphins with three to five individuals was sighted on two days in the sea between Kavaratti and Pitti, two marine turtles surfaced near the boat off the coast of Agatti, while a number of fish varieties were seen in the lagoons and in the sea beyond. The main fishes of the deep sea areas were Seer fish and Tuna (both caught by our boatmen near Pitti), and flying fish. In the lagoons, multicoloured fishes like the Surgeon, Moorish idol, Parrot fish and Butterfly fish were visible moving amidst live coral of different shapes, like the branched stag-horn corals, and various other boulder shaped, or rock-like corals. There were sea-grasses close to the shore. Enormous sea cucumbers and giant clams could also be seen. Along the shore line, apart from hermit crabs there were other species of large crabs, as well as their predator, the eel, that was observed in Kalpitti island off Agatti. Also on the same island, a turtle had come ashore apparently looking for a convenient spot to excavate a nest.

Trapping of wild birds in the islands :

The islanders made effective use of nooses to trap almost all the different species of waders from the size of a sand plover to that of a whimbrel. The use of an air gun to kill a whimbrel was also noticed by us once in Kavaratti. Keeping migratory waders as domestic pets was also observed to be a common practice. We visited households where several such birds were seen. They remove the flight feathers and let the birds roam freely in their compounds. The long-range effects of bird trapping in the island are not known.

Phosphate content of the soil samples collected from different Islands :

Analysis of the inorganic phosphate content of the soil samples collected from different islands viz. Kavaratti, Agatti, Pitti, Parali, Thinnakara and Bangaram showed an extremely high value in Pitti island soil (436.8 $\mu\text{g}/10\text{ g}$ soil - average) (Fig.3). In all other islands the value is below 55 μg phosphate/10 g soil.

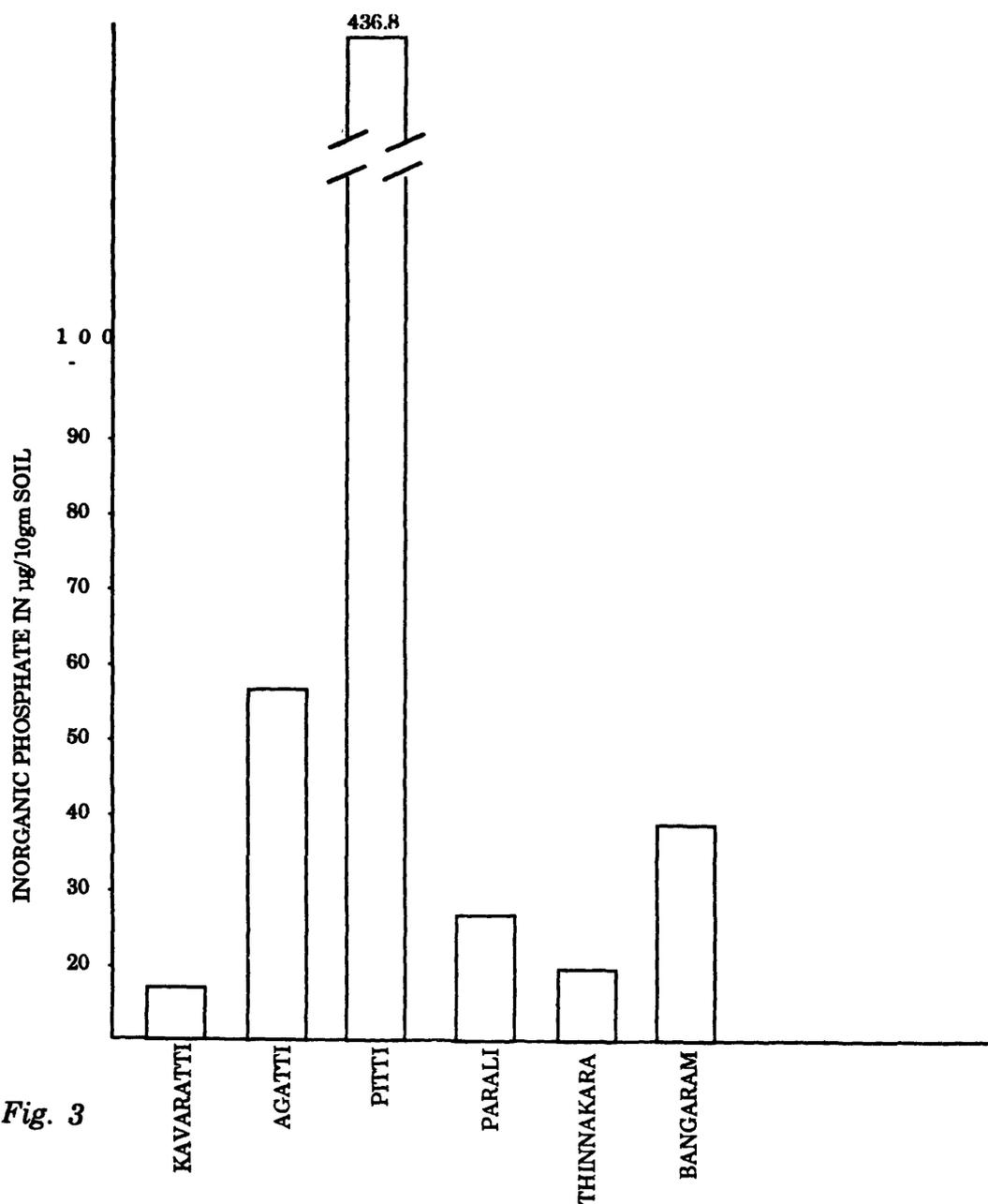


Fig. 3



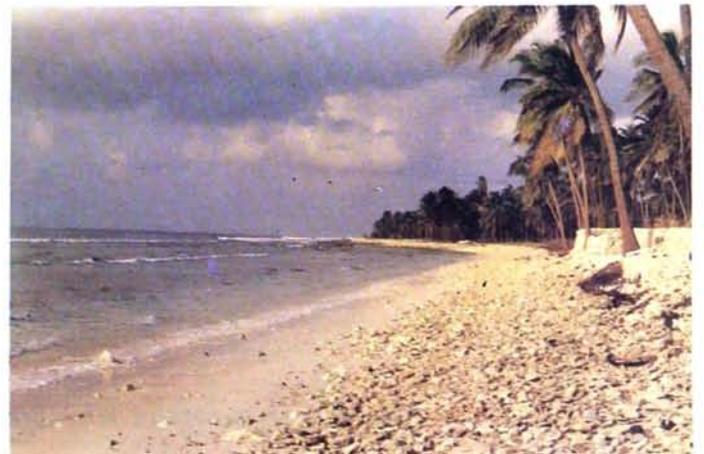
Sea Erosion - Agathi



Islander shooting a wild bird



Tetrapods to check erosion



Coral Debris on Kavaratti Beach



Oliver Ridley (Alive) - Kalpitti Island



Oliver Ridley (Dead) on Pareli Island



Sea Urchins



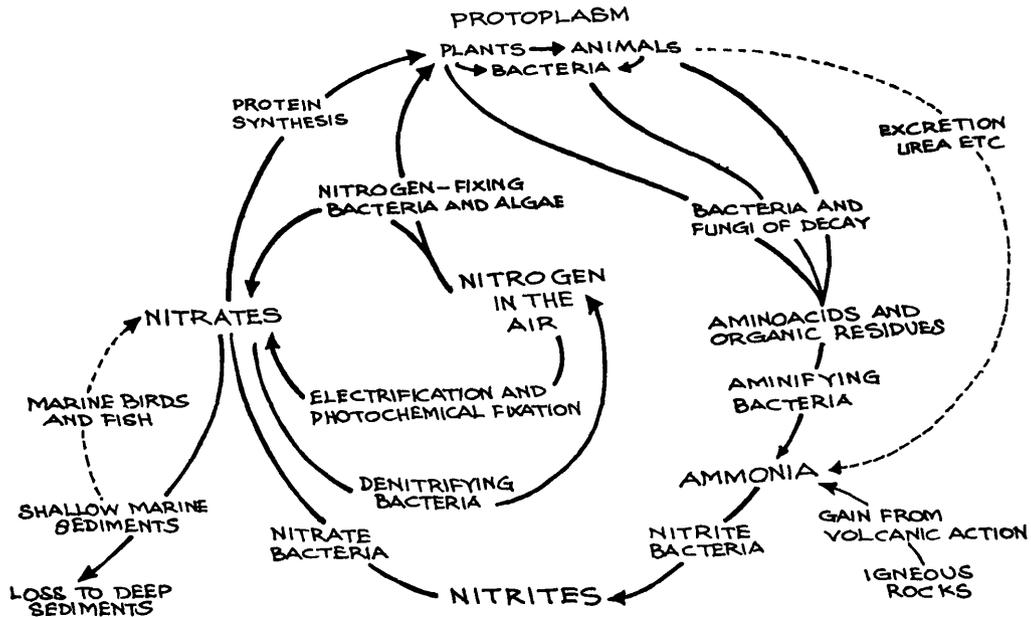
Children with captive Whimbrel

DISCUSSION

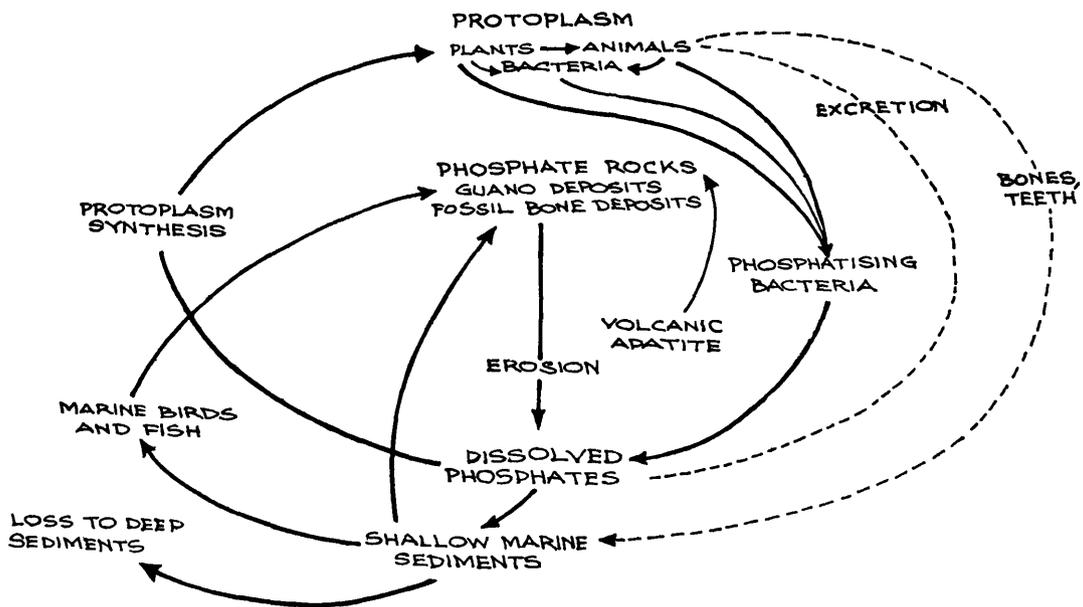
Marine Ecosystems :

Before entering into a discussion of the problem of Marine Ecosystems, it is necessary to look at some of the inherent limitations of marine communities and ecosystems which are quite different from those on land. Marine ecosystems of the world are generally poor in the supply of nutrients. (Odum 1973). To learn how sea birds like the terns of Pitti are connected to the human components of their ecosystem (other than as prey), one has to take a look at some of the chemical changes taking place in the biosphere.

Materials move from the environment into the bodies of plants and animals as they grow and return to the environment when they die and decompose and in some instances undergo complicated transformations and translocations before they are again taken up by living organisms (Fig.4-1,2). The study of the geographical distribution of materials used by plants and animals and their cycles is known as biogeochemistry (Clarke, 1954). These materials are not equally abundant in the different phases of these cycles nor do the various steps take place at uniform rates. Some materials of critical concern to living organisms (like phosphorus) have a tendency to accumulate in certain places, such as in the deep sea and are thus withdrawn from circulation for varying periods. These are then unavailable for growth of organisms. Phosphorus (Fig 4-2) is one such substance which Wells, Huxley and Wells (1939) considered to be the weakest link in the vital chain on which man's civilisation is supported. For example in the sea around Kavaratti, Nair, et. al (1986) found very low (0.04-0.06% of P_2O_5) values of sediment phosphorus. Fortunately for mankind, sea birds such as those off the coast of Peru (boobies, pelicans and cormorants) which feed on small fishes called anchovies have over the centuries deposited huge quantities of their excreta or guano on the rocky islands off the coast Peru. These guano islands yield tons of nitrates and phosphates per year. Their collection developed into a big industry. Such activity is possible only in Peru and a few other spots in the world's oceans where winds move surface water away from precipitous coastal slopes bringing up to the surface, cold water rich in nutrients which have accumulated in the depths of ocean. This last mentioned phenomenon is called upwelling and has been reported to occur to some extent in a few spots in the Lakshadweep seas. (Prasad 1951, Ramasastri et al. 1959). Pitti is one such example of an island rich in phosphorus. Analysis of soil samples from Pitti taken during the course of our investigation shows a very high phosphate content. (Fig.3) Newly exposed sand banks near Bangaram, Thinnakara and Pareli were found to be extremely fertile, and coconut seedlings planted there grew very quickly even though no fertiliser was used (Verghese, pers. com). It is highly likely that bird excreta is responsible for the fertility. This indicates that the terns of Pitti have a significant role in the life-supporting system of the islands.



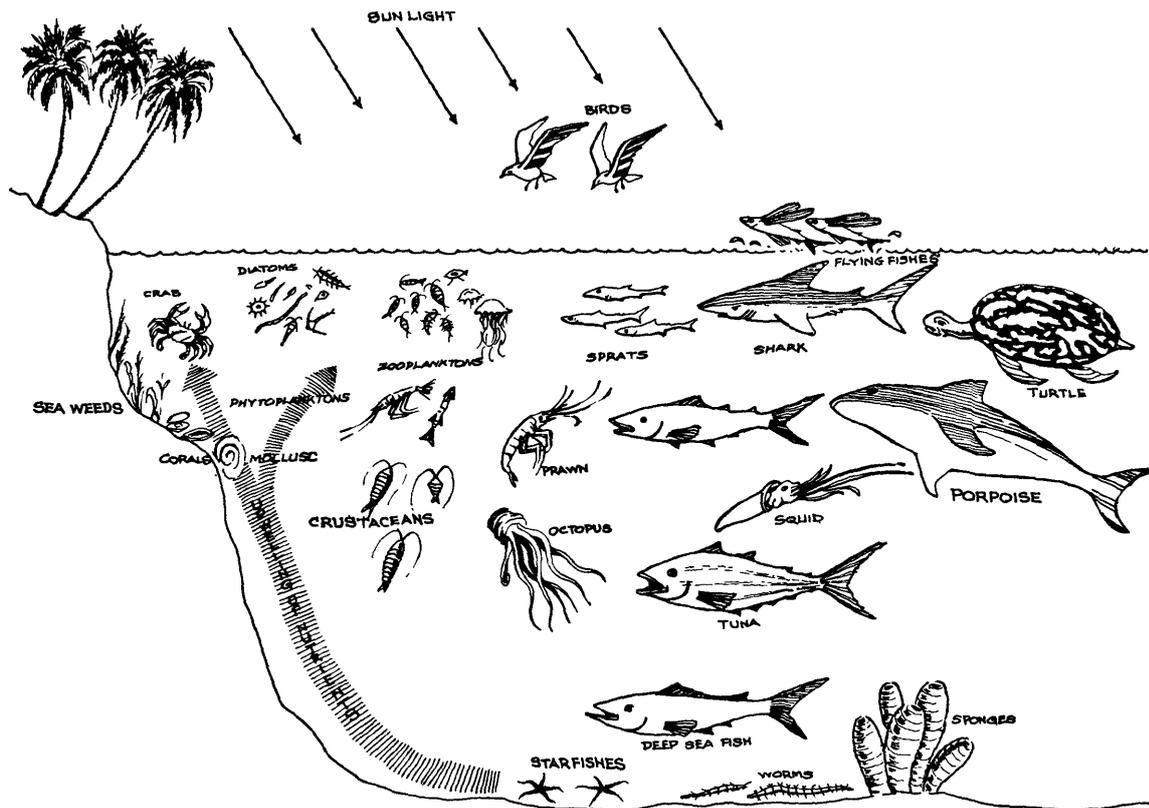
A diagrammatic representation of the nitrogen biogeochemical cycle. Below (4-2) the phosphorus cycle is depicted. Marine birds and fish have important roles to play in both. - Drawn after E.P.Odum 1971.



THE LAKSHADWEEP ECOSYSTEM

It is interesting to discuss very briefly some of the components of the island ecosystem and their function found by us or other observers. Fig.5,6

1. a) Upwelling of deep sea water delivers considerable quantities of nutrients to support abundant life near the surface particularly in Minicoy. The food chain of the tuna and the terns starts here.
- b) A zone of sinking which could cause loss of nutrients has also been found in the open ocean east of Minicoy (Nair et al. Op. Cit)



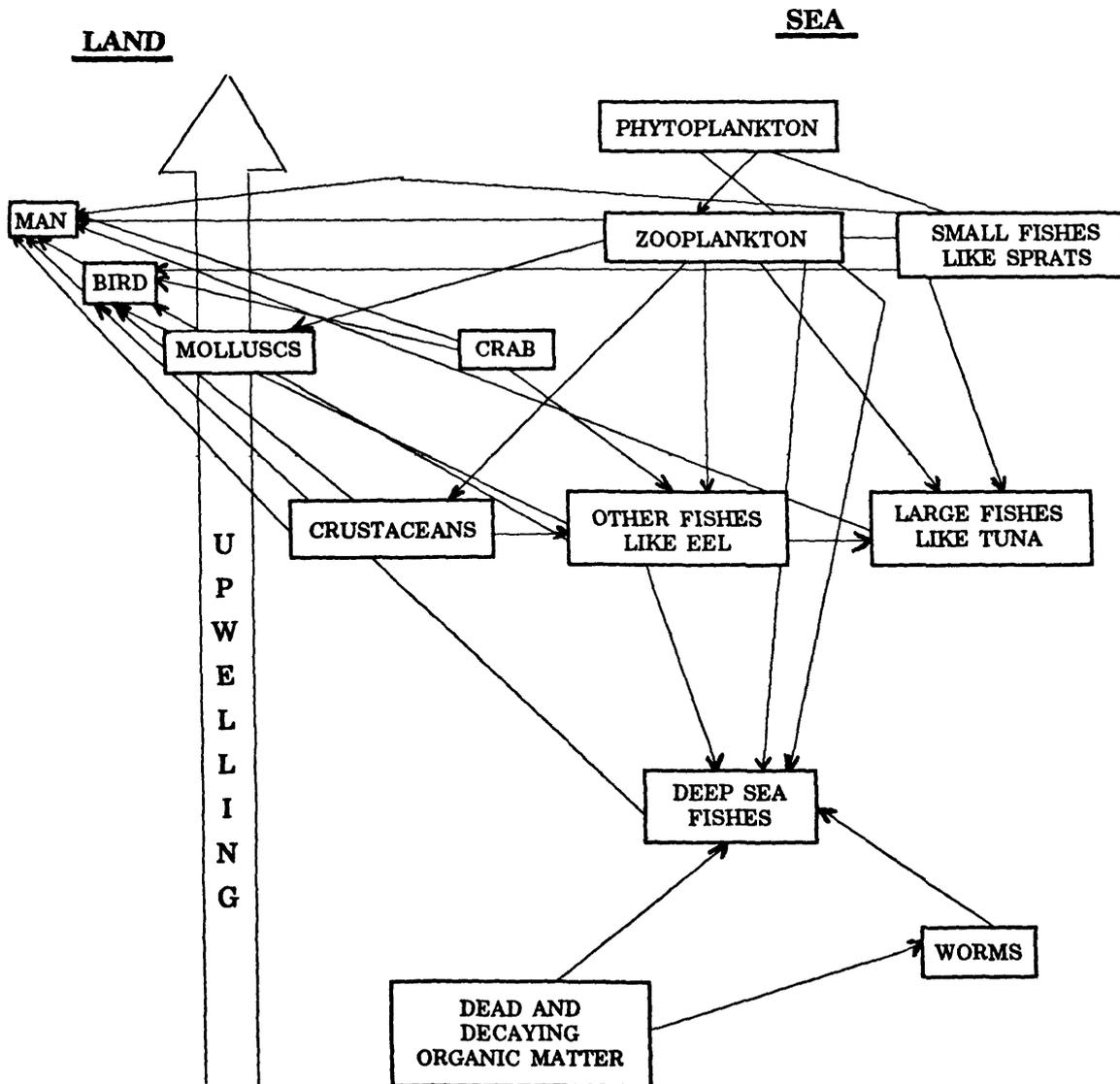
2. Run-off from land enriches the coastal waters.
3. Excreta of oceanic birds like terns is an important source of nutrients in the euphotic zone of the sea (surface layer where there is sunlight penetration), where primary production through photosynthetic activity takes place.
4. Phytoplankton or microscopic plants, sea weeds and sea grasses use the incident sunlight and plentiful supplies of nutrients to produce organic matter.
5. Zooplanktons feed on phytoplankton, and with phytoplankton form the next link in the food of consumers like small fishes and many invertebrates abundant in Lakshadweep waters. Euphausiids, a group of zooplankton, especially rich in the seas around Lakshadweep (Nair, et. al. 1986), are the staple food of the small fishes such as sprats which are in turn, consumed by the larger fish like the Tuna.
6. Small fishes like the bait fishes *Spratelloids spp* are the food of the tertiary consumers like terns and dolphins. Some animal species operate in more than one trophic level, to that extent, terns can be considered to be tertiary.
7.
 - a) The terns which are the most numerous among the visible tertiary consumers have many important roles in the ecosystem. By using different habitats and dividing their time between the sea and land they are the best permeants of the ecosystem. Terns feed on the small fishes on the surface as well as some forms of deep sea fishes, and thereby help to retain the nutrients brought up by the currents for a long time near the surface of the ocean. Thus they act as land-sea bridges of energy.
 - b) Bird excreta deposited over thousands of years are believed to have contributed to the building of the islands (Jones 1986). It is speculated that by spending long periods of time on the newly formed sand banks they (the terns and waders) fertilize and help to stabilise islands, reversing the process of erosion to some extent. The newly exposed sandbanks of Lakshadweep which are a favourite resting - spot of terns were found to be immensely fertile, and coconut trees grew well without external application of fertilizer. (Varghese pers. com.)
 - c) Eggs, juvenile and adult terns are eaten by human consumers. Eggs and young are taken by crabs.
8. The highly productive and diverse coral formation of the island also help in land building, in providing the ideal habitat for complex communities of

the sea and make the island aesthetically attractive. The corals lead a symbiotic life along with the algae.

9. The importance of crabs in recycling of nutrients by scavenging on the discarded and decomposing bodies of animals must be emphasized. The crabs represent a very vital link in the food chain. They form part of the prey of eels.

Part of the foodweb of the Lakshadweep including both Land and Sea organisms

(The actual foodweb will be infinitely complicated).



CONSERVATION AND CONSERVATION PROBLEMS OF PITTI

Our observations and those of others have not shown very large concentrations of terns in Pitti. This is not surprising when one considers the extent of the egg collection in Pitti. The period from March to May is the best part of the breeding season of terns, without much disturbance from rains. All the eggs laid during this most favourable period are collected by fishermen. It is only after the onset of monsoon when the sandbanks becomes inaccessible to humans that any tern chicks are raised. At this time rains and predation by crabs cause very heavy mortality of eggs and chicks (Verghese Pers. Com.). Of late the terns of Pitti are showing less tolerance of the human being than in the years past. It is doubtful if the terns of Pitti can hold on indefinitely if the same rate of egg collection persists, or whether they will continue to breed at all in Pitti, if the adults, chicks and eggs are predated upon at the present rate. This is particularly so since the human population of the islands has increased four fold since the turn of the century, therefore increasing the demand. Improved travel facilities also make accesibility easier. The fate of the guano producing birds of Peru is worth quoting again. There were once, about 30 million birds in this area in 1939-41. After several years of severe environmental stress and human disturbance, the bird population of Peru coast fell to one million, (Idyll 1973). In spite of the strong upwelling and very large initial sizes of the breeding populations of birds, Peru's guano-producing birds have not recovered their original population size.

Let us go back to the studies of C.J. Feare (1984) on the sea bird status and conservation in the Western parts of the tropical Indian Ocean. These studies have revealed that human settlement and interferences in the form of direct exploitation, habitat change etc. in the islands Seychelles, Amirantes, Providence, Aldabra, Chagos, Mascarenes, are deleterious to sea bird population. In these islands, of the 40 breeding colonies known to have existed within the last hundred years, two-thirds have become extinct and only ten colonies appear to have maintained their former number as illustrated by the table.

Table : Known status change of colonies *Sula sp.* and *Sterna fuscata* on Western Indian Ocean islands during the last hundred years.

Sea bird species	Unchanged	Reduced	Extinct
<i>Sula dactylatra</i>	5	2	6
<i>Sula sula</i>	3	1	12
<i>Sula leucogazea</i>	2	1	5
<i>Sula abotti</i>	0	0	3
<i>Sterna fuscata</i> (from Feare)	6	4	10

Feare's (Feare 1976) studies on the breeding colonies on sooty terns in Seyshelles give us many hints on the management of the breeding colony in Pitti. Feare found the sooty terns to be badly adapted to cope with rains, the productivity or success of the eggs laid in the rainy season was very low. According to Feare the sooty terns start laying eggs from the age of 5-6 years and each bird can live (or have a life expectancy) upto 32 years. According to the same author the killing of the breeding adults involves the removal of the most valuable section of the bird population. In the present practice in the Pitti tern colony, all the eggs laid during the fair weather months April to June and all chicks and some adults are regularly collected for local consumption. It is not therefore surprising that the tern population in Pitti is declining. The time to take corrective action for the conservation of terns in Pitti is now.

From our observations, we find that the sooty and noddy terns commence nesting by March - April, before the onset of the monsoon. The Large Crested Terns were not found nesting in this period and local information is that they breed at Pitti during the monsoon. Another species of tern, the Brownwinged tern, earlier reported to nest at Cheriabanni Island (Mathew and Ambedkar, 1964), was not encountered in the present survey. Reports from local people indicate that there is now no nesting of terns at Cheriabanni and that this island is used by fishermen to rest. The exact period and other locations of nesting of these species have to be determined by future surveys covering all the islands and sandbanks in Lakshadweep.

The destructions of the coral reef (Pillai 1983, 1989) is another factor which might indirectly affect both tuna fishery and tern populations. The reef is the natural home of some of the bait fishes on which both birds and tuna feed. Fishermen collect these small fishes from the lagoons and keep them alive in their boats when they go out to sea. They then scatter handfuls of the live bait in the water, throwing in their fishing lines at the same time. The tuna are attracted by the bait and are caught on the two or three lines put out simultaneously. The process goes on for several hours till an adequate catch is hauled in.

The tuna is then sliced into large pieces, and boiled in salted water before drying. The unused parts are buried in the sand by the water's edge, an ecologically sound practice that returns nutrients back into the ecosystem. The dried fish called "maas" is in great demand in the mainland and is also exported to other Asian countries.

To exploit the terns or their eggs for food is as shortsighted as 'killing the goose that lays the golden egg'. The most economic and ecologically sound management measure will be to give maximum protection to the terns of Pitti and to let the terns live freely and function as friendly commensals, active permeants, and tuna indicators. The energy, time and fuel spent for egg collection could be put to far better and economically sounder use by the fishermen concentrating on tuna fishery, so as to maximise their catch. By intensifying fishing and processing of tuna, which is in great demand in other countries we can increase the ecological efficiency and improve the islands' economy. In our opinion the presence of a flourishing tern community in Pitti will help to some extent in maintaining of a high rate of biological productivity including the economically important species in the sea around by facilitating a steady supply of nutrients to the surface water.

RECOMMENDATIONS

- * Pitti must be declared as a totally protected area where only personnel of the Science & Technology department of the Union Territory are permitted to land with permission of the Director of Science & Technology, Lakshadweep.
- * Landing in Pitti, collection of eggs, young birds or adults of any bird or turtle, or turtle eggs on Pitti must be made a serious punishable offence. Fishing in the waters around Pitti without disturbance to the birds may however be permitted.
- * The population of terns on Pitti must be monitored at least twice a year for more than five consecutive years to find out their numbers, and population trend. A complete survey of all the islands and sandbanks of Lakshadweep should be undertaken to locate other nesting areas of terns.
- * Since any form of habitat modification on Pitti will have disastrous consequences for the bird population, planting of coconut trees or of any other kind of vegetation should never be undertaken on this island.
- * Adequate measures must be taken to protect the coral reefs of Lakshadweep from disturbances of all kinds. Coral mining or other exploitation must be strictly controlled.
- * Other forms of marine life such as turtles and dolphins should also be strictly protected, for their functions in the ecosystem and for their value in the promotion of tourism.
- * Sufficient incentives must be given to the fishermen to maximise their catch and to take full advantage of the tuna resource of the sea, and the waste products of coconut trees such as dead leaves, bracts etc. should be fully used as fuel for processing tuna.
- * All fishermen who process tuna should be instructed and encouraged to bury the unused portion of tuna on the beach where the crabs will scavenge on these and reintroduce nutrients into the marine food chain.
- * A system for environmental monitoring must be introduced for Pitti as well as for the other islands, which could be in association with the INTACH programme for environmental monitoring in Lakshadweep Islands.

- * **Strict regulations need to be enforced on larger vessels carrying cargo from the mainland, as also on tourist ships, to ensure that waste oil and other pollutants are not discharged into the water near the islands or lagoons. Monitoring of marine pollution must be carried out on a regular basis.**
- * **Qualitative and quantitative information on marine fauna and flora occurring in the waters around the islands needs to be collected. This must have special emphasis on rare and endangered species.**
- * **Traditional conservation practices that have been observed by the islanders over the ages need to be recorded. Their opinions on the reasons for fluctuations in the bird population need to be noted, as also their methods of use of living resources around them. Such data would give excellent insights for preparing a sustainable conservation strategy for the island ecosystem.**
- * **A search must be made for uninhabited atolls or sand banks where terns could be encouraged to nest.**
- * **All possible avenues of mariculture must be explored.**
- * **Ways of increasing the production of bait fishes must be explored.**
- * **Poultry keeping and farming of birds like quails and partidges or any other suitable species of birds could be encouraged as substitutes for the terns and tern eggs. Since there are many bird-fanciers on the islands who keep captive migrant waders as pets in their homes, they could be persuaded to keep pigeons, doves etc.**
- * **The possession of air-rifles and trapping of wild birds should be banned.**
- * **Wide publicity must be given to the fact that terns of Pitti are absolutely essential for the stability and welfare of the islands.**
- * **Posters, video films, pamphlets, T-shirts, and every other possible means must be used to popularise bird and wild life preservation.**
- * **Young men must be turned away from bird and wildlife destruction by offering them suitable occupation, facilities for sports and recreation.**



Coral



Islanders at work



Drying Copra



Wasteful Burning of Coconut Fronds



*Mr. S.P. Aggarwal I.A.S.
Administrator - Lakshadweep*



*Mrs. Nalini Jeyaseelan I.A.S.
Collector - Lakshadweep*



*Dr. C.M. Ahamed
Director S & T - Lakshadweep*



*Dr. MS. Syed Ismail Koya
Dy. Director S & T - Lakshadweep*

- * Each of the islands should have a mini interpretation centre and/or museum, where exhibits on the islands, terns and wading birds are maintained and their ecology explained.

- * Islanders from all age groups, walks of life should be given opportunity to visit some wild life sanctuaries and institutions like the National Museum of Natural History, New Delhi, the Jawaharlal Nehru Park, Hyderabad and the marine museums and aquaria of the CMFRI.

We conclude this report with the following quotation from Dr.S.Jones. "These islands are nature's precious gifts and it is left to us to look after and develop them with utmost care and foresight without destroying them."

ACKNOWLEDGEMENTS

We take this opportunity to express our gratitude to all the Government officials, scientists, and many friends who helped us in this work, from the time of its inception to its conclusion.

Our grateful thanks go to the former Administrator of Lakshadweep, Mr.Wajahat Habibullah, whose concern for the Lakshadweep environment gave the necessary impetus for the scientific study of the ecology of these scenic islands. The project was conceptualised by Mr.Romi Khosla, Member, Island Development Authority. We are thankful to him for the initiative he took, and for his continued interest in the study. Dr.C.J.Saldanha, Member Steering Committee, IDA, first identified the need for this work.

We record our deep gratitude to the Administrator, Union Territory of Lakshadweep, Mr.S.P.Aggarwal IAS, for providing the funds and all the facilities required for our work in Pitti and for his sustained involvement in the study. The Collector and Development Commissioner, Mrs.Naini Jayaseelan IAS, took a keen interest in all aspects of the project, including the arrangements for our accommodation and travel. We are grateful for her guidance and help.

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The Liaison Officer at the Lakshadweep Office in New Delhi was always helpful whenever coordination and communication difficulties arose and the P.A. to the Administrator, based in Cochin for our travel permits.

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We are grateful to the Vice Chancellor - Pro Vice Chancellor and the Head of the Department of Zoology, Calicut University, and the Principal St.Joseph College Calicut, for giving two of us the necessary leave and laboratory facilities. We have to thank the Chief Librarian of the CMFRI Cochin for making many important references available to us, and to the assistant librarians for their timely help. We thank Mr.P.E.Vijay Anand, Ph.D. scholar at Kavaratti for giving us valuable information on coral reefs.

Our visits to Lakshadweep were greatly enriched by our interaction with the islanders of Kavaratti. We particularly thank Mr.Abdul Rahim a young Zoology graduate, and M/s. K.O.Mohammed Koya and Kajan Koya Agatti both for their wholehearted cooperation in our work.

APPENDIX - 1

Food of the Sooty tern in Seyschelles (Feare 1976)

I. Squids :

1. Family - Ommastrephidae
2. Family - Enoploteuthidae
3. Family - Chirotentidae

II. Fishes :

1. Carangidae - *Decapterus SP*
2. Mullidae (2 Species?)
3. Engraulidae (*Stotephorus Sp Postlaruae ?*)
4. Hemirhamphidae *Hemirhamphus Sp*
5. Emmelichthidae (*Emmelichthys nitidus*)
6. Clupeidae (*Sardinella leiogaster*)
7. Exocoetidae (*Exocoetus volitans*)

APPENDIX - II

A CHECKLIST OF BIRDS RECORDED IN THE
LAKSHADWEEP ISLANDS

Family *Procellariidae* : Petrels and Shearwaters

- | | | |
|----|-------------------------|--------------------------------|
| 1. | Wedgetailed Shearwater | <i>Procellaria pacifica</i> |
| 2. | Audubon's Shearwater | <i>Procellaria lherminieri</i> |
| 3. | Jouanin's Gadfly Petrel | <i>Bulweria fallax</i> |

Family *Hydrobatidae* : Storm Petrels

- | | | |
|----|-------------------------|------------------------------|
| 4. | Wilson's Storm Petrel | <i>Oceanites oceanicus</i> |
| 5. | Forktailed Storm Petrel | <i>Oceanodroma leucorhoa</i> |

Family *Phaethontidae* : Tropic-birds

- | | | |
|----|--------------------------|---------------------------|
| 6. | Short-tailed Tropic-bird | <i>Phaethon aethereus</i> |
|----|--------------------------|---------------------------|

Family *Sulidae* : Boobies

- | | | |
|----|-----------------|-------------------------|
| 7. | Masked Booby | <i>Sula dactylatra</i> |
| 8. | Redfooted Booby | <i>Sula sula</i> |
| 9. | Brown Booby | <i>Sula leucogaster</i> |

Family *Phalacrocoracidae* : Cormorants and Darter

10. Large cormorant *Phalacrocorax carbo*

Family *Fregatidae* : Frigate Birds

11. Lesser Frigate bird *Fregata minor*

Family *Ardeidae* : Herons, Egrets, Bitterns

12. Grey Heron *Ardea cinerea* *
13. Purple Heron *Ardea purpurea* *
14. Little Green Heron *Ardeola striatus* *
15. Pond Heron *Ardeola grayii* *
16. Cattle Egret *Bubulcus ibis* *
17. Little Egret *Egretta garzetta* *
18. Reef Heron *Egretta gularis* *
19. Yellow Bittern *Ixobrychus sinensis* **

Family *Anatidae* : Ducks, Geese, Swans

20. Ruddy Shelduck *Tadorna ferruginea*
21. Common Teal *Anas crecca*
22. Garganey *Anas querquedula*
23. White-eyed Pochard *Aythya nyroca*

Family *Accipitridae* : Hawks, Vultures etc.

24. Blackwinged kite *Elanus caeruleus*
25. Pariah kite *Milvus migrans*
26. Shikra *Accipiter badius*
27. Whitebellied sea Eagle *Haliaeetus leucogaster*
28. Pale Harrier *Circus macrourus*
29. Montagu's Harrier *Circus pygargus*
30. Marsh Harrier *Circus aeruginosus*
31. Osprey *Pandion haliaetus*

Family *Falconidae* : Falcons

32. Peregrine Falcon *Falco peregrinus*
33. Kestrel *Falco tinnunculus* *

Family *Rallidae* : Rails, Coots

34. Little Crake *Porzana parva*
35. Whitebreasted waterhen *Amaurornis phoenicurus* *

Family *Recurvirostridae* : Stilts, Avocets

36. Blackwinged Stilt *Himantopus himantopus*

Family *Dromadidae* : Crab Plovers

37. Crab Plover *Dromas ardeola* *

Family *Burhinidae* : Stone curlews

38. Stone Curlew *Burhinus oedicnemus*

Family *Charadriidae* : Plovers, Sandpipers, Snipe

39. Grey Plover *Pluvialis squatarola* *

40. Eastern Golden Plover *Pluvialis dominica* *

41. Large sand Plover *Charadrius leschenaultii*

42. Kentish Plover *Charadrius alexandrinus* *

43. Lesser sand Plover *Charadrius mongolus* *

44. Whimbrel *Numenius phaeopus* *

45. Curlew *Numenius arquata* *

46. Bartailed Godwit *Limosa lapponica*

47. Redshank *Tringa totanus*

48. Greenshank *Tringa nebularia* *

49. Green Sandpiper *Tringa ochropus*

50. Wood Sandpiper *Tringa glareola*

51. Terek Sandpiper *Tringa terek* *

52. Common Sandpiper *Tringa hypoleucos* *

53. Turnstone *Arenaria interpres* *

54. Snipe Sp. *Gallinago Sp.*

55. Eastern knot *Calidris tenuirostris*

56. Sanderling *Calidris alba* *

57. Little Stint *Calidris minuta* *

Family *Stercorariidae* : Skuas, Jaegers

58. South Polar or Antarctic Skua *Catharacta skua maccormicki*

59. Pomatorhine Skua or Jaeger *Stercorarius pomarinus*

60. Parasitic Skua or Jaeger *Stercorarius parasiticus*

Family *Laridae* : Gulls, Terns.

61. Lesser Blackbacked Gull *Larus fuscus*

62. Gullbilled Tern *Gelochelidon nilotica* **

63. Whitecheeked Tern *Sterna repressa*

64. Brownwinged Tern *Sterna anaethetus*

65. Sooty Tern	<i>Sterna fuscata</i>	*
66. Little Tern	<i>Sterna albifrons</i>	*
67. Large Crested Tern	<i>Sterna bergii</i>	*
68. Lesser Crested Tern	<i>Sterna bengalensis</i>	*
69. Noddy Tern	<i>Anous stolidus</i>	*
70. Lesser Noddy	<i>Anous tenuirostris</i>	

Family *Columbidae* : Pigeons, Doves.

71. Blue Rock Pigeon	<i>Columba livia</i>	*
72. Rufous Turtle Dove	<i>Streptopelia orientalis</i>	

Family *Psittacidae* : Parrots

73. Roseringed Parakeet	<i>Psittacula krameri</i>	*
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Family *Cuculidae* : Cuckoos

74. Pied Crested Cuckoo	<i>Clamater jacobinus</i>	
75. Cuckoo	<i>Cuculus canorus</i>	
76. Plaintive Cuckoo	<i>Cacomantis passerinus</i>	**
77. Koel	<i>Eudynamys scolopacea</i>	*

Family *Strigidae* : Owls

78. Brown Fish Owl	<i>Bubo zeylonensis ?</i>	
79. Brown Wood Owl	<i>Strix leptogrammica</i>	

Family *Apodidae* : Swifts

80. Whiterumped Spinetail	<i>Chaetura sylvatica</i>	
81. House Swift	<i>Apus affinis</i>	
82. Palm Swift	<i>Cypsiurus parvus</i>	

Family *Alcedinidae* : Kingfishers

83. Small Blue Kingfisher	<i>Alcedo atthis</i>	
84. Whitebreasted kingfisher	<i>Halcyon smyrnensis</i>	
85. Blackcapped kingfisher	<i>Halcyon pileata</i>	

Family *Coraciidae* : Rollers

86. Indian Roller	<i>Coracias benghalensis</i>	
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Family *Upupidae* : Hoopoes87. Hoopoe *Upupa epops***Family *Pittidae* : Pittas**88. Indian Pitta *Pitta brachyura* ***Family *Hirundinidae* : Swallows**89. Collared Sand Martin *Riparia riparia* **90. Common Swallow *Hirundo rustica* *91. Redrumped Swallow *Hirundo daurica*92. House Martin *Delichon urbica***Family *Laniidae* : Shrikes**93. Brown Shrike *Lanius cristatus* ***Family *Sturnidae* : Mynas**94. Common Myna *Acridotheres tristis***Family *Corvidae* : Crows**95. House Crow *Corvus splendens***Family *Muscicapidae* : Babblers, Flycatchers, Warblers, etc.**96. Blyth's Reed Warbler *Acrocephalus dumetorum* ****Family *Motacillidae* : Pipits, Wagtails.**97. Tree Pipit *Anthus trivialis* **98. Paddyfield Pipit *Anthus novaeseelandiae* **99. Yellow Wagtail *Motocilla flava* *100. White Wagtail *Motacilla alba* ***Family *Zosteropidae* : White eyes.**101. White-eye *Zosterops palpebrosa*

* Birds seen in the course of this survey.

** seen for the first time in Lakshadweep.

In addition to the above-listed birds, we also saw an unidentified raptor and duck in flight.

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This checklist is based on our own observations and on some published and unpublished accounts.

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