

The Mexican Tapos Shrimp Fishery

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Penaeid shrimp or prawns are basically a tropical group of marine crustaceans. They are highly priced export commodities in many developing countries along the tropical belt, and their fisheries have great importance there. This interest has led to a general overexploitation of their natural fishing grounds and, as a result, to the intensification of their culture to increase production.

Migratory behavior

Penaeid shrimp have a life cycle that, in general terms, starts with pelagic eggs metamorphosing, after three main larval forms (nauplius, zoea, mysis), into a postlarva, which is very similar in appearance to the adult. The postlarvae, brought to the coast by currents, enter nursery areas which are either along the coast or in the coastal lagoons or mangrove ecosystems where food is abundant. After a few months, they become subadults, and migrate back to the sea to reproduce and die.

This migratory behavior has been used in Asia, the Far East and in Latin American countries to the benefit of man, who has trapped the juvenile stages (in ponds) to harvest them when of marketable size. Other systems, like the Mexican "tapos" fishery described here, attempt to control the timing of the reproductive migration towards the sea of the subadults by blocking the outlets of the coastal lagoons with barriers. The subadult shrimp concentrate at those gates and are fished there. Though not being "aquatic ranching" as with salmonids, since no homing behavior is present, they are practices that exploit the knowledge of migratory behavior to reduce fishing effort.

Trapping systems

In the case of the trapping system of culture, which has been common in India

(Kerala state produces around 3,500 t/year from about 5,000 ha of brackish rice fields, mainly *Metapenaeus dobsonii* and *Penaeus indicus*), Thailand, Indonesia, Malaysia, Vietnam, the Philippines and People's Republic of China, the entrance of postlarvae and juveniles into the ponds is a passive one caused by the rising tide; there has been little or no intervention on the part of the farmer as the entrance is natural and uncontrolled, and the manipulation of migratory behavior is very limited. In most countries, shrimp are present as a secondary crop, as in milkfish culture in Indonesia, the Philippines, and Taiwan; there the crop consists generally of small shrimp (*Metapenaeus*), with some shrimp like *P. merguensis* and still less tiger shrimp *P. monodon*. Shrimp have

Right, a new concrete tapo. Screens have been removed. *Below*, the older type, wooden.

traditionally been a bonus for fish farmers and only recently has there been a growing interest to culture shrimp alone in brackishwater ponds more intensively. However, this author does not know of any attempts made in Asia or the Far East to monitor or control the dynamics of shrimp stocks in large coastal lagoons as has been done more traditionally in Mexico.

Mexican lagoons

Mexico has a considerable number of coastal lagoons which have supported a large shrimp fishery for many years. The lagoons on the Pacific side, covering 597,500 ha, where the tapos fishery is practiced, have been studied by a large number of Mexican and foreign researchers, so that a mosaic of knowledge on the



biology, ecology and environmental characteristics was available. To put together the pieces of this mosaic, a project was requested by the Mexican Government to the British Overseas Development Administration. This project was carried out from 1973 to 1979 by the Department of Marine Biology, University of Liverpool and the National Autonomous University of Mexico. It was confined to the study of the Huizache-Caimanero lagoon complex* (see map).

shrimp obtained as secondary crops in brackishwater ponds in countries like Indonesia or the Philippines. With this type of management, these two lagoons can be considered as enormous extensive shrimp ponds, the produce of which has reached the market value of around \$10 million in more recent years with relatively limited capital investment.

The penaeid species present in this part of the Mexican coast are two brown shrimps, *P. californiensis* and *P. breviros-*

they move from the lagoons to the sea to reproduce.

The tapos

The main fishery takes place at the tapos built on the esteros, where subadult shrimp, having been stopped on their migration, concentrate in high densities and are fished with castnets and handnets.

The tapos are weirs set across the esteros. There are two types: a traditional one made of brushwood with two or more heart-shaped collectors, and a more modern one in which the brushwood screens and the palm and mangrove poles that used to keep them in place have been replaced by wire mesh screens and reinforced concrete pillars. In the new ones, the screens are doubled to allow better cleaning. The traditional ones are entirely built with local materials, are much cheaper and, as their efficiency is not much inferior to the new type of tapo, possibly are preferable. The tapo blocks the migration of subadult shrimp, but it is not a serious impediment apparently for the small postlarval shrimp which enter the lagoons at the same time through the esteros.

These weirs are removed in April and installed again in August, although the fishermen do not normally start fishing until September, thus allowing the subadults that concentrate in the esteros to grow larger. The fishery goes on to late

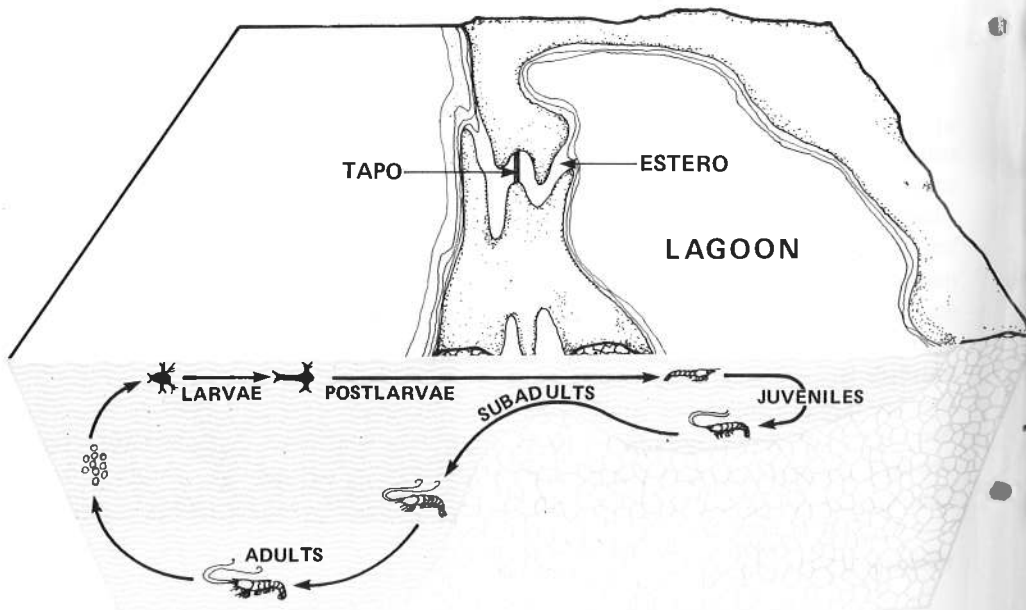
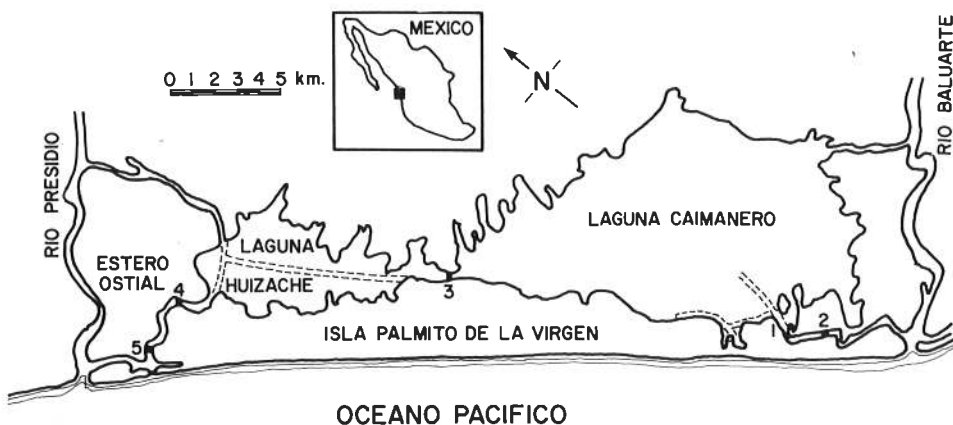
tris, and two white shrimps, *P. vannamei* and *P. stylirostris*.

These lagoons are worked by fishermen's cooperatives, which receive their fishing rights from the Mexican Government. The cooperatives fish mainly in the esteros during the migration of subadult shrimps during the rainy season, when

This rather comprehensive study of the fishery and the ecology of penaeid shrimp in these coastal lagoons has contributed a considerable amount of scientific knowledge.

The lagoons of Sinaloa State, including the Huizache-Caimanero complex, cover 212,000 ha; they are rather shallow with a variable abundance of mangrove, and present a varied array of connections with the sea, from very large mouths to long, narrow and tortuous channels called esteros. Huizache-Caimanero, covering 17,500 ha, has two main bodies of water and has sustained a fishery which produced 1,014 t in 1976-77, growing to 1,348 t in 1977-78. The figures correspond to 58-77 kg/ha, comparable to the quantity of

Above: The Huizache-Caimanero lagoon-complex showing five (numbers) tapos. Dotted lines indicate artificial canals. *Below:* Diagram of a lagoon-estero system showing how the tapo can impede the migrations of shrimp.



*B.F. Blake, A.B. Bowers and E. Naylor. 1981. Ecology and Penaeus fishery of a coastal lagoon system in W. Mexico: Report on the University of Liverpool/National Autonomous University of Mexico Lagoon Research Project 1973-1979. Overseas Development Administration, London.

December. By the end of the year, shrimp are scarce but the weirs are kept in place until April for a secondary fishery of mullets and crabs.

The idea is to set this weir at the onset of the migration, but as this varies from one year to the next due mainly to hydrological conditions in the lagoon complex and the abundance of rain, some of the stock, particularly brown shrimp, may start migrating as early as June, and thus are able to escape to the sea.

Larval entrance to as well as subadult exit from the lagoon vary depending on the species. The brown shrimps enter during June-July, a period with higher salinity levels in the lagoons than Septem-

this species at least, the postlarval migration to the lagoon is not passive, in the sense of being carried in by the tidal salt wedge, but must be caused by an attraction to low salinity levels.

Management needs

As far as improving the management of the tapos fishery is concerned, there are still areas which deserve careful attention or research. One area is the maintenance of the esteros and river mouths by dredging, to keep them open when the inward migration of postlarvae starts. Problems have arisen in certain years in which sandbars formed and remained closed for too long (especially in June) leading to poor fishery. At present, dredging is done not

shrimp migrate to the sea before the tapo is closed. Also, if postlarvae or juveniles are too abundant, the density inside a blocked lagoon can be too high, leading to high mortality and poor growth due to overcrowding.

Better knowledge of the movement of subadult shrimp inside complex lagoon systems is needed since, at least in theory, salinity control can be made by regulating the inflow of freshwater from rivers, which may retard the exit of the shrimp and allow further growth inside the lagoon.

The results of the comprehensive study done for the shrimp fishery in the Hui-zache-Caimanero lagoons should be considered when contemplating management of similar fisheries in other parts of the world. It will be wise, in further work on the regulation of extensive fisheries in other coastal lagoons of the world, to take into account behavioral characteristics of the shrimp stocks being managed. It is now very clear that not all the penaeids behave in the same way and that these differences allow cohabitation in the same environment and avoidance of strong competition among the species. Therefore, management practices can be tailor-made on the basis of such new knowledge on the bionomics of the target species.

Part of the knowledge derived from these studies on species behavior and environmental requirements, is also of great interest to the aquaculturist dealing with shrimp. Pond management is still, for many areas of the world and for many species, the weakest part of the production cycle, and it is this author's opinion that better management practices can be derived from the knowledge gained through these studies, in particular for the extensive types of culture predominant throughout the world. ○



Photos by M. Mistakidis.

Top, another view of a wooden tapo, screens removed. Below, *Penaeus vannamei*, 4 and 2 months old.

ber-October, when the white shrimp usually enter. It is in July also, when the ebb-flow starts, that subadults migrate back to the sea, but the exit reaches its maximum when the ebb-flow is at its peak, from mid-August to October/November, depending on the year.

These two groups have different feeding and ecological preferences as well as different behavior and diel cycle. It is also interesting to note that brown shrimp are predominant in the catches of the offshore trawling fleet while white shrimp dominate the catches of the tapos fishery.

Brown shrimp are, again, the first to move towards the sea at the onset of the rains, starting their migration as early as June.

If we consider the dominant ebb-flow at the time of the late entrance of white shrimp, *P. vannamei*, it is clear that for

only for the entrance of the postlarvae but also to facilitate the fishermen's transport and movements in the lagoons. A second area is the operation of the tapo itself, which is linked with regulations as to when the tapos may be opened or closed. At present, this fishery has an established period which is too rigid and does not take into account the normal variations in abundance of shrimp determined by climatic conditions. A more flexible closure regulation is necessary, linked with a program to monitor the entrance of postlarvae and the movements of subadult shrimp inside the lagoons.

At present, large numbers of brown

