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Conservation of Penaeid Shrimp Resources with Special Reference to India

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Penaeid shrimp resources world-wide are subject to high intensity of fishing pressure and exploited at levels very close to or exceeding optimum sustainable limits. Coastal penaeid shrimps in the tropics are characterised by fast growth rate, short life span and their availability to fisheries is estimated at a little over one year. This paper discusses several aspects of conservation of shrimp fisheries with special reference to India. Shrimp sanctuaries, protection of natural habitats, seasonal closures, mesh regulation, ban on export of under-sized shrimps, and control of fishing effort have been considered as means of controlling growth overfishing and improving shrimp production in India. Adoption of selective trawling techniques is recommended for reducing juvenile finfish mortality.

Penaeid shrimps constitute one of the most valuable groups of marine species and are distributed widely in tropical and subtropical waters. Exploitation of shrimp stocks is approaching or has already exceeded optimum sustainable level and it is unlikely that new significant stocks will be discovered in the coming years (Rothschild & Gulland, 1982).

Concern over the increasing intensity of fishing pressure on shrimp stocks has brought to focus the need for careful management so as to maintain their sustainability as a renewable resource and enhance their long term economic potential. Attempts to manage shrimp resources by means of legislation of some form or the other has been going on for a long time in different parts of the shrimp producing world.

Characteristics of penaeid shrimps

Life cycle, population dynamics, exploitation and management of penaeid shrimps have been reviewed by Garcia & Le Reste (1981), Gulland & Rothschild (1984), Rothlisberg *et al.* (1985), Australian Journal of Marine and Freshwater Research (1987) and Vendeville (1990). Penaeid shrimps have a very high growth rate and a short life span of the order of two years. Fecundity is very high and the larvae undergo marked changes in morphology, behaviour, food requirements and habitats during the planktonic phase. The role of environment in larval and post-larval mortality, though poorly known, is likely to be complex. The life cycle includes a juvenile phase completed in the estuaries and inshore marine habitats and an adult phase in deeper waters.

Annual stock sizes of penaeid shrimps are known to fluctuate widely and existence of stock recruitment relationship has not been conclusively demonstrated (Garcia, 1983; 1985). Availability of penaeid shrimps to the fishery is estimated to be a little over one year (Garcia & Le Reste, 1981). In India, they are exploited in two different stages of their life cycle: as juveniles in estuarine and coastal waters by the artisanal sector and as sub-adults and adults in deeper waters by the mechanised sector.

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Trends in world shrimp production

Shrimp production of top ten shrimp producing countries (MPEDA, 1974-89) has shown fluctuating trends. These countries can be categorised into three groups in terms of quantum of production. In the first group including India, China and Thailand, average annual shrimp production is above 175 thousand tonnes, the second group including Indonesia and USA produces between 130 and 135 thousand tonnes; and the third group including Malaysia, Norway, Mexico, Japan and Philippines produces between 40 and 80 thousand tonnes.

Trends in shrimp production (FAO, 1972 - 90) in the major fishing areas are presented in Fig. 1. Regional trends in world shrimp production has been discussed by Panicker (1986).

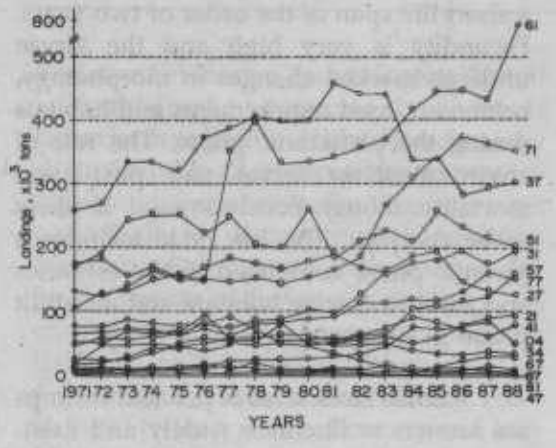

Fig. 1. Region-wise shrimp landings of the world. (Source of data: FAO, 1972-90) Numbers indicate FAO fishing areas: 61 Pacific, Northwest; 71 Pacific, Western Central; 37 Mediterranean and Black sea; 51 Indian Ocean, Western; 31 Atlantic, Western Central; 57 Indian Ocean, Eastern; 77 Pacific, Eastern Central; 27 Atlantic, Northwest; 21 Atlantic, Northeast; 41 Atlantic, Southwest; 04 Asia, inland waters; 34 Atlantic, Eastern Central; 67 Pacific, Northeast; 87 Pacific, Southeast; 81 Pacific, Southwest; 47 Atlantic Southeast

Shrimp production in India

In India, eight species of penaeid shrimps namely, *Penaeus indicus, P. monodon, Metapenaeus dobsoni, M. affinis, M. monoceros, M. brevicornis, Parapenaeopsis stylifera Solenocera indica*, contribute to the bulk of annual shrimp landings (Kurian & Sebastian, 1976). Shrimp landings in different states and in the east and west coast of India (MPEDA, 1974 - 89) are presented in Fig. 2. Contribution from the west coast which was about 90% in 1970s declined to 75% in 1983 with concurrent increase in landings from east coast. Shrimp production in India has been around 200 thousand tonnes after the initial stages of development of the fishery.

A review of the literature on shrimp fisheries in India point to economic and growth overfishing taking place at important production areas, indicating the need for conservation (Banerji, 1969; Mohammed, 1973; George *et al.*, 1980; Babu Paul, 1982, Sathiadhas & Venkataraman, 1981; Kalawar *et al.*, 1985; Alagaraja *et al.*, 1986; Thankappan Achary, 1987).

Conservation of shrimp fisheries of India

Conservation of fishery resources in different fishing areas has been approached using different management measures such as area closure, closed seasons, regulation of mesh size, minimum size limits, total allowable catch quotas, and regulation of fishing craft and gear (Pauly, 1979; Garcia & Le Reste, 1981; Panayotou, 1982; Troadec, 1983; Gulland, 1988). Due to its unique biological characteristics, vulnerability to harvesting at different life cycle stages, interaction with coastal finfish resources and its importance in the economic welfare of fishermen population, penaeid shrimp fisheries conservation in India, would need flexibility, continuous monitoring and refinement.

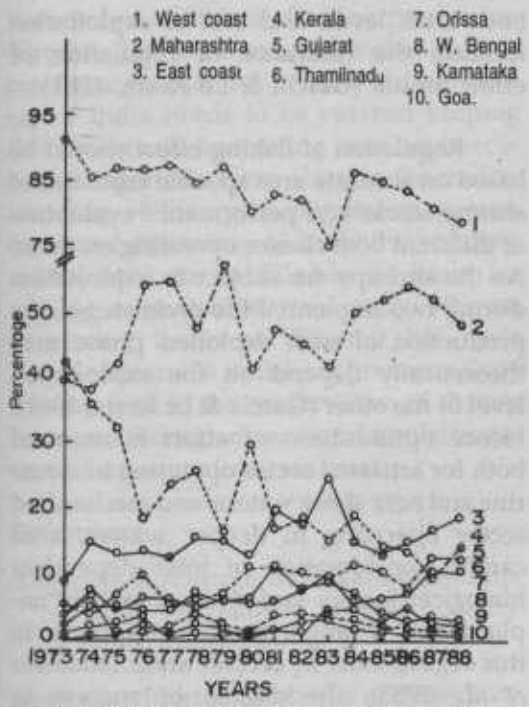

Fig. 2. Region-wise and state-wise shrimp landings of India (Source of data: MPEDA, 1974-79) 1. West Coast, 2. Maharashtra, 3. East Coast, 4. Kerala, 5. Gujarat, 6. Tamilnadu, 7. Orissa, 8. West Bengal, 9. Karnataka and 10. Goa

The most important objectives of shrimp fisheries management in India need to be the optimisation of yield from shrimps recruited to the fishery by controlling growth overfishing, i.e. by deferring harvest of small shrimp until they attain a preferred size; and protection of natural habitats from environmental degradation. Different approaches to enhance penaeid shrimp production in India by controlling growth overfishing and protecting the nursery areas are discussed below.

Shrimp sanctuaries

Permanently closed areas protect the nursery habitats from physical damage by trawling and control fishing mortality of juveniles. Ruello (1978) concluded that closure of nursery areas are undoubtedly beneficial in view of direct relationship between size and market price of prawns. However, before resorting to formation of sanctuaries it is necessary to have thorough knowledge of the life cycle of the shrimp and their migratory patterns.

Studies on shrimp sanctuary in Florida has shown that the shrimp (*P. duorarum*) do recruit to the fishery (Klima *et al.*, 1983). As a continuation of the study, Nichols (1984) has calculated a theoretical gain of 14 to 20% in weight and 45 to 64% in value from shrimp recruiting to the fishery through protected area. A series of strategically located shrimp sanctuaries need to be established after careful consideration of life cycle and migratory patterns in order to revitalize the shrimp stocks.

Protection of nursery areas

First stages of rapid growth of penaeid shrimps are completed in near-shore and estuarine areas. Environmental quality of the nursery areas such as mangroves need to be safe guarded from pollution and destructive practices, for maximising larval survival and recruitment.

Seasonal closure

Establishment of closed seasons results in protection of spawning adults and in delaying the age at first capture of young ones. Seasonal closure in Texas in 1981 was reported to have resulted in an increase by 78% in weight of brown shrimp (*P. aztecus*) and substantial additional income to the fishing fleet, (Rothlisberg *et al.*, 1985). However, this success was not repeated in 1982 and 1983 closures, indicating possible influence of climatological factors. Similar studies need to be conducted extensively in all shrimp producing areas, so that definite conclusions could be drawn. An experimental ban on shrimp trawling in territorial waters of India, spanning 45 to 60 days during monsoon for three consecutive

years would permit an impact analysis in order to conclude whether a fishing holiday is necessary to protect the shrimp resources.

Mesh size regulations

Panicker & Sivan (1965) have studied the selectivity of codend meshes of shrimp trawl and recommended mesh sizes suitable for different species and size groups at 50% retention level.

Regulation of mesh size becomes difficult when the fishery is constituted by shrimp species of different optimal sizes. Adjusting the mesh size to suit the species or species groups of regional dominance such as *Metapenaeus dobsoni* and *Parapenaeopsis stylifera* seems to be one of the solutions. Since penaeid shrimps are recruited to artisanal fishery earlier in their life cycle in estuarine and near-shore areas, mesh size regulation needs to be enforced for fishing gears operated by this sector, also.

Minimum mesh size of shrimp trawl should never be less than 30 mm stretched and minimum mesh size for stake nets and dip nets operated by artisanal sector should never be less tha 20 mm stretched.

Export ban on under-sized shrimps

For mesh size regulation to be effective a simultaneous ban on export of undersized shrimps, must be imposed.

Regulation of fishing effort

Regulation of fishing effort by limiting the number of fishing units is an effective and practical measure for controlling overexploitation of stocks and minimising costs of exploitation. Short life span of tropical shrimps, year to year variation in abundance which is greater than variation in fishing effort, and possibility of controlling both catch levels and cost of exploitation indicate the relevance of regulation of effort inputs (Garcia & Le Reste, 1981).

Regulation of fishing effort should be based on accurate area specific estimates of shrimp stocks and performance evaluation of different boat classes operating on them. As the shrimps are subject to exploitation during two sequential life cycle stages, the production of each exploited phase may theoretically depend on the exploitation level of the other (Garcia & Le Reste, 1981). Hence optimisation of effort is required both for artisanal sector operating in estuarine and near shore waters, and mechanised sector operating in deeper waters, after careful consideration of inter dependent biological factors and socio-economic implications. Though recommendations in this regard exist in certain areas (Kalawar *et al.*, 1985), the degree of success in enforcement is poor (Sanjeevagosh, 1991).

Selective shrimp trawling

Intensive fishing with shrimp trawls of codend meshes of less than 20 mm size has led to indiscriminate capture of juveniles of demersal finfishes such as *Lactarius* sp., sciaenids, ribbonfish, *Chirocentrus* sp., carangids and flat fishes. It seems necessary to de-link shrimping from the present-day practice of shrimp-cum-fish trawling using specialised shrimp trawling techniques such as double rig trawling and twin trawling (Panicker *et al.*, 1977; 1978). Selective trawls which separate shrimps from fish have been developed by taking advantage of their differential behaviour in the net (FAO, 1973). Such separator trawls need to be introduced to commercial use in order to control large-scale mortality of finfish juveniles taking place during shrimp trawling.

The biological management of penaeid stocks is frequently limited by inadequate

knowledge of factors affecting production (Crocos, 1987). A comprehensive fishery management plan for penaeid shrimp fishery of India needs to be evolved keeping the biological, harvesting and socio-economic aspects in view. Gaps in the understanding of life cycle, population parameters and migration of individual shrimp stocks need to be filled-in as basis for reliable estimates of yield and optimum harvesting levels at different life cycle stages vulnerable to fishing pressure. Only this can lead to the conservation of shrimp resources through meaningful implementation of management measures.

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