OBSERVATIONS ON SOME PLANKTONIC GROUPS OF KAVARATTI ATOLL (LACCADIVES)

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Studies were undertaken on the total zooplankton biomass and the faunistic groups together with the diurnal species variations in the lagoon and of the surrounding sea of the Kavaratti atoll (Laccadives).

The temperature, salinity and oxygen values were higher for the lagoon than for the sea during the day. There was nocturnal abundance of zooplankton both in the open sea and in the lagoon. The latter had higher biomass than the former. The major planktonic groups were Copepoda, Decapoda, Amphipoda, Chaetognatha Mysidacea and fish eggs and larvae. The copepods formed an important constituent of the faunistic groups both inside and outside the lagoon during the day. However, mysids outnumbered copepods during the night in the lagoon. The fish eggs were more in the lagoon at night whereas, the fish larvae were abundant in the sea during the day. The planktonic groups and the numerical abundance of different species under various groups were more for the stations in the open sea than in the lagoon.

INTRODUCTION

The Laccadives Archipelago consists of a group of twenty islands in the Arabian Sea about three hundred kilometres from the southwest coast of India (Kerala). All the islands except Minicoy are situated between Lat. 10°N and 12°N and Long. 71°41'E and 74°E. Of these islands, at least ten are atolls, each with a lagoon surrounded by a ring-shaped coral reef.

Since Gardiner's (1903—1906) classical work on the fauna and geography of the Maldive and Laccadive Archipelago, there has been no other comprehensive study on this region. Recently. Tranter and George (1969) have described the nocturnal abundance of zooplankton. Qasim and Sankaranarayanan (1970), Qasim and Bhattathiri (1971) and Qasim *et al.* (1972) have carried out studies on the primary production and other related parameters.

Besides these, however, no other published account seems to be available on plankton in relation to the varying hydrographical conditions both inside and outside the lagoon in regard to the atolls of Laccadive region.

As a part of the Arabian Sea Islands Research Project sponsored by the Indian National Science Academy, studies were undertaken on the total zooplankton

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biomass, the general faunistic groups and species abundance in relation to hydrographical conditions of the lagoon and of the surrounding sea of Kavaratti atoll. The results of these investigations have been discussed in this paper.

Topographical features

Kavaratti, a perfect atoll (Gardiner 1906) is located along Lat. 10°33'N and Long. 72°36'E. The lagoon of the atoll is oriented in a north-south direction, with the island on the east and the coral reef on the west (Fig. 1). It is approximately 4,500 m long, 1,200 m wide with an average depth of 2 m. The main navigational enterance to the lagoon is at the northwest end. The transport of water from the sea to the lagoon is maintained all the time by the action of the surf which breaks across the reef and is swept into the lagoon. The coral reef borders the western side of the lagoon and is visible only during the low tide. Details of topographical features have been dealt with by Qasim *et al.* (1972).

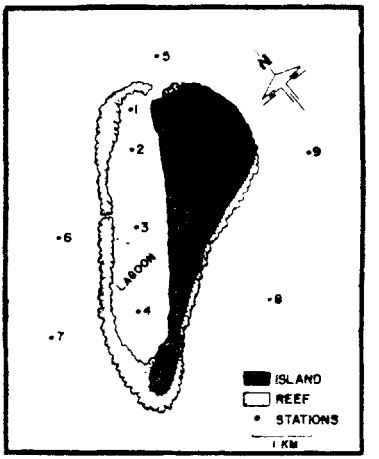

FIG. 1. Kavaratti Atoll showing the position of the stations worked out.

MATERIALS AND METHODS

Studies on the zooplankton and hydrographical conditions were made during the month of April, 1971. Nine stations were fixed, four inside the lagoon and five in the surrounding sea (Fig. 1). In all, thirty six zooplankton samples were collected during the day (09.00–11.00 hours) and night (19.00–21.00 hours). Hydrographical observations were made simultaneously at each station. Most of the observations were made during the high tide and the values for zooplankton and hydrographical factors were averaged.

Zooplankton samples were collected from surface using a modified WP–2 net (Unesco 1968). The plankton net was made of nylon gauze with a mesh width of 0.2 mm. The samples were fixed 5 per cent sea-water formaldehyde buffered with 1 per cent hexamine. In the laboratory, each zooplankton sample was divided into

four aliquots; one part was used for the estimation of displacement volume and for wet and dry weight, the second for faunistic composition, the third for taxonomic studies and the fourth was kept as a reference collection.

RESULTS

Hydrography

The hydrographical conditions in the lagoon and in the surrounding sea have been shown in Fig. 2. The temperature varied from 29.7 to 31.9°C in the lagoon and from 29.8 to 31.1°C in the sea. The salinity values ranged from 34.15 to 35.64 ‰ and 34.10 to 34.98‰ and *p*H from 7.9 to 8.3 and 8.1 to 8.3 in the lagoon and sea respectively. The temperature and salinity values during the day were higher for the lagoon than for the surrounding sea. This can be attributed to the shallowness of the lagoon.

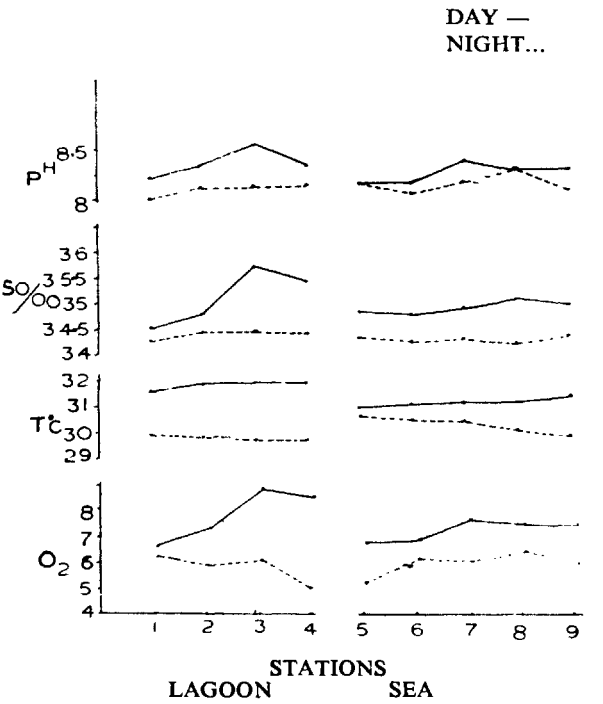

FIG. 2. Hydrographical features of lagoon and sea during day and night.

Zooplankton

Biomass—The displacement volume (ml/1000 m³) and wet weight (mg/1000 m³) of the total zooplankton and of the gelatinous organisms during day and night have been shown in Figs. 3 and 4 respectively. It is evident that the values were higher for the night collections than for the day and also that lagoon has a higher biomass then the open sea. The dry weight values (Fig. 5) also follow a similar pattern as that of the wet weight for a lagoon and sea stations during day and night.

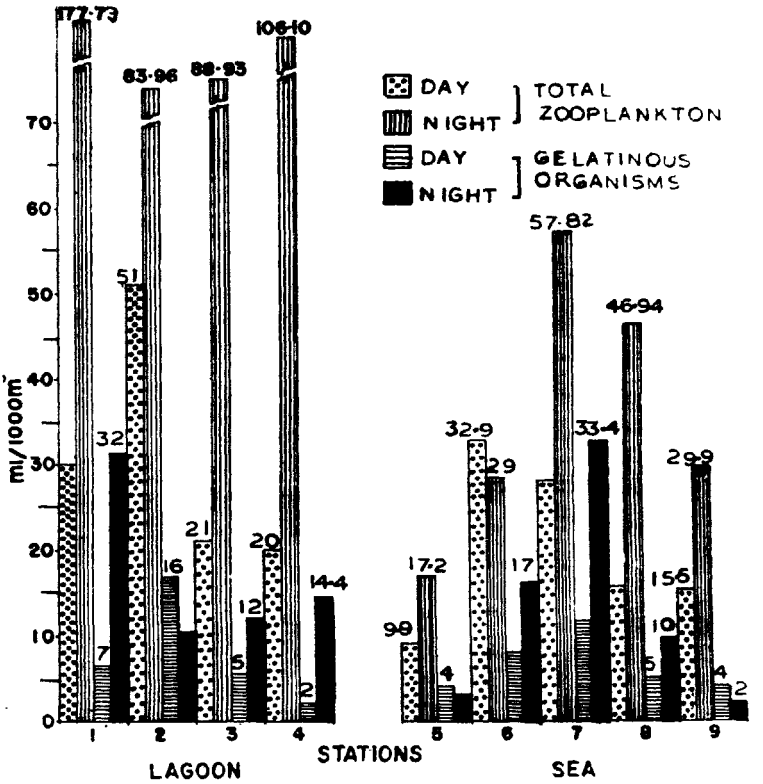

FIG. 3. Displacement volume of total zooplankton and gelatinous organisms during day and night.

Species composition and diurnal variation

The percentage composition of the seven planktonic groups for all the stations during day and night has been shown in the Fig. 6. The variation of species composition of some important planktonic groups are as follows :

Chaetognatha—This group showed preference to waters of the open sea and appeared in large numbers during day than at night. In all, eight species belonging to three genera, viz. *Sagitta enflata* Grassi, *S. pacifica* Aida, *S. robusta* Doncaster, *S. regularis* Aida, *S. neglecta* Aida, *S. pulchra* Doncaster, *Pterosagitta draco* (Krohn), and *Krohnitta pacifica* Aida were recorded.

The percentage distribution of species at all the stations during day and night has been shown in Fig. 7. *Sagitta enflata* is the most common species, especially in the lagoon. This group was absent in the lagoon collections during night. Species of *Krohnitta pacifica* and *Pterosagitta draco* were observed only at the sea stations.

Mysidacea—This group was abundant in the lagoon during night, the highest percentage recorded being 74.59 per cent (Fig. 7). Species of the genera *Animysis, Gastrosaccus* and *Siriella* were recorded. *Gastrosaccus indicus* and *Siriella gracilis* were present in the lagoon waters.

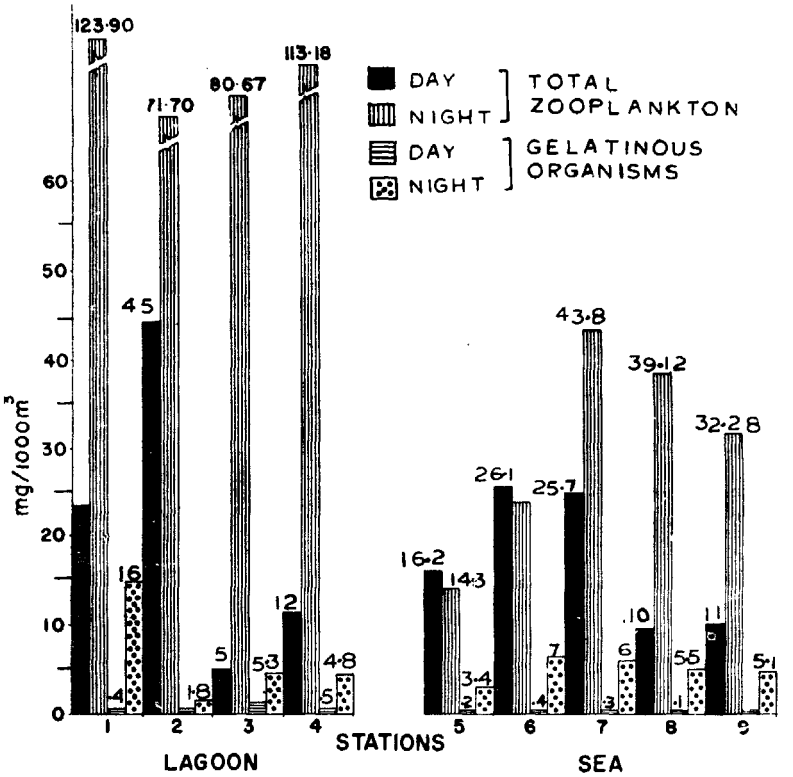

FIG. 4. Wet weight of total a zooplankton and gelatinous organisms during day and night.

Polychaeta—This group was also represented more in the night collections. Species belonging to the genera *Typloscolex, Glycera, Nereis, Pelagobia* and *Vanadis* were recorded. *P. longicirrata* and *G. laccadivae* were observed in waters around the Kavaratti atoll. Peter (1971) has reported the occurrence of *P. longicirrata, Phyllodoce castanea, Lopadorhynchus nationalis* from waters of Kavaratti and Kalpeni islands.

Amphipoda—This group was abundant in the night samples. The highest percentage obtained was from the lagoon where a swarm of gammarid amphipods were observed. In the sea stations, amphipods belonging to the suborder Hyperiidea were present. Species of *Hyperia schizogenoios* and *Platyblus senatulus* were predominant in the sea.

Copepoda—This group was the major component of the plankton community both in the lagoon and around atoll during day. It is quite clear from the Table I that the number of species as such, is more in the sea than in the lagoon. *Eucalanus elongatus; Eucalanus attenuatus; Eucalanus monachus; Paracalanus aculeatus; Euchaeta* sp; *Centropages* sp; *Centropages elongatus; Lucicutia flavicornis; Pontella spinipes;* and *Pleuromamma xiphias* were present in the zooplankton collections around the atoll. Inside the lagoon, the harpacticoid species *Dactylopus maldivensis; Macrostella gracilis, Miracia efferata, Euterpina acutifrons* and *Amphidiscus* sp.

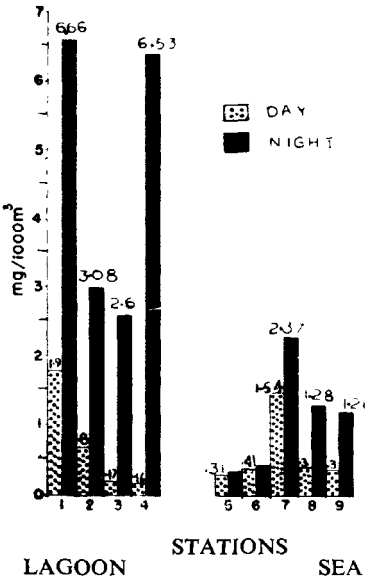

FIG. 5. Dry weight of total zooplankton during day and night.

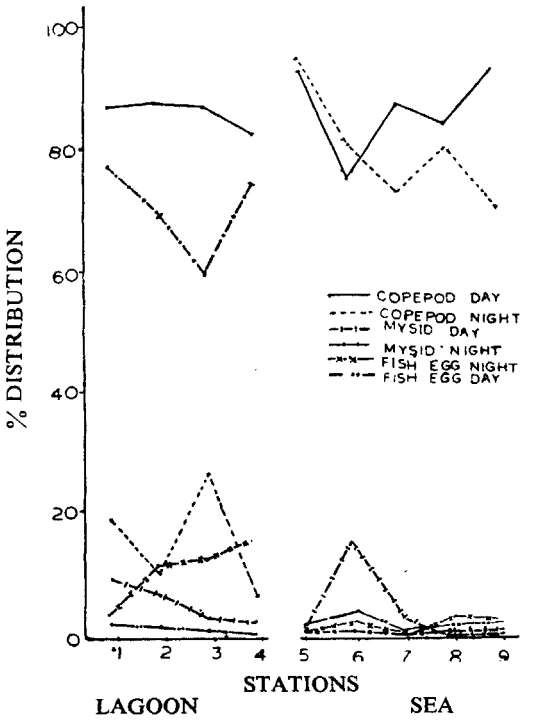

FIG. 6. Percentage composition of planktonic groups during day and night.

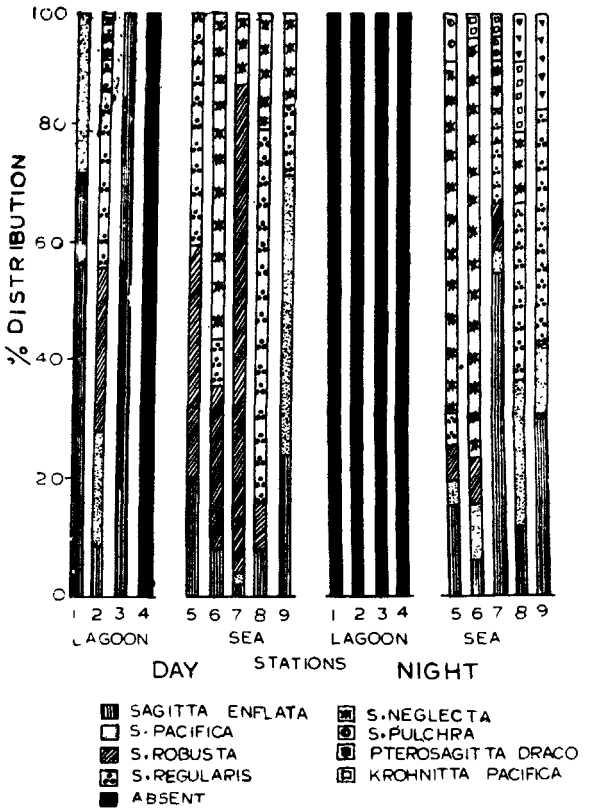

FIG. 7. Per cent distribution of Chaetognath species during day and night.

were abundant. *Dactylopus maldivensis* and *Amphidiscus* sp. seem to form an endemic population in the Kavaratti lagoon. Wolfenden (1906) has also recorded *Dactylopus maldivensis* and *Amphidiscus* sp. from this region.

Decapod larvae—The percentage occurrence of this group is greater in the lagoon than in the sea, Zoea of Brachvura were abundant at all the stations. Members of the families Inachidae, Lencosiidae and Xanthidae were recorded at the sea stations. *Pagurid glaucothae* was present in the lagoon collections and appears to be an endemic species. Lucifers were represented by a single species *Lucifer typus,* common both to the lagoon and sea stations.

Fish eggs and larvae—The percentage of fish eggs was highest during night in the lagoon collections. The fish larvae, on the other hand, were more in the sea during day. The fish larvae belonging to the families Gobiidae, Myctophidae and Holocentridae were observed in both lagoon and the sea. However, the members of the family Gobiidae were comparatively more in the lagoon than in the sea. The larvae of the families Stomiatidae, Stromateidae, Scorpaenidae and of the order pleuronectiforms were recorded in the sea collections. Jones (1961) and Jones and Kumaran (1962) have given list of fish larvae identified by them around Laccadive islands.

TABLE I

Distribution of Copepod species in the lagoon and sea at Kavaratti atoll

Species	Lagoon	Sea
Neocalanus gracilis (Dana)	—	+
Neocalanus sp.	—	+
Nannocalanus minor (Claus)	+	+
Canthocalanus pauper (Giesbrecht)	+	+
Undinula vulgaris (Dana)	+	+
Undinula darwinii (Lubbock)	—	+
Eucalanus crassus Giesbrecht	+	+
Eucalanus subcrassus Giesbrecht	+	+
Eucalanus elongatus (Dana)	—	+
Eucalanus attenuatus (Dana)	—	+
Eucalanus monachus Giesbrecht	—	+
Rhincalanus nasutus Giesbrecht	—	+
Paracalanus parvus (Claus)	+	+
Paracalanus aculeatus Giesbrecht	—	+
Paracalanus sp.	—	+
Acrocalanus gracilis Giesbrecht	—	+
Acrocalanus gibber Giesbrecht	—	+
Acrocalanus monachus Giesbrecht	—	+
Acrocalanus longicornis Giesbrecht	—	+
Clausocalanus arcuicornis (Dana)	—	+
Euchaeta wolfendeni A. Scott	—	+
Euchaeta sp.	—	+
Centropages orsinii Giesbrecht	+	+
Centropages élongatus Giesbrecht	—	+
Centropages furcatus (Dana)	—	+
Centropages sp.	—	+
Calanopia aurivillii (Cleve)	+	+
Labidocera pectinata Thompson & Scott	+	+
Pontellina plumata (Dana)	+	+
Pontella spinipes Giesbrecht	—	+
Acartia danae Giesbrecht	+	+
Acartia sp.	—	+
Pleuromamma abdominalis (Lubbock)	—	+
Pleuromamma xiphias (Giesbrecht)	—	+
Pleuromamma sp.	—	+
Macrostella gracilis (Dana)	+	+
Clytémnestra scultellata Dana	+	+
Oithona plumifera Baird	+	—
Oithona tropica Wolfenden	+	+

(*Contd.*)

TABLE I (*Contd.*)

Species	Lagoon	Sea
Oithona robusta Giesbrecht	—	+
Oithona similis Claus	—	+
Oncaea venusta Philippi	+	+
Oncaea conifera Giesbrecht	—	+
Corycaeus pellucidus Dana	+	+
Corycaeus gibbulus Giesbrecht	+	+
Corycaeus longistylis Dana	—	+
Copilia mirabilis Dana	+	+
Copilia quadrata Dana	—	+
Sapphirina ovatolanceolata Dana	—	+
Porcellidium tuberculatum Wolfenden	+	—
Dactylopus maldivensis Wolfenden	+	—
Amphidiscus sp.	+	—

+ = Present; — = Absent

DISCUSSION

The atolls of the Laccadives are characterised by the shallowness of their lagoons. The average depth of Kavaratti lagoon is about 2 m. The clarity of water, high illumination owning to shallowness and the presence of thick growth of macrophytes, make the Kavaratti lagoon, a very productive marine environment. Qasim *et al.* (1972) have also recorded higher primary production in the lagoon of Kavaratti atoll. Almost all the atolls of the Laccadives, are oriented in the north-south direction, receiving heavy south-west monsoon from June to September and less forceful northeast monsoon from November to December. The month of April, being the premonsoon month, it depicts stable conditions in the environment. Four parameters *viz.* temperature, salinity, oxygen and *p*H were recorded during present investigation. The temperature and salinity values have always been higher for Kavaratti lagoon during day, which may be due to the shallow nature of the lagoon. Patil and Ramamirtham (1961) have recorded surface values for *p*H, temperature, salinity and oxygen as 8.3 to 8.5, 28.0 to 29°C, 34.2 to 36.2 $^{\circ}/_{\circ\circ}$ and 4.3 to 4.66 ml/L respectively for the waters around Laccadive islands in the month of December.

The zooplankton biomass for the month of April was quite low as compared to the general biomass values for the neritic waters. This may be because of the massive bloom of blue green alga, *Irichodesmium* (Qasim 1970), or due to the presence of large number of scyphozoan medusae of the genus *Chiropsalmus* which feed voraciously on zooplankton. The zooplankton biomass was greater during the night than during the day. The nocturnal abundance of zooplankton has been reported by Tranter and George (1969) from Kavaratti atoll and also by Emery (1968) from waters near coral reefs. The zooplankton biomass was higher for the lagoon than that of the sea at Kavaratti atoll. This may be due to the circulatory pattern of current or luxuriant

growth of sea grass—*Thalassia hemprichii* and *Cymodocea isoetifolia* and/or presence of more organic particulate matter in the lagoon (Qasim and Sankaranarayanan 1970). Michel (1969) has given the biomass values for the lagoon about seventeen times higher than for the surrounding sea at Mururoa atoll. Iranter and George (1969) have reported lower biomass values for the Kavaratti lagoon during post-monsoon period. They have attributed the lower values to the consumption of zooplankton by the corals as the water passes over the coral-reef. It seems that the presence of sea grass plays an important part in the ecosystem of Kavaratti lagoon since the decaying sea grass as detritus form the food of certain animal species.

The faunistic composition of zooplankton in Kavaratti lagoon and at the sea stations varied both qualitatively and quantitatively, during the day and at night. Michel (1969) has reported that only eight species formed almost the total holoplankton population of the lagoon while large number of species occurred at sea stations at Mururoa atoll. Chaetognaths were distributed more in the sea stations. Vijayalahshmi and Rao (1971) have recorded that the chaetognaths are very poor in the Kavaratti lagoon. However, they have reported the presence of *S. bedoti* and *S. ferox* in the waters around Kavaratti atoll and absence of *Pterosagitta draco* in the lagoon. Copepod species were more in the sea than in the lagoon of Kavaratti atoll. The zooplankton population of harpacticoid copepods, gammarid amphipods and mysids showed higher degree of endemicity in Kavaratti lagoon. Johnson (1954) has also reported similar endemic population from the lagoon of Bikini.

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References

Emery, A. R. (1968). Preliminary observations on coral reef plankton. *Limnol. Oceanogr.*, **13**, 293–303.

Gardiner, J. S. (1906). The Fauna and Geography of the Maldive and Laccadive Archipelagoes. Vol. 2. Cambridge Univ. Press. pp. 1–1097.

Jones, S. (1961). Notes on eggs, larvae and juveniles of fishes from Indian waters. *Indian J. Fish.*, **9**, 107–120.

Jones, S., and Kumaran, S. (1962). Notes on eggs, larvae and juveniles of fishes from Indian waters. *Indian J. Fish.*, **9**, 155–167.

Johnson, M. W. (1954). Plankton of Northern Marshall Islands. *Prof. Pap. U. S. Geol. Surv.*, 260–E, 301–314.

Michel, A. (1969). Plankton du Lagoon Et 'des abords extre 'ricrs de L' atoll de Mururoa. *Extract des coshiers du Pacilique* No. 13, 81–131.

Patil, M. R., and Ramamirtham, C P. (1961). Hydrography of the Laccadives offshore waters. A study of the winter conditions. *J. mar. biol. Ass. India*, **5**, 159–169.

Peter, G. (1971). New Records of some pelagic polychaeta from Arabian Sea and from Kavaratti and Kalpeni atolls (Laccadives). (*in press*).

Qasim, S. Z. (1970). Some characteristic of *Trichodesmium* bloom in the Laccadives. *Deep Sea. Res.*, **17**, 660–665.

Qasim, S. Z., and Bhattathiri, P. M. A. (1971). Primary production of a sea grass bed on Kavaratti atoll (Laccadives). *Hydrobiologia,* **38**, 29–38.

Qasim, S. Z., and Sankaranarayanan, V. N. (1970). Production of particulate organic matters by the reef on Kavaratti atoll (Laccadive). *Limnol. Oceanogr.*, **15**, 574–578.

Qasim, S. Z., Bhattathiri, P. M. A., and Reddy, C. V. G. (1972). Primary production of an atoll in the Laccadives. *Int. Revue. ges. Hydrobiologia*, **57**, 227–246.

Tranter, D., and George, J. (1969). Nocturnal abundance of zoo plankton at Kavaratti and Kalpeni, two atolls in the Laccadives Archipelago. (*Abstract*). Symp. Corals and Coral-reefs. Mar. biol. Ass. India, No. 21, 16.

Unesco. (1968). Zooplankton Sampling. Monograph on Oceanographic Methodology, **2**, 1–176.

Vijayalakshmi, R. N., and Rao, T. S. S. (1971). Chaetognaths from the Laccadives with a note on the new record of *Spadella angulata*. *Kiel. Symp.* Germany. (*In press*).

Wolfenden, N. R. (1906). Notes on the collection of Copepoda. *In :* The fanna and geography of the Maldive and Laccadive Archipelagoes, (Ed. : J. S. Gardiner Vol. II and Suppl. I and II, Cambridge Univ. Press, 989–1040.