UTILIZATION OF BRACKISH WATER AREAS FOR PRAWN CULTURE

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Maximum utilization of the vast brackish water areas constituted by the various estuaries, swamps, inland bays, tidal pools, lakes and backwaters along the entire coastline of India for cultivation of prawns under controlled conditions requires very urgent consideration in the context of increased food production in the country. Although a small portion of these areas, especially those in Kerala, are being utilised for capture of prawns by a special indigenous process called filtration, vast stretches of these backwaters and estuaries still remain unutilized. These areas in most cases provide biologically potent environment for healthy growth of many a species of fishes, prawns and crabs. Existing knowledge about the life histories and other biological aspects of the two varieties of prawns, namely the marine prawns of the family Penaeidae and the river prawns of the family Palaemonidae are reviewed. In this context the recent finding that short-duration culture yields better prawn catches in the paddy field, prawn filtration practices of Kerala has been appraised. Possible means of increased utilization of backwater areas for prawn culture and use of *Macrobrachium* spp. for culture and transplantation to river systems where they do not occur are indicated.

INTRODUCTION

The brackish water areas of India may be grouped under two categories, namely open estuaries and enclosed brackish waters. Under the first category may be included the typical estuaries of river mouths, brackish water lakes and backwaters. These may be either perennial, like the Gangetic delta and the backwaters of Kerala where there is flow of water all the year round, or seasonal like the mouths of many of the smaller rivers and coastal lakes which get isolated from the sea by narrow sand bars and thus dry up during the summer months. The second category includes the confined areas of estuaries, lakes and backwaters reclaimed under various schemes. The paddy fields adjoining the Kerala backwaters and the low-lying land under reclamation in the Gangetic delta in Bengal belong to this type and in these areas the culture practices of prawns of marine origin are carried out to a limited extent at present.

About 11,000 acres (4,400 ha) of paddy fields forming enclosed brackish water areas in Kerala are presently utilized for a lucrative prawn fishery during certain months of the year. The fishery is seasonal and is carried out in these

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months of the year when the fields are free from rice cultivation. This fishery is generlly described as a mere process of trapping of the juveniles of certain penaeid prawns and the operations have been described by several authors (Panikkar 1937; Menon 1954; Gopinath 1955; Kesteven and Job 1957). The season lasts from November to April every year. The catch per acre varies from 300 to 900 kg. The fishery is essentially a trapping of the fry and juveniles of the prawns brought in by the tidal action. Recent experiments conducted by the Central Marine Fisheries Research Institute has shown that though it looks like a trapping mechanism, some amount of culturing of the juvenile prawns takes place inside the rice fields. According to George *et al.* (1958), "these paddy fields are not merely a part of the trapping mechanism but they provide an active and suitable biological environment for the life and growth of these prawns".

The *bhasa badha* fisheries described by Hora and Nair (1944) in the Sunderbans in Bengal is another fishery where some sort of farming is carried out while in the paddy fields of Kerala mostly prawns are caught, in which prawns form only part of the catches. Due to the tidal action the beds of many of the rivers and creeks in the estuarine areas of Bengal get gradually silted up and in due course such areas are reclaimed for agricultural purposes by putting up bunds to keep away floods and tidal water. Some portions of such reclaimed areas which are too low for cultivation are usually utilized for fish farming. Many of the reclaimed areas where cultivation is done are provided with an additional outer bund and the low-lying land in between is also used for fish culture purposes. Water is let into these areas during high tide through sluice gates and the inflowing water brings in fishes and prawns. Fishing is generally done in winter months after allowing sufficient time for growth inside. Thus, culture for a few months is involved in this fishery.

Species and Their Biology

In the brackish water culture of prawns, the species involved are representatives of two groups of Decapod Crustacea, namely the marine prawns of the family Penaeidae and the river prawns of the Caridean family Palaemonidae. As a rule, most of the commercially important marine penaeid prawns are closely associated with brackish, shallow water environments. Nearly a dozen species, each with a different and somewhat restricted geographical distribution along the coastline of India support important coastal fisheries. The most important among these are *Metapenaeus dobsoni*, *M. affinis*, *M. brevicornis*, *M. monoceros*, *Penaeus indicus*, *P. monodon*, *P. merguiensis*, *Parapenaeopsis stylifera* and *P. sculptilis*. In the context of brackish water culture it is of particular interest that these prawns have a distinct life history characterised by a period of more or less predictable length of time spent in estuarine or comparable brackish water environment. In each of these species the parent population breeds in the sea at varying distances from the shore and the large numbers of microscopic, semi-buoyant eggs released hatch out

into small planktonic nauplii. These larvae pass through different stages during their movements towards the inner reaches of backwaters. The time taken between hatching and entry of the small post-larval prawn into the backwaters of estuaries vary with species. Once inside the brackish waters the post-larvae settle to the bottom and quickly transform into juveniles. They enter the paddy fields and similar low-lying areas in these stages and contribute to the fishery mentioned earlier.

Species of Palaemonid prawns, in which the females carry their eggs underneath the abdomen externally and the young ones hatch out at a comparatively advanced stage of development, are of somewhat lesser importance commercially. A couple of species of the genus *Macrobrachium (M. rosenbergii* and *M. malcolmsonii)* contribute to commercial fishery in the various river systems of the country. Some aspects of the fishery and biology of these species have been studied by Ibrahim (1966), Raman (1964, 1965) and Rao (1965, 1967). Ling (1962) has worked out the complete life history of *M. rosenbergii* and it is observed that a certain amount of salinity is needed for the spawning of the species and the growth of the early larval stages. The adult mature prawns are thus found to descend from the upper reaches of the rivers to brackish regions of river mouths for spawning. After the development of the early stages in this environment the young ones again move back to the freshwater areas of the rivers. The large sizes attained by these prawns, especially in the case of *M. rosenbergii* (growing to nearly a foot in length) make it particularly desirable for artificial cultivation.

Brackish Waters as Habitat of Prawns

The role played by the brackish water areas in the life history of these prawns has to be understood properly. The penaeid prawns of commerce move in and out of the estuaries in the manner described earlier simply because they are evolved that way. It is known when and where the young prawns occur and it is also possible to describe their surroundings. But in defining the functional role of the highly dynamic environment in which they are during the juvenile phase of their life history, we fall far short of the mark. The major factors regulating the occurrence and development of the immature prawns in the estuarine environment are water circulation caused by tides and currents, temperature, salinity and other chemical properties, turbidity and fertility, vegetation and nature of substratum. It must be emphasised that all the above factors play complex and interactive roles in determining the distribution, survival and growth of young prawns during their sojourn in the estuaries. The mechanics involved and the extent to which changes in these factors influence the productiveness of commercial prawn resources remain to be fully elucidated.

The animal life found in these environments is generally endowed with a wide range of adaptability to withstand extreme fluctuations in physical conditions. Panikkar (1951) studied the regulatory capacity and physiological adaptations in an estuarine marine fauna including penaeid prawns. Subse-

by Rao (1958), Williams (1960), Dobkin and Manning (1964) and Zein-Eldin and Aldrich (1965) impart considerable understanding as to how prawns adjust physiologically to the varying environment. Although these observations partly answer the questions of why and how these organisms satisfactorily cope with their dynamic environment, it is still not clear as to what degree does these changes affect the magnitude of their stock. Among others, Menon (1967) expressed apprehension about the possible detrimental effects of the changes of the brackish water environment such as reclamation for agriculture, port and dock operations, construction of spillways in the furtherence of salt water exclusion schemes and other engineering activities on the prawn resources. It is highly problematical whether the estuary-dependent marine prawns of commerce can adjust to the environmental changes and consequent modification in the various factors and still maintain their stocks at the present levels. Our knowledge of the biology and dynamics of the prawn resources in relation to the various environments is slowly being enhanced by various researches. But much remains to be accomplished before we could muster the necessary information by which we can defend the inadvisability of modifications in the important coastal bays, swamps and such other brackish areas. However, a rational approach is highly essential in planning all the projects entailing curtailment of the brackish water areas vitally important for the prawn resources.

Results of the Experiments Conducted

Realized with the importance of the paddy field prawn fishery of Kerala in respect of the marine trawl fishery of the area, the Central Marine Fisheries Research Institute has been carrying out experiments to study the various aspects of this fishery and the nature of prawn farming involved. Menon (1954) studied the growth of juvenile prawns of *Penaeus indicus* stocked in small compartments and cultured for a period of two months and reported substantial growth, more rapid than what was observed in the same species from the backwaters and canals. As a result of experiments conducted by him in a two-acre farm which was not used for rice cultivation, he concluded that approximately 360 to 545 kg of prawns could be produced annually from such fields. According to him "farms developed in such coastal tracts with facilities for taking in water by tidal action from backwaters and canals could be expected to yield between 1,000 and 1,500 lb (ca. 450 to 680 kg) of valuable food per acre annually" including fish obtained along with prawns. Recent experiments carried out (George *et al.* 1968) to determine whether culture methods could be advantageously introduced into the existing prawn filtration practices in the paddy fields adjoining the backwaters of Kerala showed that culturing of juvenile prawns for short periods and fishing them at intervals of about a month instead of the existing practice of fortnightly fishing resulted in relatively better catches of larger-sized prawns.

In the case of the river prawn *Macrobrachium rosenbergii*, Ling (1962) has succeeded in breeding them in the laboratory. But he did not follow it up by

introducing and culturing the laboratory reared young ones in natural ponds. Raman (1964) succeeded in locating a nursery area in the Pampa river system from where young prawns could be collected in large numbers for stocking and rearing. A farm for the culture of the species is already in the initial stages of its operation at Edathua in Kerala. The presence of young ones of this species in large numbers in the Hooghly estuary has been reported by Rao (1965). Ibrahim (1962) indicated the possibility of culturing the relatively smaller prawn *M. malcolmsonii* by properly tapping the source of the upstream moving juveniles over the first anicut of the river Godavari. It is found that along the coastline of India this species occurs only in some river systems, mostly in the northern region. The possibility of transplanting the species to river systems in the south should be seriously examined.

Prospects of Development

In order to increase the production of prawns in the country by culture practices utilizing brackish water areas, the following points are to be considered :

The method of paddy field prawn filtration could be advantageously introduced in similar estuarine and backwater areas along the entire coastline of India. Already such fishing has been introduced with encouraging results in some estuaries along the Malabar and Mysore coasts. The method recently introduced at Kagal in the Aghanashini estuary near Karwar has shown that similar methods could be introduced in other estuarine areas too.

There are extensive swamp areas and brackish water pools connected with the various rivers and lakes along the coastline of the country where the paddy cultivation and prawn filtration practised in Kerala cannot be introduced as such. These areas could be converted into brackish water ponds by construction of proper dikes and provision of sluices with sliding shutters to regulate inflow and outflow of tidal waters. Rao (1949) estimated a cost of Rs 10,000 per square mile for preparing such farms. According to him, "if at least a fourth of the area of the coastal salt water pools or ponds is suitably prepared and made available for fish culture, the cost would work out to half a crore of rupees". This estimate will, no doubt, require reassessment under the present conditions. A significant yield of prawns in addition to other fishes could be expected from these sources.

Salt marshes, shallow lagoons and many swamps should be converted into prawn ponds by excavation and diking. In Japan abandoned solar-salt beds have been converted into modern prawn-rearing ponds where the marine prawn known as "kuruma shrimp" is successfully cultivated (Fujinaga 1963). The critical problem of obtaining a steady supply of seed prawn is solved in this case by most highly developed methods of prawn culture. Here the prawns are reared from egg to adult stage under closely controlled conditions. Similar methods should be tried with the Indian species and suitable farming techniques evolved for a steady supply of seed prawns.

In the existing paddy field prawn filtration method of the brackish water

areas of Kerala, a method of trapping-cum-culture practice is recommended in order to increase the catch as well as the size of prawns. Fishing at intervals of about a month has been proved to result in increased catches and also larger sizes of prawns.

In the paddy field prawn filtration practices at present, the supply of prawn fry is entirely dependent on the tidal water flowing into the field from the backwaters. The stocking of the field is only accomplished by letting in water into the fields at high tides. It is felt that this could be amplified by collection of post-larvae from the outside waters and stocking in the fields as is done in some of the Far East countries like the Philippines and Formosa.

The possibility of culturing the river prawns *M. rosenbergii* and *malcolmsonii* in ponds should be explored. Transplantaion of *Macrobrachium* spp. to river systems where they do not occur at present is another [illegible] to be considered, for example, *M. rosenbergii* is at present not found to [illegible] in the northern river system emptying into Cochin backwaters, while very common in the southern rivers flowing into the same backwaters. Similarly *M. malcolmsonii* is not found in the river systems in the southern [illegible]. Transplantation in these cases could be tried with advantage.

All these developments envisaged would require accurate data on the [illegible]nditions in order to make realistic plans. Here the need for properly directed research must be emphasised.

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