J. Mar. biol. Ass. India, 1968, **10** (1) : 78-87

ON THE DISTRIBUTION OF PALINURID AND SCYLLARID LOBSTERS IN THE INDIAN OCEAN[1]

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INTRODUCTION

DURING the course of a study of the phyllosoma larvae collected from the Indian Ocean the need for compiling information on the distribution of the various species of adult lobsters recorded from the region was felt. Further, the increasing demand for lobster tails and consequent stepping up in the commercial exploitation of lobsters necessitate a study of the geographical distribution of the various species which constitute the fishery. Identifying phyllosoma larvae is an extremely difficult task. Two ways this could be achieved are by rearing them in the laboratory or by a process of elimination based on the knowledge of the geographical distribution of the adults. While identification by the latter procedure will still be provisional the former will give more precise data. Based on rearing work the authors (see Prasad and Tampi, 1957, 1959a and 1960) have already described the phyllosoma of four species viz., *Thenus orientalis*, *Scyllarus sordidus*, *Panulirus ornatus* and *P. homarus* (as *P. burgeri*). On account of great difficulties in rearing all the known species in the laboratory it was thought that the unknown types of larvae could be tentatively assigned to different species on the basis of the distribution of the adults. Therefore, data on the distribution of the species of adult palinurids and scyllarids recorded from the Indian Ocean region, at present lying scattered, have been brought together here.

The preparation of this report has been made somewhat difficult owing to the confusion in the taxonomic status of some of the species plus the fact that in several instances, particularly in the earlier records, the locality has not been accurately given.

The authors are thankful to the Crustacean Division of the Central Marine Fisheries Research Institute for the help rendered in the preparation of the charts.

DISTRIBUTION

PALINURIDAE

All the nine genera constituting this family are represented in the Indian Ocean. Eighteen species belonging to these genera have been reported as occurring in various parts (Fig. 1). Considerable uncertainty yet prevails in the taxonomy and the validity of some of the species reported in literature appears doubtful. In this

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account only those names which are widely used have been included disregarding all references to varieties. Even at that some species mentioned here may constitute more than one species. As an example the confusion prevailing in the nomenclature of the species *Jasus lalandei* could be cited. According to Holthuis (1963) the species *Jasus lalandei* should be separated into six species *viz.*, *J. lalandii*, *J. paulensis*, *J. novaehollandiae*, *J. frontalis*, *J. edwardsii* and *J. tristani*. Silas (1965) has described in some detail the taxonomy of the genus *Jasus*. Fielder and Olsen (1967) have treated these as the 'lalandei' complex. Pending further studies on the usefulness of the character of abdominal sculpturing, the name *Jasus lalandei* is used here.

The available information shows that while all the nine genera are found in the region south of the equator, five genera *viz.*, *Jasus*, *Projasus*, *Palinurellus*, *Justitia* and *Linuparus* have not been recorded in the northern half. Similarly amongst the eighteen species, distribution of which is shown, *Puerulus sewelli* and *Panulirus japonicus* are confined to the seas north of the equator, whereas *Jasus lalandei*, *J. verreauxi*, *Panulirus cygnus*, *Palinurus gilchristi*, *Palinurellus wieneckii*, *Justitia longimana*, *Projasus parkeri* and *Linuparus trigonus* are found only in the southern half. In regard to the distribution of *J. verreauxi*, Gruvel (1911) has given it as 'Ocean Indien'. Since information on the exact locality is not available the distribution has not been indicated in Fig. 1. Further, as the genus *Jasus* has been recorded only from the southern hemisphere it is presumed that this species too is restricted to the southern half. Eight species *viz.*, *Puerulus angulatus*, *Panulirus longipes*, *P. homarus*, *P. penicillatus*, *P. polyphagus*, *P. ornatus*, *P. versicolor* and *Palinustus mossambicus* are common to both halves. It is not unlikely that more intensive search would reveal that some of these genera and species may have wider distribution. In this context it is of interest to note that the first phyllosoma stage of *Jasus* was recorded by the authors near the Laccadive islands (Prasad and Tampi, 1959*b*). While describing these larvae the authors remarked: 'It is unlikely that these early stages could have been carried all the way into this area from the known northern distribution limit of the adults. Further, it may be mentioned here that the maximum concentration of phyllosomas was recorded at station No. 448 all of which were in the first stage suggesting the greater possibility of these larvae being released in the vicinity.... Therefore, the chances of the occurrence of *Jasus* in the Northern Hemisphere also somewhere in the neighbourhood of these islands cannot be overlooked.' In fact recent surveys carried out in the deeper waters along the coast of India have brought to light the occurrence of several species of crustaceans not recorded earlier from the Indian Ocean.

The localities from which the various species mentioned above have been collected are as follows. For the sake of completeness localities even outside the Indian Ocean region have been mentioned.

A—*Palinurellus wieneckii* (de Mann)—Port Louis, Mauritius, Pulu Tikus near Benkulen, Sumatra, Borneo and Caroline Islands.

B—*Palinustus mossambicus* Barnard—Portuguese East Africa and Sulu Sea. Recently from south-west coast of India.

C—*Linuparus trigonus* (Von Siebold)—Portuguese East Africa, Japan, Tokyo, Yokohama, Tokyo Bay, Sagami Bay, Mie Prefecture, Seto near Wakayama, Honshu, Komai and Ikari, Kyushu, Yeddo, Oomura and Simabara Bays near

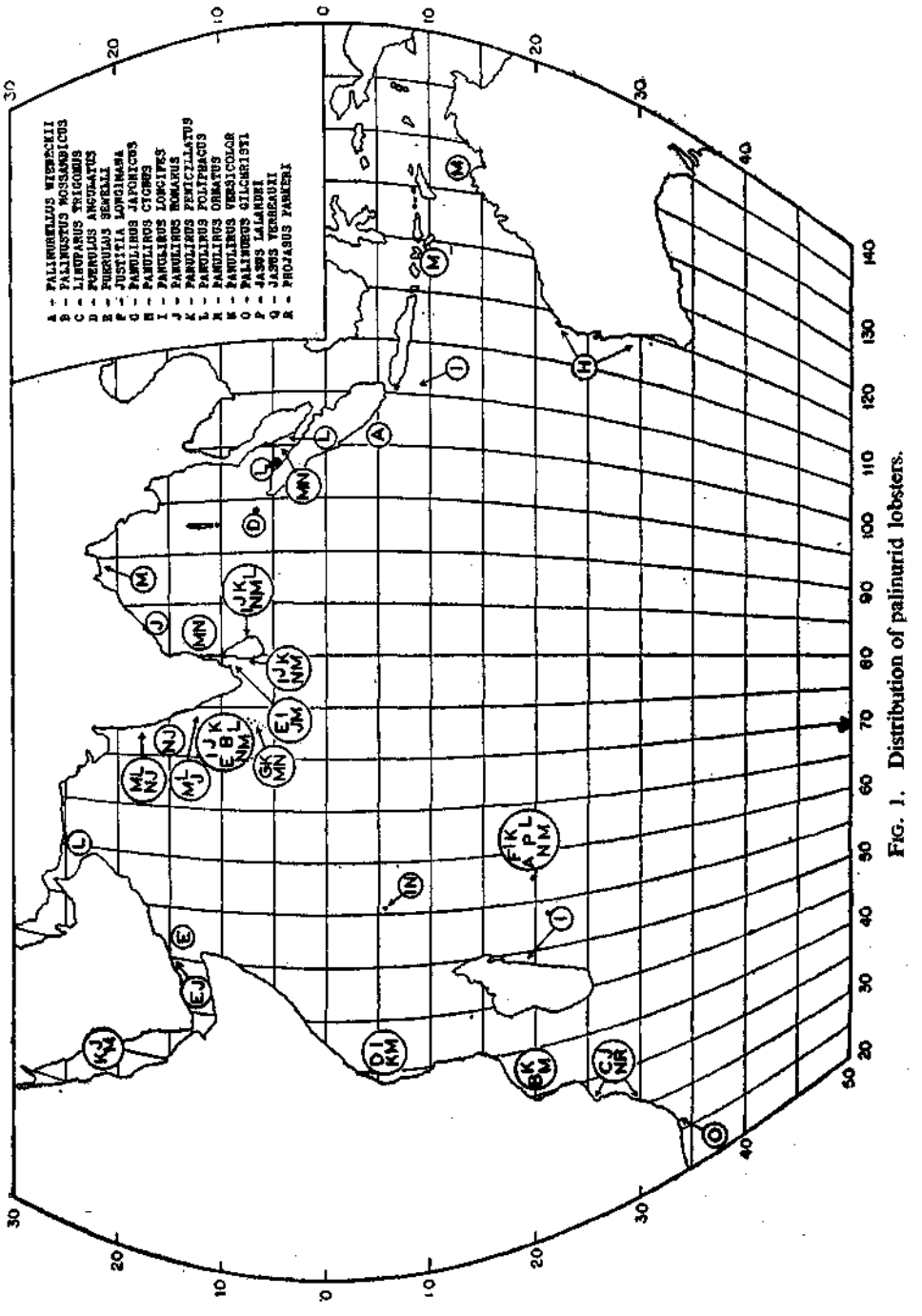

FIG. 1. Distribution of palinurid lobsters.

Nagasaki, Korea, Ningpo, Chekiang, China, Chushan, Formosa, New South Wales, Australia, off Inhambane and Philippines.

D—*Puerulus angulatus* (Bate)—East of Zanzibar, near Saya de Malha Bank, western Indian Ocean, west of Nicobar Islands, north of New Guinea, Bali Sea, off Kominato, Bosyu Province, Honshu, Japan and Philippine Islands.

E—*Puerulus sewelli* Ramadan—Gulf of Aden, Arabian Sea off Kerala, India, west of Colombo Light, Ceylon and Gulf of Mannar.

F—*Justitia longimana* (H. Milne-Edwards)—Cuba, Santa Cruz, Martinique, Antilles and Mauritius.

G—*Panulirus japonicus* (Von Siebold)—Japan, Korea, East China Sea, Amoy, China, Formosa, Tamsui, North Formosa and Maldives.

H—*Panulirus cygnus* George—Entire west coast of Australia.

I—*Panulirus longipes* (A. Milne-Edwards)—Zanzibar, Delagoa Bay, Portuguese East Africa off Natal, Madagascar, Réunion, Mauritius, Ceylon, Indomalayan seas, Christmas Island, north of Sumatra, Moluccas, New Guinea, south coast of Papua, New South Wales, Australia, Loyalty Islands, New Hebrides, Ellice Islands, Japan and Tahiti.

J—*Panulirus homarus* (Linnaeus)—Madagascar, South Arabia, Red Sea, Indian seas, Gulf of Mannar, Ceylon, Sagami Bay, East India, Sabang Bay, Sumatra, Borneo, Makassar, Ambon, Aroe Islands, Marquisas, North Celebes, Moluccas, New Guinea, New Britain and Southern seas.

K—*Panulirus penicillatus* (Olivier)—Red Sea, Gulf of Aqaba, El Qoseir, Jidda, Natal, Madagascar, Mozambique, Réunion, Mauritius, Chagos Archipelago, Minicoy Island, Arabian Sea, Maldives, Ceylon, Korea, Formosa, Indomalayan seas, Mindoro, Simaloer Island, Nias, Sumatra, Christmas Islands, New Guinea, North Australia, South Seas, Pacific Islands, Marianne Islands, New Hebrides, New Caledonia, Loyalty Islands, Rotuma, Fiji, Samoa, Tahiti, Wake Island, Hawaiian Islands, Johnston Island, Hao, Taumotu Islands and Galapagos Islands.

L—*Panulirus polyphagus* (Herbst)—Natal, Mauritius, Indian seas, Baluchistan, Ceylon, Maldives, Singapore, Japan, Amur reef, Annam, Cochinchina, Luzon, Java, West Borneo, Ambon, Great Barrier Reef and Tahiti.

M—*Panulirus ornatus* (Fabricius)—Red Sea, Obock, Mozambique, Zanzibar, Durban, Natal, Madagascar, Nossy Bé, Réunion, Mauritius, Indian seas, Gulf of Mannar, Ceylon, Singapore, Formosa, Amoy, Swatow, Hongkong, Annam, Luzon, Mindoro, Sangihe Islands, South Celebes, Java Sea, Ambon, New Guinea, North Australia, North Queensland, Southern seas and Nissan Atoll.

N—*Panulirus versicolor* (Latreille)—Persian Gulf, Nossy Bé, Madagascar, Mauritius, Seychelles Bank, Maldives, Indian seas, Ceylon, Singora, Japan, Formosa, Annam, Philippines, Mindoro, Nias, Simaloer, Poeloe Berhala, Java Sea, North and South Celebes, Talaud Islands, Ternate, Soela Sanana, Ambon, south of Ceram, Banda Sea, Lucipara Islands, Kai Islands, Aroe Islands, Soembawa, Flores, Roti, Sawoe, north of Timor, Christmas Island, New Guinea, New Britain, Solomon Islands, Thursday Island, Australia, Fiji and Samoa.

O—*Palinurus gilchristi* Stebbing—False Bay and Agulhas Bank to Algoa Bay (South Africa).

P—*Jasus lalandei* (H. Milne-Edwards)—South Africa, St. Paul and Amsterdam Islands, south-east Australia, Otago, Stewart Island, Tasmania, Juan Fernandez, New Zealand, Tristan da Cunha, Chile, St. Felix and St. Ambrosius Islands.

Q—*Jasus verreauxi* (H. Milne-Edwards)—Indian Ocean, North Island, New Zealand and Australia (New South Wales).

R—*Projasus parkeri* (Stebbing)—Off East London (South Africa).

SCYLLARIDAE

There are at present six genera recognized under this family of which five have been recorded from the Indian Ocean. The genera *Ibacus* and *Parribacus*, however, seem to be confined to the southern half. Although the number of genera in the family is fewer compared to Palinuridae there is a larger number of species in Scyllaridae. Of the twenty species included here five are restricted to the northern half, eight to the area south of the equator and the remaining seven common to both (Fig. 2). The species found only to the north of the equator are *Scyllarus batei*, *S. paulsoni*, *S. pumilus*, *S. rubens* and *S. ornatus*, while *S. cultrifer*, *S. thiriouxi*, *S. amabilis*, *Scyllarides squamosus*, *Scyllarides elisabethae*, *Ibacus incisus*, *I. novemdentatus* and *Parribacus antarcticus* are reported only from the southern half. *Scyllarus arctus*, *S. martensiii*, *S. nobili*, *S. rugosus*, *S. sordidus*, *Scyllarides haanii* and *Thenus orientalis* are found throughout the Indian Ocean. Here mention may be made about the information available on the distribution of *Scyllarus arctus*. De Mann (1916) has stated the distribution as western Indian Ocean. Bouvier (1917) has given the distribution as ' Atl. oriental et des Etats-Unis ' and the Mediterranean. Ramadan (1938) has recorded *S. arctus* var. *paradoxus* from the south Arabian coast. Owing to lack of more precise information on the localities in the Indian Ocean region from which the species has been collected the distribution has not been marked in Fig. 2 and it is presumed that it occurs north and south of the equator.

Details of localities where the different species have been recorded are as follows:

A—*Scyllarus arctus* (Linnaeus)—Mediterranean, Adriatic, Eastern Atlantic from Canaries to Great Britain, east coast of America from Cape Hatteras to Rio de Janeiro, Pacific coast of Mexico and western Indian Ocean.

B—*Scyllarus cultrifer* (Ortmann)—Arafoera Sea, Japan, Kai Islands and East Africa.

C—*Scyllarus martensii* Pfeffer—Throughout the Indo-Pacific region, Maldives, Laccadives, Singapore, Annam, Sulu Islands, Celebes, Lesser Sunda Islands, Zanzibar, Japan and the Hawaiian Islands.

D—*Scyllarus nobilii* (de Mann)—Persian Gulf.

E—*Scyllarus batei* Holthuis—Gulf of Aden, Zanzibar area, Arabian Sea of Calicut, Bay of Bengal off Madras, Philippines, Lesser Sunda Islands, between Roti and Timor and north of Soembawa.

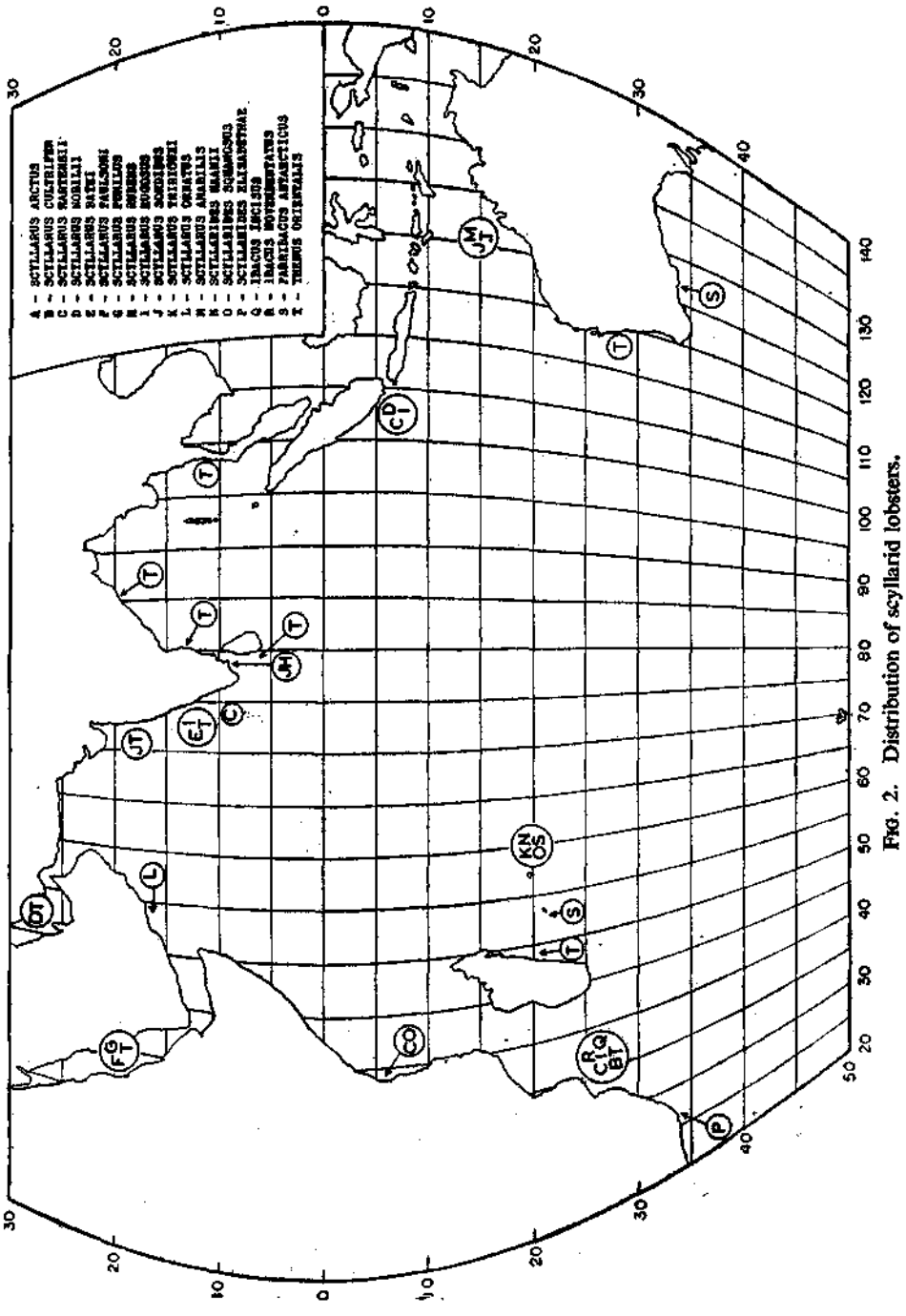

FIG. 2. Distribution of scyllarid lobsters.

F—*Scyllarus paulsoni* Nobili—Red Sea.

G—*Scyllarus pumilus* Nobili—Red Sea.

H—*Scyllarus rubens* (Alcock and Anderson)—Gulf of Mannar.

I—*Scyllarus rugosus* H. Milne-Edward—East Africa, Indian Ocean, Pondicherry, Malay Peninsula, Singapore, Japan, Hong Kong, between New Guinea and Australia.

J—*Scyllarus sordidus* (Stimpson)—Hong Kong, the Philippine Islands and Australia to the Gulf of Mannar.

K—*Scyllarus thiriouxi* (Bouvier)—Mauritius.

L—*Scyllarus ornatus* Holthuis—Off the Arabian coast, 18°03.5'N., 57°02.5'E.

M—*Scyllarus amabilis* Holthuis—North-west Australia.

N—*Scyllarides haanii* (De Hann)—Mauritius, Singapore, Japan, Formosa, Ambon, Aroe Islands and the Bay of Batavia.

O—*Scyllarides squamosus* (H. Milne-Edwards)—Zanzibar, Mauritius, Japan, east of Australia, Lifu, Loyalty Islands, Hawaiian Islands and north of Clipperton Islands.

P—*Scyllarides elisabethae* (Ortmann)—South Africa, St. Helena, Port Elizabeth, Agulhas Bank and off Natal coast.

Q—*Ibacus incisus* (Peron)—Southern seas, Sydney, Valparaiso, off East London, off Natal coast, Portuguese East Africa and Natal coast.

R—*Ibacus novemdentatus* (Gibbes)—Hong Kong, China, Formosa, Japan and off the mouth of Umvati River, East Africa.

S—*Parribacus antarcticus* Lund—Indian Ocean, Asiatic seas, Réunion, Mauritius, Japan, Formosa, Philippines, Sabang Bay, Sumatra, Talaud Islands, Ternate, Ambon, New Guinea, Duke of York Islands, Australia, Southern seas, Marshall Islands, Loyalty Islands, Rotuma, Upolu, Fiji Islands, Samoa, Hawaiian Archipelago, Johnston Island, Palmyra, Tahiti, Rikitea, Tuamotu Islands, Hao and Carysfort Island, Caribbean Sea, Jamaica, Santa Cruz, Virgin Islands, Barbados, Surinam and Pernambuco, Brazil.

T—*Thenus orientalis* (Lund)—Red Sea, Gulf of Aden, Persian Gulf, Portuguese, East Africa, Natal coast, Mozambique, Madagascar, Mauritius, South African coast, Saya de Malha Bank, Indian seas, Gulf of Mannar, Ceylon, Madras and Orissa coasts, China, Pescadores Islands, Formosa, Philippines, Annam, Saigon, Gulf of Siam, Malay Peninsula, Singapore, Mergui Archipelago, Ambon, Christmas Island, Arafoera Sea, Swan River, west Australia, North-west Australia, Kermadec Islands and China.

Discussion

The different species of lobsters are found as far as 35°S which means that they are distributed from tropical to subtropical and temperate regions and almost all these species described here enjoy a wide distribution in the Indo-Pacific. It is

well-known that these lobsters are found near the coast particularly in areas where rocks or reefs offer retreats for them. Investigations carried out have shown that the adult lobsters do migrate from place to place but such migrations do not cover considerable distances. Although isolated cases of long migrations were noticed in the American spiny lobster *Panulirus argus* by Dawson and Idyl (1951) and Smith (1958) they observed that, in general, the movements were random wanderings usually over short distances. *Panulirus longipes*, the Australian species studied by Sheard (1962), is relatively sedentary in nature. Recent studies on the Indian spiny lobster *Panulirus homarus* showed extremely limited movements (Mohammed and George, 1967). Widespread distribution thus is mainly due to the dispersal of the phyllosoma larvae caused by water movements.

Although these lobsters show a wide distribution there are evidences to indicate that some species prefer certain regions or habitat. George (1967) while discussing about *Panulirus* spp. has remarked ' Ecological separation of the 6 sympatric species of the Indo-West Pacific region is indicated since regional or habitat dominance can be demonstrated. On the regional scale, *P. ornatus* is the dominant species in East Africa, *P. homarus* on the Arabian Coast, *P. polyphagus* on the Indian west coast and *P. penicillatus* on the east Pacific offshore islands.' It may be added here in partial modification of this observation that along the west coast of India *P. polyphagus* is dominant only on the northern region and according to Chhapgar and Deshmukh (1961, 1964) and Deshmukh (1966) 99 % of the total spiny lobster population around Bombay consists of this species. Along the southern region, however, it is *P. homarus* which dominates. George (*op. cit.*) further adds that ' On a much smaller scale, personal observations at three localities in the North West Cape area of Western Australia have shown that on the limestone reef directly below the North West Cape Lighthouse, only *P. cygnus* (the dominant west coast and commercially important spiny lobster) is found while 3 miles to the north east among the coral at the North West Cape reef only *P. versicolor* occurs, and 20 miles southwest of the North Cape Lighthouse, in the pool with fine sediment at Melyering Beach *P. ornatus* was the only species found.'

Such habitat dominance has been reported along the coasts of Ceylon by De Bruin (1962) also. According to him *P. polyphagus* was found only on mud banks off the north-east coast of Ceylon at depths of 8-10 fathoms. *P. homarus* (as *P. dasypus*) was dominant on the west coast in depths up to 12 fathoms, *P. ornatus* in the northern region and *P. versicolor* along the east coast beyond 3 fathoms in depth. Along the coasts of India also dominance of species in different regions and habitat has been noticed. Along the northern part of the west coast *P. polyphagus* is the dominant species. On the extreme south-west rocky coast it is *P. homarus* which is the dominant species and contributes to a lucrative fishery. Again it is *P. polyphagus* which is the common species along the east coast (Chopra, 1939), whereas in the south-east coast the species which dominates is *P. ornatus*. Perhaps a continuation of the distribution of this species is seen in the northern region of Ceylon as mentioned above. The species *Puerulus sewelli* which has been recently located as occurring in commercially exploitable quantities in the deeper waters off Kerala is reported to occupy a more or less hard bed formed of sand, shell fragments and stones with a small percentage of silt (Kurian, 1968). The scyllarid lobsters are generally found to be represented in areas with a sandy or a sandy mud bottom. The preference for the habitat shown by the adults on the one hand and the possibility of the widespread dispersal of the species through the pelagic phyllosoma would result in the same species establishing in widely separated geographical regions. In order to have more effective exploitation of this valuable resource

detailed studies on the ecological aspects of the environments delimiting the various commercially important species to specified localities will be essential.

Summary

There are eighteen species, representing the nine genera in the family Palinuridae, reported from the Indian Ocean region. Likewise, among the Scyllaridae twenty species comprising five genera also occur in the same region. All these species have been listed with their distributional records so that the data thus gathered and presented here furnish a complete picture of the distribution of adult palinurids and scyllarids from the Indian Ocean region as a whole. The preference for particular substrata in distributional pattern of some of the common species is also briefly discussed.

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