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CANDIDATE SPECIES AND THEIR SPECIAL CHARACTERISTICS  
FOR AQUACULTURE

C. Suseelan

Central Marine Fisheries Research Institute, Cochin-682018

INTRODUCTION

Selection of suitable species is an important prerequisite for successful prawn culture. This becomes more essential when the prawn population of a given locality or region is multi-species in nature and the individual species possess different biological characteristics. Some species are extremely vulnerable for handling under controlled conditions, while the others do not yield easily to artificial manipulations. Further, all those species which can be cultured in the practical sense need not necessarily be profitable also because of various reasons. The culture operation being an elaborate and expensive process involving production and maintenance of different life stages of the prawns, it is imperative to have a clear understanding of the biological process and other desired qualities before any species is selected for this purpose in order to obtain good results. The present paper discusses the important species of marine prawns available at present, potentially cultivable species and the characteristics which make them suitable for aquaculture.

## CANDIDATE SPECIES FOR CULTURE

Although several species of prawns occur in the marine environment contributing to the capture fisheries only a few of them are at present used for culture purpose. Except for some experimental studies carried out on a few species of caridean prawns in Europe in the recent past (Reeve, 1969; Forster & Wickins, 1972; Ling & Castello, 1976), the culture work is mostly restricted to penaeid prawns obviously because of certain special qualities inherent in them. Majority of the species belonging to two important genera of this group namely Penaeus and Metapenaeus have an estuarine phase in their lifecycle and many of them are subjected to large scale culture in many countries especially in South-East Asia. (The fundamental principle involved in the existing culture practices is taking advantage of the brackishwater phase in the lifecycle of the prawns. Species of these genera breed in the sea as the other penaeids and after completing their larval phase the postlarvae migrate into estuaries and backwaters where they grow fast and then return to the sea on reaching or nearing adulthood. Though this is the general pattern of lifecycle, the extent of dependance on estuarine environments vary from species to species depending on their ecophysiological properties.

Presently cultured species in the world

The penaeid prawns at present used for culture purpose in different parts of the world include the following 35 species (Holthuis, 1980; Muthu et al, 1982).

<u>Penaeus japonicus</u>	<u>P. stylirostris</u>
<u>P. chinensis</u>	<u>P. penicillatus</u>
<u>P. marginatus</u>	<u>P. plebejus</u>
<u>P. monodon</u>	<u>Metapenaeus ensis</u>
<u>P. semisulcatus</u>	<u>M. brevicornis</u>
<u>P. indicus</u>	<u>M. moyebi</u>
<u>P. merguensis</u>	<u>M. affinis</u>
<u>P. latisulcatus</u>	<u>M. dobsoni</u>
<u>P. kerathurus</u>	<u>M. monoceros</u>
<u>P. paulensis</u>	<u>M. lysianassa</u>
<u>P. brasiliensis</u>	<u>M. stebbingi</u>
<u>P. schmitti</u>	<u>M. joyneri</u>
<u>P. notialis</u>	<u>M. bennettae</u>
<u>P. aztecus</u>	<u>M. macleayi</u>
<u>P. duorarum</u>	<u>Parapenaeopsis stylifera</u>
<u>P. setiferus</u>	<u>Pleoticus muelleri</u>
<u>P. vannamei</u>	<u>Artemesia longinaris</u>
<u>P. californiensis</u>	

Of these, the first 7 species of each of the Genera Penaeus and Metapenaeus are the important ones contributing to the traditional culture fisheries of the South-East Asian countries and the well established intensive or semi-intensive culture practices of the Indo-Pacific region. P. japonicus is the candidate species cultivated in Japan employing the highly advanced techniques of prawn culture. Table 1 indicates the various species cultured in different countries in some form or other.

#### Cultivable species and their general distribution in Indian coasts

The Indian waters are well known for their rich resources of prawns and among the penaeids as many as 52 species are known to occur in the coastal region (George, 1979). While

several of them contribute to the capture fisheries of the marine and estuarine environments the following nine species are important from the stand point of aquaculture, as they are either traditionally cultured in large quantities or have gained substantial progress in culture experiments in the country.

P.indicus

M.dobsoni

P.monodon

M.affinis

P.semisulcatus

M.brevicornis

P.merguensis

P.stylifera

M.monoceros

Apart from these, many other species also occur along the west and east coasts which have immense potentialities for brackish water culture. The most important among them are P.canaliculatus, P.penicillatus, P.japonicus, M.kutchensis and Parapenaeopsis sculptilis.

The above mentioned candidate species can be distinguished based on certain morphological features. Characters such as rostrum, carapace with its various spines, ridges and grooves, telson, appendages and the secondary sexual characters such as petasma, thelycum and appendix masculina are important for taxonomic purpose (Fig.1 & 2). The individual species can be identified by following the field keys provided by George (1969, 1979) and Kunju (1978).

Although suitable species for aquaculture are available through the Indian coasts, regional variations occur with regard to the type of species and their relative abundance. George and Suseelan (1982) recently studied the distribution pattern of cultivable species of prawns in the brackish water areas of the maritime states. The occurrence and relative preponderance of important cultivable species of penaeid in different parts of Indian coasts are shown in Table 2.

Table 1. Penaeid prawns cultured in different parts of the world

Country/region	Species
Japan	<u>P.japonicus</u> *, <u>P.latisulcatus</u> , <u>M.joyneri</u>
Korea	<u>P.chinensis</u> *, <u>P.japonicus</u> , <u>M.joyneri</u>
Taiwan	<u>P.marginatus</u> *, <u>P.penicillatus</u> , <u>P.japonicus</u> , <u>P.monodon</u> , <u>P.semisulcatus</u> , <u>M.ensis</u> * <u>M.joyneri</u>
Philippines	<u>P.monodon</u> *, <u>P.indicus</u> *, <u>M.ensis</u> *
Thailand	<u>P.merguensis</u> *, <u>P.indicus</u> *, <u>P.latisulcatus</u> , <u>P.monodon</u> , <u>P.semisulcatus</u> , <u>M.brevicornis</u> *, <u>M.ensis</u> *, <u>M.monoceros</u> *
Malaysia	<u>P.indicus</u> *, <u>P.monodon</u> , <u>M.ensis</u> *, <u>M.moyebi</u> *, <u>M.affinis</u> *, <u>M.brevicornis</u> *
Singapore	<u>P.indicus</u> *, <u>P.merguensis</u> , <u>M.moyebi</u> , <u>M.ensis</u> *, <u>M.brevicornis</u> *, <u>M.lysianassa</u> *
Indonesia	<u>P.indicus</u> *, <u>P.merguensis</u> *, <u>P.monodon</u> *, <u>P.semisulcatus</u> , <u>M.brevicornis</u> *, <u>M.ensis</u> *, <u>M.monoceros</u> *
Australia	<u>P.latisulcatus</u> , <u>P.plebejus</u> , <u>M.bennettiae</u> , <u>M.macleayi</u>
Bangladesh	<u>P.indicus</u> *, <u>P.monodon</u>
India	<u>P.indicus</u> *, <u>P.monodon</u> *, <u>P.semisulcatus</u> *, <u>P.merguensis</u> , <u>M.brevicornis</u> *, <u>M.dobsoni</u> *, <u>M.monoceros</u> *, <u>M.affinis</u> , <u>P.stylifera</u>
Kuwait	<u>P.semisulcatus</u> , <u>P.monodon</u> , <u>M.affinis</u> , <u>M.stebbingi</u>
Mediterranean coast (Italy & Spain)	<u>P.kerathurus</u>
France	<u>P.japonicus</u>
Argentina	<u>P.muelleri</u> , <u>A.longinaris</u>
Uruguay	<u>P.paulensis</u>

Table 1 contd..

Country/region	Species
Brazil	<u>P. brasiliensis</u>
Cuba	<u>P. schmitti</u> , <u>P. notialis</u>
U.S.A.	<u>P. aztecus</u> , <u>P. duorarum</u> , <u>P. setiferus</u> , <u>P. vannamei</u>
California	<u>P. californiensis</u> , <u>P. stylirostris</u>
Hawaii	<u>P. marginatus</u>

\* Major species supporting pond culture fisheries

Table 2. Candidate species available for aquaculture along the coasts of maritime states in India

Maritime states	Region	Species
Gujarat	North	<u>P. penicillatus</u> , <u>P. merguensis</u> , <u>M. kutchensis</u> , <u>M. brevicornis</u> .
	South	<u>P. penicillatus</u> , <u>M. monoceros</u> , <u>P. sculptilis</u>
Maharashtra	Throughout	<u>P. penicillatus</u> , <u>P. merguensis</u> , <u>M. monoceros</u> , <u>M. affinis</u> , <u>M. brevicornis</u> , <u>P. sculptilis</u> .
Goa	Throughout	<u>P. merguensis</u> , <u>P. indicus</u> , <u>M. dobsoni</u> , <u>M. monoceros</u> .
Karnataka	North	<u>P. merguensis</u> , <u>P. indicus</u> , <u>M. dobsoni</u> , <u>M. monoceros</u> .
	South	<u>P. indicus</u> , <u>P. merguensis</u> , <u>P. monodon</u> , <u>M. dobsoni</u> , <u>M. monoceros</u> , <u>M. affinis</u> .
Kerala	Throughout	<u>P. indicus</u> , <u>P. monodon</u> , <u>P. semisulcatus</u> , <u>M. dobsoni</u> , <u>M. monoceros</u> , <u>M. affinis</u> , <u>P. stylifera</u> , <u>P. canaliculatus</u> .
Tamil Nadu	South	<u>P. indicus</u> , <u>P. monodon</u> , <u>M. monoceros</u> , <u>M. dobsoni</u> .

contd..

Table 2 contd.

Maritime states	Region	Species
	North	<u>P.indicus</u> , <u>P.monodon</u> , <u>P.semi-sulcatus</u> , <u>P.japonicus</u> , <u>M.dobsoni</u> , <u>M.monoceros</u> , <u>M.affinis</u> .
Andhra Pradesh	South	<u>P.monodon</u> , <u>P.indicus</u> , <u>P.merguensis</u> , <u>M.monoceros</u> , <u>M.brevicornis</u> , <u>M.dobsoni</u> , <u>M.affinis</u> .
	North	<u>P.indicus</u> , <u>P.monodon</u> , <u>M.monoceros</u> , <u>M.dobsoni</u>
Orissa	Throughout	<u>P.indicus</u> , <u>P.monodon</u> , <u>M.monoceros</u> , <u>M.dobsoni</u> , <u>M.affinis</u> .
West Bengal	Throughout	<u>P.monodon</u> , <u>P.indicus</u> , <u>P.semi-sulcatus</u> , <u>M.brevicornis</u> , <u>M.monoceros</u> , <u>M.affinis</u> , <u>P.sculptilis</u> .

Among the species of Genus Penaeus, the most common species locally available for culture purpose are P.penicillatus and P.merguensis along the northwest coast, P.indicus in the southwest and southeast coasts, P.monodon, P.indicus and P.merguensis in the central east coast and P.monodon and P.indicus in the extreme northeast coast. The genus Metapenaeus is predominantly represented by M.kutchensis in Gujarat, M.monoceros in Maharashtra, Andhra Pradesh and Orissa, M.dobsoni in Goa, Karnataka, Kerala and Tamil Nadu and M.brevicornis in Andhra Pradesh and West Bengal.

#### DESIRABLE QUALITIES OF THE SPECIES FOR AQUACULTURE

##### 1. Availability in space and time

In a multispecies population the availability of suitable species in the locality at the appropriate time is an important factor for success in commercial prawn culture. Most of the culture operations at present carried out are in the coastal areas or in the vicinity of estuaries and backwaters and

therefore those species which are readily available around these zones of operation have greater advantage than those occurring far away from this area. Further, selection of local species will be always more beneficial than introducing new ones to the area because of the risk involved in their acclimation to an unfamiliar environment.

## 2. Reproductive behaviour and fecundity

Occurrence of spawners close to the area of culture, their availability during greater part of the year, capacity to breed many times during life span, high fecundity and readiness to spawn under controlled conditions are some of the important reproductive features of prawns which contribute to their suitability for culture. In our waters, P.indicus and M.monoceros are found to breed in comparatively deeper areas of the littoral zone, while species such as M.dobsoni and P.stylifera do the same in shallow waters within about 20 m depth. Most of the species of penaeid prawns have protracted breeding habits and are capable of producing large number of eggs. The total number of eggs produced by the female prawn at a time varies from species to species and with the size of the prawn. The estimated fecundity range for some of the common species are: P.indicus - 68,000 to 731,000, P.monodon - 300,000 to 700,000, P.semisulcatus - 67,900 to 660,900, M.dobsoni - 34,500 to 160,000, M.affinis - 88,000 to 363,000 and P.stylifera - 39,500 to 236,000 eggs (Rao, 1978). Recent laboratory studies carried out in India on prawn breeding have shown that P.monodon, P.indicus, P.merguensis, P.semisulcatus, M.dobsoni, M.monoceros, M.affinis and P.stylifera readily spawn in captivity and considerable progress have been achieved in the country for large scale production of their seeds in the hatchery.



### 3. Larval development

The length of larval phase and the number of larval stages involved in the lifecycle of prawns are important aspects to be considered especially for the development of efficient hatchery systems. A shorter period of metamorphosis coupled with less number of larval stages would make the hatchery process easier and economical. The duration of larval development in most of the penaeid prawns mentioned above is relatively short and the metamorphosis which involves 12-15 larval stages is completed in 8-12 days.

### 4. Growth rate and the size attained in brackishwater

Selection of species for commercial culture largely depends upon the rate of growth and the maximum size attained by them in brackishwater enclosures. Fast growing species which could yield short-term harvests are the most suitable species for intensive prawn farming. It is well known that majority of the species which have an estuarine phase in their lifecycle grow fast in brackishwater environments where their growth rate varies from species to species. Similarly, the maximum size attained by them in these habitats are also highly variable. Among those species which occur in the estuarine ecosystems species belonging to the genus Penaeus grow to very large size relatively shorter period of time and hence they are superior to any other prawns for culture purpose. P.monodon reaches to the maximum size of about 250 mm in brackishwater followed by P.indicus, P.merguensis and others.

### 5. Feeding habits and food conversion efficiencies

The habit of feeding on a wide range of items and the ability to grow well with more of natural food are important aspects contributing to the prawn's suitability for culture.

The food preference varies considerably at different life stages of the prawns. While the larval prawns feed on planktonic items, juveniles and adults subsist on organic detritus and a variety of animal and plant materials available at the bottom. A wide range of feeding habits in different habitats effect a faster growth rate and higher survival rate for the prawns.

Ready acceptability of artificial diets and better food conversion efficiency are the other desired qualities of the prawns especially for intensive culture.

#### 6. Hardiness of the animal

The hardiness of prawns make them suitable for any type of aquaculture operations. Since the various stages in the lifehistory of prawns are distributed in different environmental conditions between the sea and estuaries they show different tolerances and preference to environmental parameters. Among these, salinity and temperature are the most important factors which play significant roles in the maturation of ovaries, breeding and distribution of young ones. Most of the candidate species occurring in India have the capacity to tolerate wide range of salinity and temperature conditions in the postlarval and juvenile stages making them suitable for culture in all brackishwater gradients. Among the common species, P.indicus, P.monodon, M.dobsoni and M.monoceros are able to survive well in salinities below 5 ppt (George & Suseelan, 1982).

#### 7. Compatibility with other species

The compatibility of prawns with brackishwater fishes and fellow species of prawns at various stages of growth is of prime importance for consideration in mixed/polyculture operations.

## 8. Market demand and economic factors

Among the sea foods exported from India, prawns and shrimps constitute the major portion. The increasing demand for prawn products in foreign markets makes prawn farming more attractive. The freezing companies have also become wide spread all over the country and the demand for large sized prawns by the industry has stepped up considerably. The competitive demand for prawns from all over the world is so much that new price levels are being reached every year for this commodity. In the context of greater demand for larger prawns in the export trade, species that grow very rapidly and attain bigger size in the shortest period have to be selected for profitable commercial culture. Owing to the large sizes attained in brackishwater conditions species of the genus Penaeus are preferred for aquaculture all over the world.

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