

Marine Aquaculture 7

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Major cultivated species of shrimps and prawns

Attention has so far been directed to the culture of tropical and sub-tropical species of shrimps, and the so-called giant fresh-water prawn, *Macrobrachium rosenbergii*. Spawning and larval rearing of the kuruma shrimp in captivity in Japan in the 1950s aroused considerable interest in intensive farming of shrimps and this species became the focus of attention for a number of years. It was introduced in many countries in Asia, southern Europe, West Africa, the southern USA and Central and South America. Very soon, attention turned to some of the larger local species of shrimps, which were better adapted to prevailing temperature conditions, and the larvae and juveniles of which were readily available to supplement inadequate production from hatcheries. In Asia, the more important species are the tiger shrimp *P. monodon* and the Indian or white shrimp *P. indicus*. The banana shrimp *P. merguensis*, the green tiger or bear shrimp *P. semisulcatus* and the oriental shrimp *P. orientalis* (= *chinensis*) are also of commercial interest in some countries of the region. The

red-tailed shrimp *P. penicillatus* is a species cultured in Taiwan. *Metapenaeus monoceros*, *M. brevicornis* and *M. ensis* form subsidiary species in shrimp farms in several Asian countries.

Besides the imported *P. japonicus*, the main interest in the Mediterranean countries of Europe has been in the local Mediterranean shrimp (triple-grooved shrimp) *P. kerathurus*.



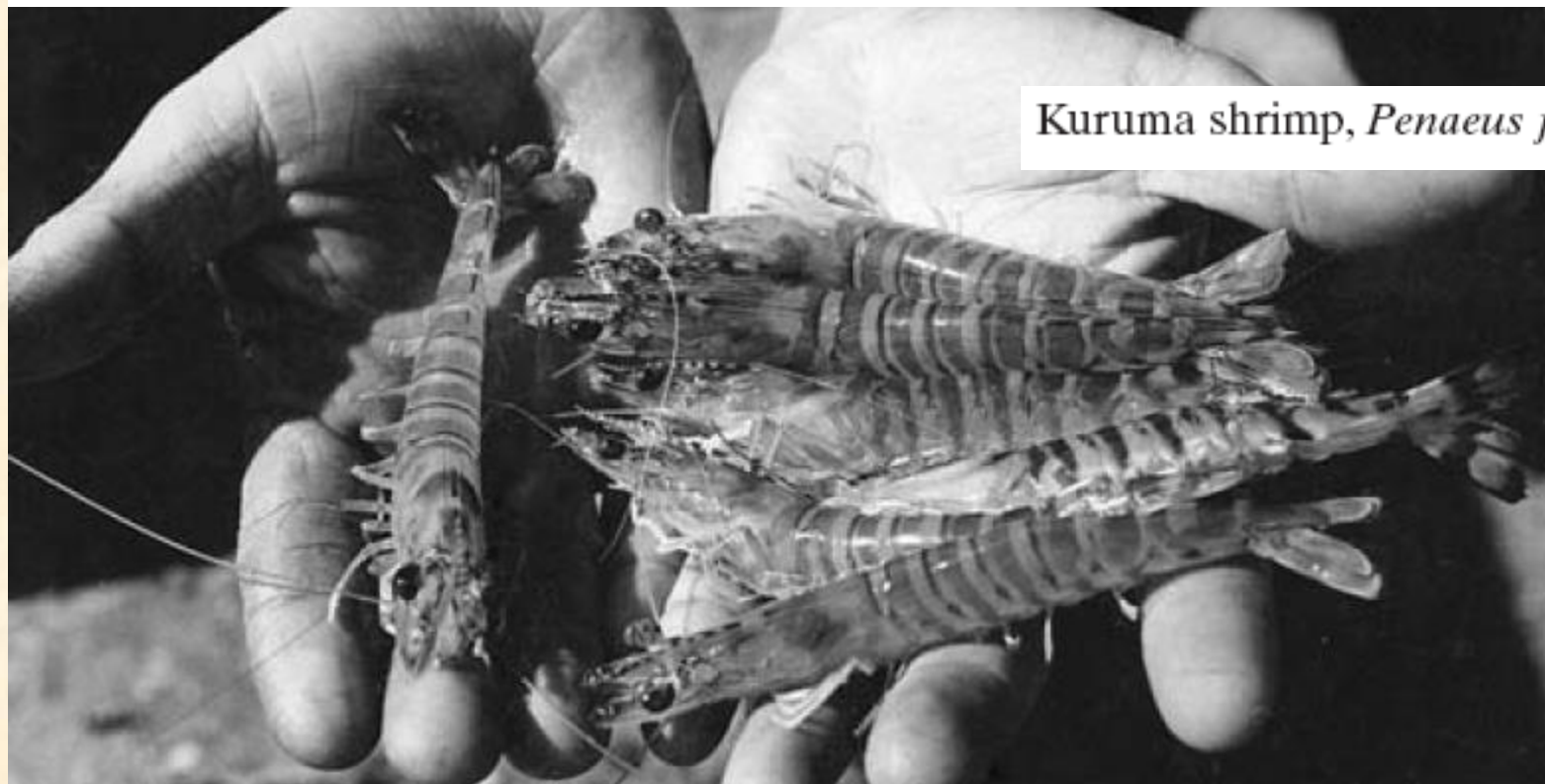
Much of the research effort on shrimp culture has been concentrated on the development of hatchery techniques for controlled spawning and larval rearing, as in the case of other marine aquaculture species. In the early years of investigations, considerable problems were faced in rearing and feeding the hatchlings through the different stages of development and obtaining reasonable survival rates.

The search for species that may be easier to reproduce and have a shorter larval history resulted in investigations on the giant freshwater prawn, *Macrobrachium rosenbergii*. The success achieved in the mass production of post-larvae of this species in the 1970s led to widespread interest in its culture, and it has been imported into an impressive number of countries in the tropical, sub-tropical and even temperate climates, in almost every continent.

The fresh-water prawn *M. rosenbergii* is commercially important because of its size, as well as its eating qualities. The males can attain a size of about 25 cm and the females about 15cm. Though adults are found in fresh- and brackishwater areas, the species requires water of about 12 ppt salinity for larval rearing. This requirement has created problems in siting hatcheries near grow-out facilities, but it has now been shown that this can be overcome by the use of sea water or brine trucked in from the nearest source, as performed by operators of small back-yard hatcheries in Thailand, or by the use of artificial sea water as in a commercial farm in Zimbabwe. The adults are omnivorous and feed on a variety of foods of animal and vegetable origin.

Table 25.1 World production of major shrimp species and giant freshwater prawn in 2000. Derived from FAO, 2002.

Species'	Production (million tons)	Value (billion US\$)	Price (\$/kg)
<i>Penaeus monodon</i>	0.571	4.047	7.09
<i>Penaeus chinensis</i> (= <i>orientalis</i>)	0.219	1.325	6.05
<i>Penaeus vannamei</i>	0.144	0.878	6.10
<i>Macrobrachium rosenbergii</i>	0.119	0.410	3.45
Total crustaceans	1.647	9.371	5.69



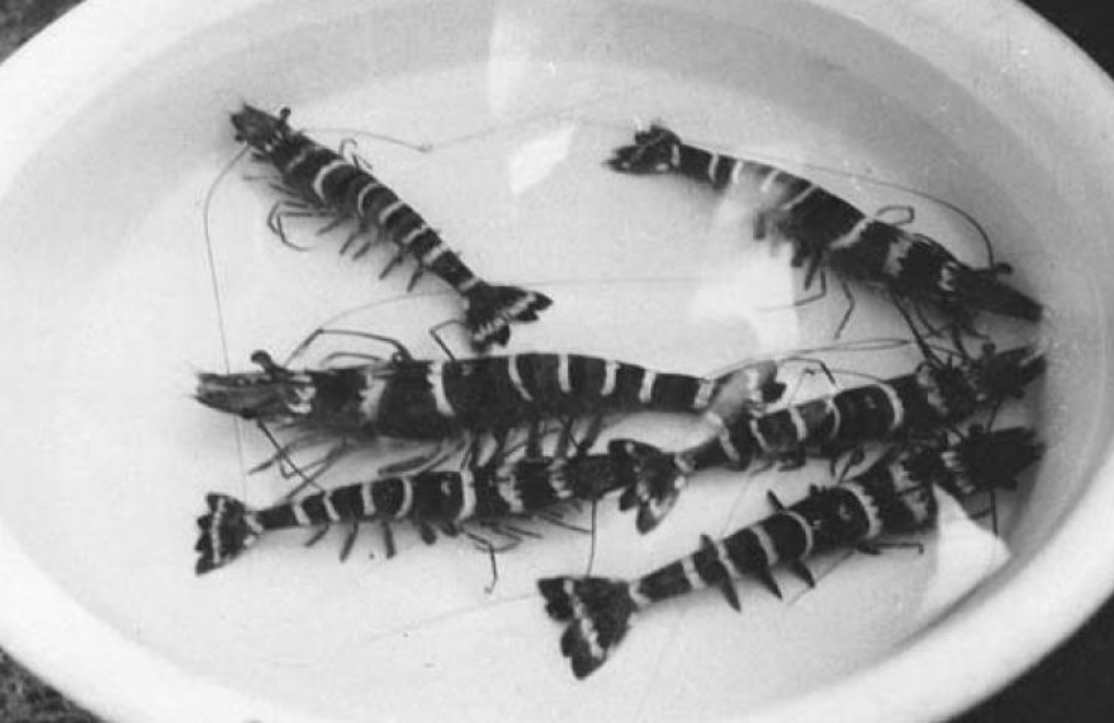
Kuruma shrimp, *Penaeus japonicus*.

Among the species so far studied, *P. japonicus* (fig. 25.1). *P. orientalis* and *P. setiferus* are considered to be most suited for production in temperate climates. *Penaeus japonicus* is cultured in Japan, Taiwan and in a less intensive way in Brazil, France, Spain and Italy. *Penaeus orientalis* is cultured in Korea and China. *Penaeus setiferus* is the species of interest in the temperate regions of the USA. Much of the available knowledge on modern shrimp culture

originated with intensive studies on *P. japonicus*. It is a hardy species, but cannot tolerate low salinity or high temperatures. It requires diets containing about 60 per cent protein for satisfactory growth and grow-out ponds or tanks should have a sandy bottom.

The tiger shrimp *P. monodon* (fig. 25.2), is the fastest growing species used in aquaculture in Asia. The species is euryhaline and can tolerate almost fresh-water conditions, even though 10–25 ppt is considered optimum. It cannot tolerate temperatures below 12°C and the upper limit of tolerance is around 37.5°C.

Penaeus indicus and *P. merguensis* (figs 25.3 and 25.4) have very similar habits in many respects, but in aquaculture the former species exhibits a preference for sandy substrates and the latter for muddy ones. Both species require high salinities (20–30 ppt) for good growth and cannot tolerate salinities outside the range 5–40 ppt. The lethal temperature is above 34°C. Under the current pond management systems, the duration of culture cannot exceed three months, as heavy mortalities occur after that period.



Tiger shrimp, *Penaeus monodon*.

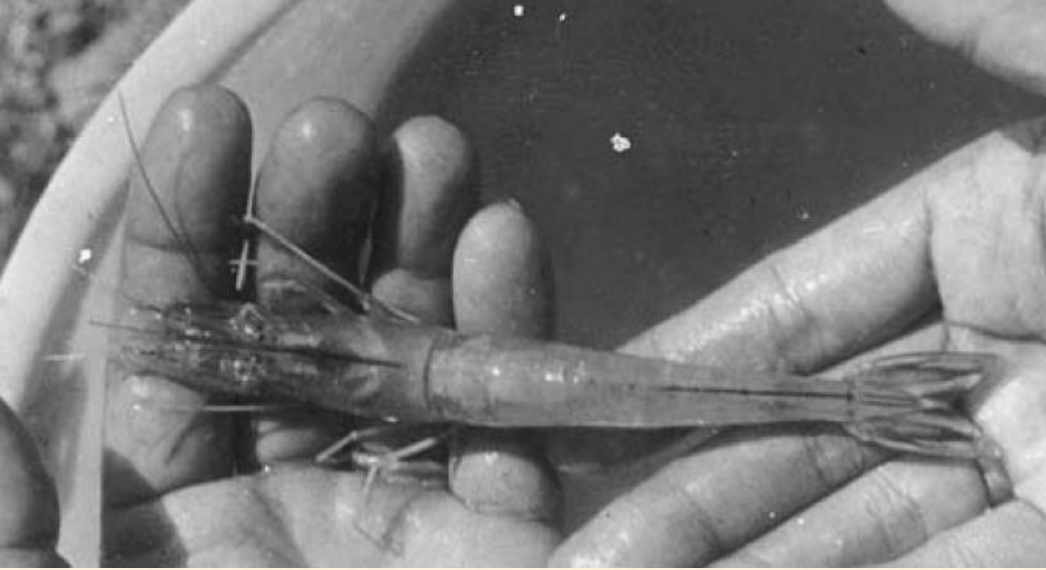
The Indian shrimp or white shrimp, *Penaeus indicus*.



The three Metapenaeid species, *M. monoceros*, *M. brevicornis* and *M. ensis*, are easier to culture, as they mature readily in captivity and their larval culture presents fewer problems. *Metapenaeus monoceros* and *M. brevicornis* are known to breed in ponds. They are tolerant of low salinities and high temperatures and can therefore be cultured in a wider variety of sites. Harvestable size is attained in a shorter time of two to three months, and survival rates are high. But their final size is smaller, generally about 14 cm for *M. monoceros* and *M. ensis* and 7.5–12.5 cm for *M. brevicornis*.

Penaeus semisulcatus (fig. 25.5) grows to a large size and fetches a good price in the markets in Asia and the Middle East, but it requires high salinities and its growth in ponds is slow. Though easy to propagate, survival rates in grow-out facilities are reported to be very

low. Among the shrimps cultured in Central and South America, *P. vannamei* (fig. 25.6) is highly euryhaline and can withstand salinities ranging from 0 to 50 ppt and temperatures ranging from 22 to 32°C. Low salinities and warmer temperatures are characteristic of the rainy season (December to April) in countries like Ecuador and higher salinities and cooler temperatures prevail during the remaining months. This partly accounts for the higher survival rate of *P. vannamei* compared to *P. stylirostris*, and its preference in pond farming in these countries.



Banana shrimp, *Penaeus merguensis*.



Tiger or bear shrimp, *Penaeus semisulcatus*.

Shrimp culture systems

Traditional and modern shrimp culture are carried out mainly in ponds. In traditional systems, where natural stocking was achieved through the intake of tidal water carrying large numbers of shrimp larvae, pond designs were simple and were meant to serve largely as trap ponds; many farmers releasing larvae directly into the rearing or production ponds. It is only in recent years that nursery ponds have been incorporated for growing larvae to an advanced juvenile stage, before transfer to production ponds.

With the adoption of techniques of controlled propagation, many shrimp farms now include hatchery units, together with nursery facilities. There is also greater specialization in

the rearing of post-larvae or juveniles for sale to farmers for grow-out. Such nursery farms may maintain brood ponds, hatcheries and nurseries, together with facilities for growing natural food for larvae.

When the larvae are

collected from the wild, only nursery and live-food growing facilities may be maintained. Even though earth ponds are widely used, many farms adopting semi-intensive systems of culture have nurseries and even rearing ponds with cement concrete dikes. *Macrobrachium* ponds in Taiwan are often made of cement or bricks, or lined with plastic sheets, but sandy loam bottoms containing clay are preferred as they contribute to natural food production. Different kinds of shelters and artificial substrates are provided in ponds, including water plants, hollow bricks, framed nets, plastic pipes, styro-foam sheets, etc.

As mentioned earlier, traditional shrimp culture was necessarily a polyculture system because of an inability to control the composition of the seed stock. In coastal ponds or impoundments, shrimps formed only a small percentage of the harvest. Obviously the species combinations were not always compatible, and the culture procedures were not favourable for high survival rates for shrimps. Recent attempts at polyculture of milkfish and shrimps have shown the conflict of requirements between the species. For example, the shallow depths of milkfish ponds are not

favourable for shrimps and do not allow high stocking rates. There is considerable disparity in the time required to grow the species to marketable size. The transfer of stock from pond to pond, practised in milkfish culture, is not very easy for many species of shrimps, and every transfer generally results in injuries or deaths. In view of these practical problems, it is often preferable to adopt monoculture methods.

Even combinations with other shrimp species do not seem to be very useful in many situations, in view of the differences in environmental requirements between species.

On the other hand polyculture of *Macrobrachium* with certain species of finfish is believed to be beneficial. Although not so common, *M. rosenbergii* is cultured together with Chinese carps (bighead and grass carp) in Taiwan and Malaysia. There are also reports of successful experimental and commercial culture with grey mullets, tilapia and red swamp crayfish, *Procambarus clarkii*