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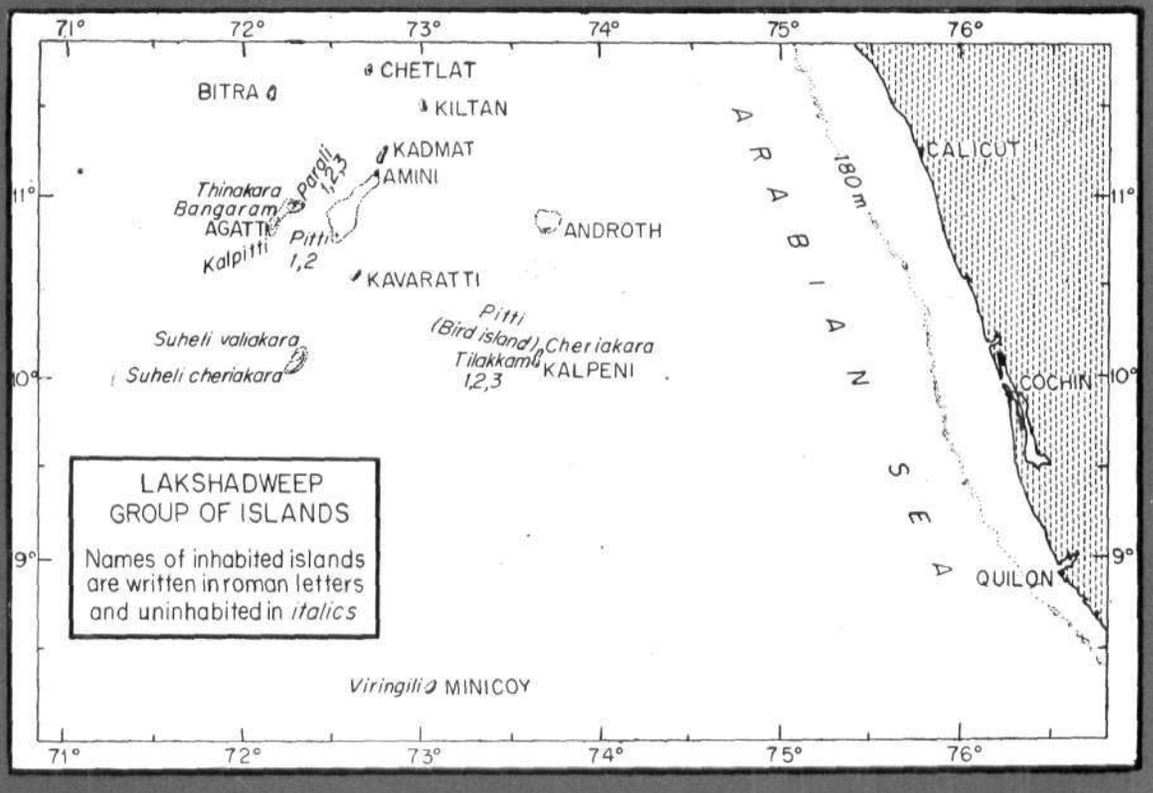

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MARINE FISHERIES RESEARCH IN LAKSHADWEEP – A HISTORICAL RESUME

P. S. B. R. James, C. S. Gopinadha Pillai, P. P. Pillai, P. Livingston and Madan Mohan
Central Marine Fisheries Research Institute, Cochin

The Lakshadweep

The Lakshadweep is located on the Laccadive-Chagos ridge which is supposed to be the continuation of the Aravali mountains, and the islands are believed to be the remnants of the submerged mountain cliffs. The archipelago is composed of 22 islands and 5 attached islets scattered between latitudes 08°00′ N and 12°30′N and between longitudes 71°00′E and 74°00′E. Except Androth, all the islands have a lagoon, some of which, as in Kiltan and Minicoy, are fast getting filled up by calcareous sand. Only ten islands are inhabited. Coconuts and tuna are the mainstay of the economy of this Union Territory. The vast stretches of blue waters around the islands are rich in tunas which are exploited by both mechanised and non-mechanised vessels which use pole and line method with the help of live-baits.

The history of the fishery of Lakshadweep should be as old as the history of human settlement in these tiny tots of islands. The marine biological and fishery research in the Lakshadweep Sea dates back to the end of the 19th century, when the surgeon naturalist A. Alcock set sail on 17th October, 1891 by R.M.S. *Investigator*. For two months he cruised in the Lakshadweep Sea, "sketching and checking the position of the islands, running lines of deep-sea soundings and occasionally taking a turn with the deep-sea dredge" (Alcock, 1902). He also left short but graphic descriptions of many islands. An account of the deep-sea fishes collected from the Lakshaweep Sea has also been presented by Alcock (1894).

The Cambridge University Expedition under the leadership of Prof J. Stanley Gardiner was the next significant event in the marine research of Lakshadweep, though, the expedition touched only Minicoy at the southern tip of the Archipelago. The results of the marine biological and oceanographic research were reported in the two volumes of *'Fauna and Geography of the Maldive and Laccadive Archipelagoes* (J. S. Gardiner (Ed.) 1903–1906). Later Hornell (1910) and Ayyangar (1922) described briefly the tuna fishing methods in the Lakshadweep. The establishment of the research centre of Central Marine Fisheries Research Institute and the Department of Fisheries in the Lakshadweep in 1958 and 1959 respectively gave a fillip to the fisheries research in this remote area. In the last 28 years scientists of the CMFRI and the National Institute of Oceanography have furthered our knowledge on the environmental characteristics, fishery resources, fishing methods and fishery biology of important tunas and live-bait fishes of the Lakshadweep Sea. Researches on corals and coral reefs have also been strengthened.

The ichthyofaunal studies

A valuable contribution towards the knowledge of the ichthyofauna of Lakshadweep is that of Balan (1958). He set sail in March, 1954 and after a hazardous journey visited the islands of Agatti, Kavaratti, Amini and Kadmat. He has documented from these islands 80 species of fishes belonging to 65 genera. Jones and Kumaran (1959) while describing the fishing industry of Minicoy also listed 154 species of fishes from the lagoon and reef, many of which being new records. The list was further elaborated by Jones (1960a, 1960b, 1969) and Jones and Kumaran (1967a, 1967b, 1967c) and culminated in the publication of the *'Fishes of the Laccadive Archipelago'* (Jones and Kumaran, 1980). In the book they have documented information on 603 species of reef fishes including many bathypelagic forms. Due consideration has been given to the systematics of commercially important tunas and related fishes as well as the common live-bait fishes. This work remains to be the most comprehensive account on the fish fauna of the Lakshadweep.

Exploratory surveys

As early as 1928 the erstwhile Madras Fisheries Department conducted experimental trawling in the Lakshadweep Sea using the Steam Trawler *Lady Goschen* (Sundara Raj, 1930). Material brought up from the Basses de Pedro Bank included *Lethrinus* spp., *Epinepheles* (reef cod), *Lutjanus* spp., and a variety of invertebrates. Jones (1959a) has given a detailed account of the co-operative oceanographic investigations carried out by R.V. *Kalava* in the Lakshadweep waters. During the cruises of this vessel many valuable information on the oceanographic conditions and fishery resources of the seas around Lakshadweep were collected. The

larval fishes collected from this area included those of *Xiphias gladius, Istiophorus gladius, Katsuwonus pelamis, Euthynus affinis* and *Auxis* sp. (Jones, 1958). The results of the exploratory surveys of R.V. *Varuna* in the sea around the islands have been well documented by Silas (1969, 1972).

Assessment of fishery potential of the Lakshadweep Sea

The steady increase in landings and decrease in mean length of the yellowfin tunas exploited by the Japanese tuna fishing fleet had caused much concern over the tuna populations in this area since 1950s. Therefore, studies on the assessment of stock of tunas in the Lakshadweep and nearby seas were given priority in the research programmes of the CMFRI. The earlier estimates revealed that only a total of 650 tonnes of fish were being fished from the Lakshadweep waters annually against a potential yield of 3,300 t of pelagic and demersal fishes, most of which being tunas (Jones, 1968). George *et al.* (1977) estimated a projected exploitation potential of 50,000 t of tunas against the total local annual exploitation of 2,740 t.

Research on tunas and related fishes, and their fishery

Scientific observations on the craft and gear and fishing methods began under the erstwhile Madras Fisheries Department. Hornell (1910), Ayyangar (1922) and Ellis (1924) recorded their valuable observations on the fishing tackles and tuna fishing industry in the islands. Hornell (1910) gives an account of the 'pole and line' fishing method of Minicoy. Jones and Kumaran (1959) described the fishing craft, the gear and the method as they existed just at the end of the pre-mechanisation era. The mechanised 'skipjack-boat', its fishing gear and fishing methods for skipjack as well as for live-baits are described in Ben Yami (1980) and Silas and Pillai (1982).

Studies on the fishery and biology of commercially important species of tunas and tuna live-bait fishes are being undertaken by the CMFRI at Minicoy since its establishment in this Union Territory. Aspects such as length-frequency distribution, age and rate of growth, length-weight relationship, maturity and spawning and food and feeding habits of the two commercially important tunas viz. the oceanic skipjack and the yellowfin have been studied (Appukuttan *et al.*, 1977; Raju, 1964a, 1964b, 1964c; Thomas, 1964a; Madan Mohan & Koya, 1981). Data on the fishing effort, catch, species composition and catch per unit of effort, relating to the tuna fishery have also been collected.

Investigations on live-bait resources

Realising the importance of live-baits for a successful and sustained tuna fishery, Jones (1960-1980) carried out long-term researches on them. During the cruises of R.V. *Kalava* he observed the occurrence of *Spratelloides delicatulus* around many islands and pointed out its importance as potential live-bait (Jones, 1960a). Subsequently, in 1961 he recorded *S. japonicus*. Later Jones (1964a) published the results of a preliminary survey of the live-bait fishes of the Lakshadweep wherein 45 species have been listed. A detailed account on the fishing method, storage and utilisation of the live-bait fishes has been published (Jones, 1958).

The next major contribution towards our knowledge on the live-baits of Lakshadweep is that of Thomas (1964b) who during 1960-'61 period made some observations on the fluctuations of live-bait fishes in Minicoy. He observed that 11 species of these fishes were being regularly fished. Studies on the length-frequency distribution of *Lepidozygus tapeinosoma, Archamia fucata, Caesio caeruleus, C. tele, C. crysozona, Diplerygonotus leucogrammicus, Chromis caeruleus* and *Spratelloides* sp. were also made (Thomas, 1964b). Jones (1964b) thought of *Tilapia mossambica* as an alternative source for live-baits and sent a consignment of 21 specimens to Minicoy. Today, the species has established throughout the Lakshadweep; in all fresh water wells and ponds, and is found in purely marine conditions also in some of the tidal pools at the southern tip of Minicoy. However, *Tilapia* has not been a successful alternative to the other live-baits.

Pillai and Madan Mohan (MS) paid some attention to the ecology and biology of reef fishes at Minicoy with special reference to live-baits during the 1981-'84 period. Based on two years data, the biology of several species was worked out for the first time. These included *Spratelloides japonicus* and *S. delicatulus* (Madan Mohan and Koya, 1986c), *Chromis caeruleus* (Madan Mohan, Pillai and Koya (in press), *Dascyllus aruanus, Acanthurus triostegus* and *Abudefduf glaucus* (Pillai, Madan Mohan and Koya) (MS).

The microhabitat and coral association of the live-bait-fishes of the lagoon of Minicoy was elucidated by Pillai (1983). A correlation between the lunar cycle and the occurrence of pelagic bait fishes was also demonstrated (Madan Mohan) (unpub.). Based on prolonged observations on the corals of Minicoy, Pillai (1983) pointed out the impact of mass mortality of corals on reef associated fishes including live-baits.

Fishery environmental studies

The physical, chemical and biological parameters of the marine environment and also some oceanographic features such as currents, water masses, upwelling etc. have been studied by the CMFRI, in the recent past, during the cruises of R.V. *Kalava* and R.V. *Varuna*.

The investigations of Ramasastry (1959) and Jayaraman *et al.* (1960) have revealed the existence of four distinct water masses in the southern Arabian Sea. Prasad (1951) and Jayaraman *et al.* (1960) have brought to light the influence of the nutrient rich Antarctic bottom water in the Lakshadweep sea area. The physico-chemical characteristics of the water studied by Jayaraman *et al.* (1960) showed that the highly nutrient rich water was maintained around the islands for considerable length of time by the geotrophic pattern of circulation existing around the islands. Later Ramamirtham (1979) showed that a large cyclonic gyre type circulation exists in the northern region while an anticyclonic gyre type circulation exists in the southern region of the islands mainly in the sub-surface layers associating with the convergence and divergence in the sea. Other works of oceanographic importance done in the Lakshadweep seas and adjacent waters are those of Patil and Ramamirtham (1963), Rao and Jayaraman (1966), Sankaranarayanan (1973) and Sen Gupta *et al.* (1979).

Productivity studies

The early studies on the primary production of the tuna grounds of the Lakshadweep is by Prasad and Nair (1964). Later Nair and Pillai (1972) estimated the productivity of the reefs in Minicoy lagoon. Qasim *et al.* (1972) made a fairly comprehensive study on the primary production of the ambient waters and reefs of Kavaratti atoll. The primary production of the sea grass beds of Kavaratti atoll has been determined by Qasim and Bhattathiri (1971). Other major investigations on primary production of Lakshadweep waters are those of Bhattathiri and Devassy (1979) and Qasim *et al.* (1979).

The earliest work on zooplankton of the Lakshadweep is that of Wolfenden (1906) on copepods. Jones (1959) carried out some studies on the zooplankton assemblages around some of the northern Lakshadweep islands. During the cruises of R.V. *Varuna*, Silas (1972) estimated the zooplankton biomass closer to the reefs of the islands. He has also made some studies on the Deep Scattering Layers closer to the islands and suggested that the DSL constituted an important source of forage to pelagic fishes. A quantitative study of the zooplankton of the Kavaratti and Kalpeni atolls has been made by Tranter and Jacob (1972) who accounted for the loss of zooplankton over the reefs. Others who did creditable work on the zooplankton assemblages of the Lakshadweep waters are Prasad and Tampi (1959), Goswamy (1973, 1979, 1983), Madhu Pratap *et al.* (1977), Nair and Rao (1973) and Mathew (M.S.).

Marine invertebrates

Early information on the marine fauna of Lakshadweep are mostly based on the various articles published in the two volumes of *'Fauna and Geography of Maldive and Laccadive Archipelagoes'* (Gardiner(Ed.) 1903–1906). Nagabhushanam (1972) made a detailed ecological survey for the marine fauna of the Minicoy atoll. The marine animals so far studied, mostly from Minicoy, include foraminifera (Chapman, 1895); corals (Gardiner,1903b,1906a,b,c; Cooper, 1906; Pillai, 1971a, 1971b, 1972); sponges (Thomas, 1979); other coelenterates (Borradaile, 1906 d; Browne, 1906a, 1906b), nemertines (Punnet, 1903); echiuroids (Shipley,1903a); sipunculoids (Shipley, 1903b); stomatopods (Lanchester, 1903); crabs (Borradaile, 1903a, 1903b, 1903c, 1903d, 1906a, 1906b, 1906c; Kathirvel (MS); Sankarankutty, 1961); lobsters (Meiyappan and Kathirvel, 1978; Pillai *et al.*, 1984a); alphids (Coutiere, 1903, 1905, 1906); molluscs (Eliot, 1906; Hoyle, 1906; Smith,1906; Hornell, 1910; Rao *et al.*, 1974; Nair and Dharmaraja, 1983; Panicker, (unpub.); Appukuttan and Pillai (MS) and echinoderms (Bell, 1903; Sivadas, 1977; Murty *et al.*, 1980; James (MS).

Though the marine fauna of Lakshadweep is rich and varied the present day information is mostly confined to Minicoy. The living marine resources of the northern Lakshadweep islands need further study. The CMFRI has programmes for indepth surveys of the islands with a view to furthering our knowledge on the marine ecosystem, the fauna and the resources. While the resources may be exploited rationally, measures for conservation of the ecosystem, especially the corals and coral reefs have to be given due importance in future plans for the development of the islands.