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**THE MARINE FISHERIES INFORMATION SERVICE:** Technical and Extension Series envisages the rapid dissemination of information on marine and brackish water fishery resources and allied data available with the National Marine Living Resources Data Centre (NMLRDC) and the Research Divisions of the Institute, results of proven researches for transfer of technology to the fish farmers and industry and of other relevant information needed for Research and Development efforts in the marine fisheries sector.

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**Front cover photo:**

A prawn culture pond in salt pan area at Veppalodai, Tuticorin showing the catching pit for easy harvest.

**Back cover photo:**

A view of salt pan area at Veppalodai, Tuticorin where prawn culture has been carried out. In the background are heaps of salt.

# DISTRIBUTION, HABITS AND HABITATS OF PALINURID LOBSTERS AND THEIR LARVAE

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## Introduction

The lobster fishery has assumed considerable economic importance in the last few years and consequently there has been an increased effort in several parts of the world to study and understand the various aspects of the species that constitute the fishery. Under the popular name 'lobsters' four families have been recognised. They are the clawed lobsters belonging to the family Nephropsidae, amongst which *Homarus gammarus* the European lobster, *H. americanus* the American lobster and *Nephrops norvegicus* the Norwegian lobster are the well-known ones. The other three families are closely related and they are the Synalidae (the coral lobsters) with a single genus *Palinurellus*, the Scyllaridae (the slipper lobsters) with several genera and the spiny lobsters - Palinuridae. Both the clawed lobsters and the spiny lobsters are of commercial importance.

The spiny lobsters or Palinuridae are widely distributed throughout tropical and sub-tropical seas and

Photo courtesy: Mr. M. Kathirvel

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by limiting the stocking density to about 70,000/ha. Improvements in flushing system, increase in the water depth, steady supply of nutritive food, provision of 'water blender' to avoid oxygen depletion are some of the suggestions for more effective implementation and higher production. The peak summer period may be avoided for stocking and the duration of culture can also be reduced to realise a better economic return from the yield.

In Japan 70 percent of the prawn ponds are converted salt pans. About 1,20,000 ha of brackishwaters in the form of disused salt pans and low lying coastal areas are available for culture purposes in Tamil Nadu. The Government of India has already cleared a project for the development of 150 ha of brackishwater area for farming in Thondikadu in Tanjore District, Valinokkam in Ramanathapuram District and Pinnakayal in Tirunelveli District or in Pulicat Lake (Dixitulu, 1986). Realising their commercial value, a number of private farmers have just started prawn culture practices in salt pan areas in Palayakayal, Pinnakayal, Vaipar and Vembar. With the available technology in prawn farming, the salt pan areas can be profitably utilised for prawn culture in the near future.

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a few species occur in temperate waters also. The Family Palinuridae consists of nine genera and all these are represented in the Indian Ocean. Altogether eighteen species belonging to 9 genera have been recorded from the Indian Ocean. Of these, seven species viz., *Panulirus homarus*, *P. ornatus*, *P. versicolor*, *P. polyphagus*, *P. penicillatus*, *P. longipes* and *Puerulus sewelli* are common in the Indian waters. *P. sewelli* is known to occur in commercially exploitable quantities in the deeper waters especially off the coast of Kerala. The results of recent exploratory fishing conducted by the Integrated Fisheries Project have indicated the occurrence of large quantities of *Palinustus mossambicus* also in the deeper waters of the southwest coast of Kerala. The commercial possibilities of exploiting this species are, however, not known. This makes eight species of palinurids of commercial importance. Amongst the six species of *Panulirus*, all of which are inhabitants of shallow waters especially rocky areas or where there are extensive coral reefs which offer suitable retreats, only four species form the mainstay of the commercial fishery. These are *P. homarus*, *P. polyphagus*, *P. ornatus* and *P. versicolor* and details of the distribution of which are given together with the distribution of *Puerulus sewelli* and *Palinustus mossambicus* with the description of species at the end.

#### Habits and habitat

##### Habits

Spiny lobsters are shelter dwellers and include singular or multiple den residency and show definite homing patterns. Most of the species do not undertake extensive migrations. They are nocturnal foragers and generally begin to feed at dusk, are gregarious and return to their dens before dawn. According to Kanciruk (1980) "Interactions between environment (temperature, light, photoperiod, salinity etc.) and palinurid behaviour are complex, and evidence indicates that such environmental parameters strongly affect activity patterns, migratory movements, reproduction, growth and regional and local distribution. Based on current research, the most important of these factors seems to be light (controlling activity patterns) and temperature (influencing or triggering migratory behaviour and breeding activity)."

##### Habitat

Although these lobsters enjoy wide distribution, there are clear evidences to show that most species prefer particular regions or habitat. There is a great variation

in the habitat preference of adult lobsters and it may vary from the intertidal zone to great depths of the ocean characterised by mud-ooze substrate and perpetual darkness. It is generally believed that the adult lobsters do not undertake long migrations. Studies carried out by Mohamed and George (1967) on the migration of *P. homarus* showed extremely limited movements. It is, however, reported that *P. ornatus* undergoes mass migration between habitats which explains the significant contrast between the habitats of the juveniles and adults of this species. "The most characteristic feature of the habitat of many of the palinurids is the residence area or den. Dens are not usually constructed by the Palinuridae but are opportunistically chosen from the surrounding habitat. The burrowing ability of most Palinuridae is usually assumed to be minimal." Except in a few regions, detailed studies on the habitat preferences of lobsters have not been carried out. Some of these studies have indicated that there are 'true home dens' to which individual lobsters will repeatedly return after their nocturnal foraging. The available information has been compiled by Kanciruk (1980). In regard to the four species, which contribute mainly to the lobster fishery of India, Prem Kumar and Daniel (1975) have given a detailed account of their distribution pattern in the Indian region.

*P. ornatus*: It occurs in appreciable quantities along the southeast coast of India where they constitute a good fishery. The species has been recorded from other regions also along the coast of India.

*P. polyphagus*: This species although recorded from both the coasts of India, is more common along the west coast particularly the northwest coast of India forming a good fishery. Chopra (1939) has, however, stated that this is the only species of lobster of commercial importance off Calcutta.

*P. versicolor*: Although this species also enjoys a fairly wide distribution along the coasts of India and the Andaman and Nicobar islands, it does not contribute significantly to the fishery and is the rarest commercial species.

*P. homarus*: Amongst the four species which contribute to the commercial fishery, this is the most important and forms a good fishery in several places along the coasts of India and the Andaman and Nicobar Islands. The bulk of the fishery is concentrated along the southwest coast of India. Berry (1971) has observed that along the East African coast *P. homarus rubellus* inhabits the surf zone and is most tolerant to surge and

turbulence. He also reported that the distribution is correlated to the occurrence of its main food which is the mussel *Perna perna*. It is interesting to mention here that large-scale settlement of the puerulus stage of *P. homarus* was noticed in the spat collectors kept off the coast of Kovalam (near Madras) for collecting the spat of *Perna viridis*. This may indicate that in this region also mussels constitute the main food of the puerulus as well as the adults of *P. homarus*.

*Puerulus sewelli*: This is known to occur in commercially harvestable quantities in the deeper waters off Kerala. So far no attempt has been made to fish them on a commercial basis.

### Larval history

The eggs are attached to the endopodites of the pleopods of the female and no reliable information is available on the time taken for development and hatching of the larvae. In most cases hatching takes place at night. Generally the first larval stage is recognized as the phyllosoma. Some authors have, however, recorded stages earlier to the phyllosoma stage and these have been referred to as 'pre-naupliosoma', 'naupliosoma' or 'prephyllosoma.' These, whenever present, last only for a few hours before moulting into the phyllosoma. Therefore, some believe that the "pre-naupliosoma stage probably represents an embryonic form occurring as a result of premature rupturing of the eggs in most species, although the finding of pre-naupliosoma of *P. argus* in the plankton by Sims (1965) shows this is not universal" (Phillip; and Sastry, 1980). In regard to the species occurring in Indian waters the only record of a free larval stage prior to phyllosoma is that of Deshmukh (1968) who observed in *P. dasypus* (= *homarus*) a larval form different from the naupliosoma and phyllosoma and suggested the name 'prephyllosoma.'

Phyllosoma larvae, as the name indicates have flat and leaf-like body. They are transparent, have long legs and protuberant eyes and have orange-red chromatophores particularly on the coxal segments of the pereopods and between the base of the first and second antennae. The first stage of phyllosoma (Fig. 1) measures from 1.1 to 2.3 mm in body length (from the tip of the abdomen to the tip of the forebody between the eyes) depending on the species. The eyes are thick stalked but unsegmented and are about as long as the first antenna. The first antenna is about one and a half times the length of the second antenna and both are unsegmented. The first maxilliped may be present

or absent and the second maxilliped is segmented. The third maxilliped is biramous with setose exopodite. There are three pereopods of which the first two are biramous with setose exopodites. The abdomen is

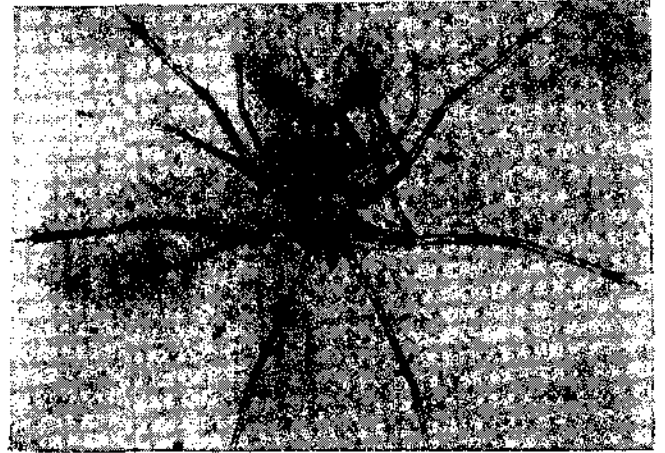


Fig. 1. First stage phyllosoma larva of *Panulirus homarus* (Linn.) (Photo courtesy: Mr. M. Kathirvel).

unsegmented. The shape of the cephalic shield varies from species to species. Differences have been observed by many workers between the larvae reared in the laboratory and those obtained from plankton.

The specific identification of the phyllosoma larvae has been a major problem especially in regions where there are several species of lobsters co-existing. The identification in most cases therefore, has been based on circumstantial evidence relating to the intensity of larval population and the abundance of particular species. Positive species identification is possible either through laboratory hatched larvae or from the last stage of phyllosoma metamorphosed into the puerulus stage

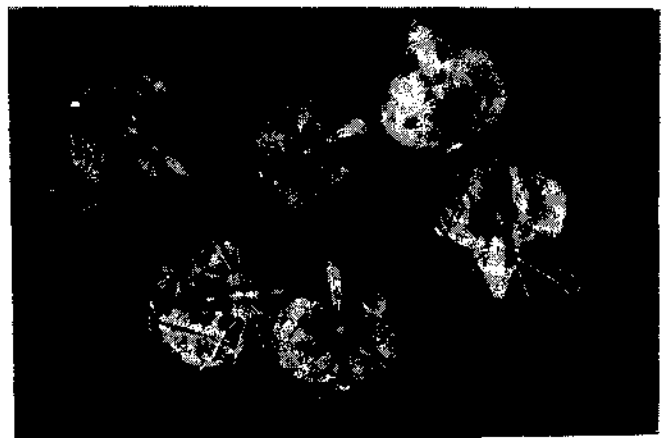


Fig. 2. A group of advanced phyllosoma larvae of *Scyllarus* sp. (Photo courtesy: Mr. M. Kathirvel).

in the laboratory whose specific identity could be determined. Out of the different species of lobsters recorded from the Indian Ocean, the first phyllosoma of only six viz., *P. homarus*, *P. ornatus*, *P. polyphagus*, *P. longipes*, *P. japonicus* and *Puerulus sewelli* are correctly known. These are based on laboratory hatched larvae. Rearing of these larvae in the laboratory through successive stages has met with relatively little success. The phyllosomas pass through a series of moults and with each moult the larvae increase in size. Each moult, however, does not necessarily mean that there is a concurrent change in the stage of development because laboratory experiments have shown that there may be several moults between successive stages. Different workers have assigned varying number of stages through which the phyllosoma larvae pass from the newly hatched to the time they metamorphose into the puerulus stage when they start assuming some of the characters of the adults. At this stage they generally change from a planktonic to a settled life and moult into the juvenile stage and assume the morphological features of the adults.

It is believed that in the case of the Indian species there are about 10 or 12 stages of phyllosoma and that the larval life in different species ranges from 3 to about 6 or 7 months. Depending on the species, the last phyllosoma stage varies in length between 30 and 43 mm. In the final stage all the pereopods are fully developed, the pleopods have become biramous and so also the uropod is fully developed. This last stage of phyllosoma metamorphoses into the puerulus and Gurney (1942) describes this as "the most profound transformation at a single moult known among Decapoda."

#### Distribution and abundance of phyllosoma larvae

##### Distribution

The distribution of phyllosoma is determined by several factors particularly in view of its prolonged larval life and the influence exerted by the prevailing water movements. Most of the studies, however, have shown a greater concentration of phyllosoma along the coast or near islands. This is to be expected owing to the fact that majority of the species of adult lobsters inhabit coastal regions, around islands and coral reefs. It is also generally believed that these larvae are seldom found beyond the geographical limits of the adult populations. In spite of extended planktonic life, during which period they are subjected to varying influence of water movements, it is interesting that the larvae still remain concentrated in certain restricted areas thereby facilitating the restocking of these regions. Tampi and

George (1975) while studying the International Indian Ocean Expedition collections have remarked that "one of the strange features worthy of notice is the lack of larval specimens in any appreciable numbers along the coastal regions of India and Ceylon. While adults of the palinurids are present in large numbers around Ceylon, southwest and southeast coasts of India contributing to commercial fishery (De Bruin, 1960; 1962; George, 1968), the absence of larvae from this region in the collections covering a period of 5 years excepting for a single specimen from the Lakshadweep area is quite intriguing." Attempts have been made to study the mechanisms of larval transport and dispersal, and different explanations have been given for the peculiar features of distribution, but still these are not fully understood. The problem has to be viewed from the methods of collection, time and area of sampling and more detailed analysis of the larval transport in relation to the hydrological factors of the regions particularly the water movements are required. Phillips and Sastry (1980) have stated that "The overall direction of the phyllosoma larvae during the larval movements seems to be fortuitous, and there is no suggestion that the larvae actually seek to travel in a particular direction. Under this assumption the presence of larvae in a water mass has been used by oceanographers as indications of the origins of that particular water mass (Murano, 1957; Johnson and Brinton, 1963). Larvae released in shallow inshore areas are typically described as being carried offshore in the particular watermass in which they are released. Thus, while the mechanisms of the return of the larvae back to the coast are not fully understood, their return can be taken as indicating the presence of water movements. The data on the early phyllosoma larvae of *P. cygnus* show that these larvae are transported offshore by the action of surface wind drift, passing over the top and moving contrary to the direction of the described major circulation of the area. This suggests that caution should be used in the interpretation of the movements of the larvae in relation to water circulation features, although the basic truth of the statement is unchanged." Phillips (1981) has, however, remarked in the case of phyllosomas of *P. cygnus* that most of them complete their planktonic period without re-entering the continental shelf waters and that concentrations of the late stage of the larvae have been found in the waters near the edge of the continental shelf.

It is believed by some investigators that the larvae which are carried farthest from the coast and which cannot return to the same area and consequently considered lost may be the source of recruitment to other

areas. This has been observed in the South Florida waters, Australia-New Zealand region and the Madagascar-Southeast Africa region. The ability of the phyllosoma larvae to postpone their metamorphosis into the puerulus stage until they are in the neighbourhood of a suitable benthic habitat has also been mentioned in the literature as a possibility. This may be an inbuilt control mechanism for self preservation.

In the pattern of vertical distribution these larvae show some interesting features. The larvae collected from the Indian Ocean by the DANA Expedition which constitute numerically the best collection, show the quantitative vertical distribution of these larvae. Contrary to the expectations, the maximum number of larvae is found at about 50 m with very few near the surface. They were fairly abundant at 100 m. Their number decreased with increasing depth although fairly large numbers were obtained at 200, 300, 500 and 600 m. The occurrence of the I stage phyllosoma of *P. ornatus* at 2,000 m is difficult to explain and that of IX and XII stages of *P. penicillatus* as far down as 3,500 m is rather interesting. With the available data it is not possible to explain precisely the vertical distribution pattern and the factors influencing this. In general, it could be stated that the majority of the larvae obtained from deeper waters were fairly advanced stages. The study of the oceanographical conditions suggests that the greater concentration of the larvae in the upper 100 m is closely related to the distribution of the pycnocline which acts as an effective barrier for the vertical movements of the larvae. It is also known that intensity of light plays a vital role in the vertical distribution of these larvae, the early stages of which are reported to show a strong photopositive reaction to dim light. In the case of the phyllosoma larvae of *P. cygnus* recent investigations have shown that they perform daily diurnal migrations, rising to the surface at night and descending to lower depths during day time. Therefore, light appears to be an important factor in influencing the vertical distribution.

#### *Abundance*

In spite of increasing attention being paid to the study of the phyllosoma larvae, no serious attempt seems to have been made to study the abundance and quantitative distribution of these larvae. A large number of species of adults have been recorded from Indian waters but the paucity of their larvae in the regular plankton collections made even in regions where the adults are known to inhabit is somewhat puzzling. This could partly be attributed to the type of net used,

method and time of collection. Ritz (1972) observed that the densities of the early stages of phyllosoma of *P. cygnus* are apparently independent of the plankton biomass but in the case of late stages a correlation between the larval density and the plankton biomass was noticed. Tampi (1973), however, reported that generally "the areas of poor phyllosoma catch coincide with regions of low zooplankton biomass and especially the decapod larvae."

The richest collection of panulirid phyllosomas from the Indian Ocean appears to be the one made by the DANA Expedition during 1928-1930 and described by Prasad, Tampi and George (1975). The larvae have been assigned to 10 species belonging to 4 genera, whereas adults of 10 species belonging to 3 genera have been recorded from Indian waters. It is interesting to note that in the DANA collections as well as the International Indian Ocean Expedition collections studied by Tampi and George (1975) the maximum number of larvae was that of *P. versicolor* although this species does not contribute substantially to the commercial fishery along the Indian coast.

Despite the considerable amount of information that has been gathered on the distribution of the adult lobsters and many workers have been studying the larval history, much more remains to be done to have a complete picture of the life history of this group of crustaceans which have great economic value. Specific identity of the larval stages of most of the species is unknown, the distribution pattern in space and time and the effects of environmental factors on this, their mortality rates and number of stages through which the larval phase is completed, their food and feeding habits and conditions necessary for the phyllosomas to metamorphose into the puerulus stage thereby changing from a planktonic to a benthic life are some of the aspects which require detailed study. It would also be interesting to conduct some experiments to find out whether the normal lengthy larval period could be abridged so that when a complete culture system is evolved considerable time could be saved in producing marketable size lobsters. These data together with the information on the ecology and biology of the adults are essential for the management of this valuable resource.

#### **Description of the species**

The following is a brief description of the important distinguishing characters of the different species of panulirids occurring in the Indian waters.

**Panulirus homarus\*** (Linnaeus)

Synonyms

*Locusta marina* Rumphius  
*Locusta marina indica* Rumphius  
*Cancer homarus* Linnaeus  
*Astacus homarus* Fabricius  
*Palinurus homarus* Fabricius  
*Palinurus burgeri* De Haan  
*Palinurus (Panulirus) dasyopus* Heller  
*Palinurus femoristiga* De Man  
*Panulirus burgeri* Bouvier

The antennular plate has four principal spines, the anterior pair being larger than the posterior. In between them there is a group of spinules. The median and lateral spines of the fused coxicerites of the antennae are small and placed almost in a line. One to three spinules may be present in between the median and lateral spines. The exopod of the second maxilliped is with or without a flagellum which if present may vary in its number of segments. The third maxilliped is without an exopod. The abdominal somites have an interrupted or uninterrupted transverse groove, the anterior margin of which is crenulated and with setae.

The colouration is generally bluish grey with numerous minute white dots. A row of six or seven large white spots are present on either side of the carapace. Each abdominal somite has a conspicuous white spot on either side and the walking legs have irregular yellowish-white spots.

**Panulirus ornatus\*** (Fabricius)

Synonyms

*Cancer (Astacus) homarus* Herbst  
*Palinurus ornatus* Fabricius  
*Palinurus sulcatus* H. Milne Edwards  
*Panulirus sulcatus* White  
*Panulirus ornatus* Stimpson  
*Palinurus (Senex) brevipes* Pfeffer  
*Palinurus (Senex) sulcatus* Pfeffer  
*Palinurus homarus* Pfeffer  
*Panulirus polyphagus* Borradaile

Four principal spines, the anterior pair being larger than the posterior, are present on the antennular plate. Small spinules may be present in between the two pairs of spines. The median spine of the fused coxicerites of the antennae is larger than the lateral spine and the three spines are situated almost on the same line. There

are no spinules. The second maxilliped has an exopod without a flagellum but with a tuft of setae, whereas the third maxilliped is without an exopod. Abdominal somites without a transverse groove.

Bluish green in colour, the carapace has pale cream vermiculate lines and bright orange spots. Each abdominal somite has a dark blue transverse band with one or two cream coloured oblique spots on the sides. Walking legs alternately banded or marbled with cream and maroon.

**Panulirus penicillatus\*** (Olivier)

Synonyms

*Astacus penicillatus* Olivier  
*Palinurus penicillatus* Olivier  
*Panulirus penicillatus* White

The antennular plate has four principal spines united at the base, the anterior pair being smaller than the posterior. Rest of the antennular plate is unarmed. The median spine of the fused coxicerites of the antennae is larger than the lateral spines and there are one or two spinules in between the median and lateral spines. The second maxilliped has an exopod with many jointed flagellum while the exopod of the third maxilliped is without a flagellum. The abdominal somites have an uninterrupted transverse groove, the anterior margin of which is non-crenulated and without setae.

Dark brownish green or brownish pink in colour with numerous orange yellow spots. The entire abdomen is speckled with minute white spots and on top of the 'plate D' a conspicuous white spot is present. There are pale yellow straight or wavy lines along the length of the walking legs.

**Panulirus polyphagus\*** (Herbst)

Synonyms

*Cancer (Astacus) polyphagus* Herbst  
*Palinurus fasciatus* Fabricius  
*Panulirus fasciatus* Milne-Edwards  
*Panulirus polyphagus* Nobili

The antennular plate with two principal spines situated far anteriorly and the rest of the plate is unarmed. The median spine of the fused coxicerites of the antennae is large and situated in front of the lateral spines. There are no spinules. The exopod of the second maxilliped has a many jointed flagellum, whereas the third maxilliped is without an exopod. The abdominal somites are without transverse groove.

Greenish grey or muddy brown in colour with numerous indistinct white spots. A row of six large white spots are present on either side of the carapace. There is a large oblique patch on either side of the first abdominal somite. The hind margin of each abdominal somite has a brown band with a white line in the middle. Yellowish white spots are present on the walking legs.

***Panulirus versicolor*\*** (Latreille)

Synonyms

- Palinurus versicolor* Latreille
- Palinurus taeniatus* Lamark
- Palinurus fasciatus* Von Siebold
- Palinurus (Panulirus) ornatus* var. *decoratus* Heller
- Panulirus dasypus* Ortmann
- Panulirus demani* Borradaile
- Puer spiniger* Bouvier
- Puerulus spiniger* Calman
- Panulirus versicolor* Calman
- Panulirus versicolor* Borradaile
- Palinurus ornatus* Rathbun
- Panulirus ornatus* Rathbun
- Palinurus fasciatus* Musgrave
- Panulirus versicolor* De Man

The antennular plate has four principal spines, the anterior pair equal to or larger than the posterior one. Rest of the antennular plate is unarmed. The median and lateral spines of the fused coxicerites of the antennae are large and subequal, the former being in advance of the latter. No spinules are present. The exopod of the second maxilliped has usually a single jointed flagellum. The third maxilliped is without an exopod. The abdominal somites have transverse furrows in the juveniles while these are absent in the adults.

In colouration they are usually bright green with a bluish tinge. The carapace has almost symmetrical dark bluish-black patches and flecks bordered by cream lines. Patches are present at the sides with cream coloured wavy lines inside. Hind margin of each abdominal somite has a dark bluish-black band with a white line in the middle. Walking legs have white lines along their entire length.

***Panulirus longipes*\*** (A. Milne Edwards)

Synonyms

- Palinurus longipes* A. Milne Edwards

\* Descriptions of the six species of *Panulirus* have been taken from Nair *et al.* (1973).

@ Description from Ramadan (1938).

- Palinurus guttatus* Hoffmann
- Palinurus (Panilurus) longipes* Miers
- Palinurus longitarsus* Lenz and Richters
- Panulirus japonicus* Gruve
- Panulirus japonicus longipes* De Man
- Panulirus longipes* George and Rao
- Panulirus longipes longipes* George and Holthuis

The species *longipes* occurring along the Indian coasts is considered to be a distinct sub-species and is called *P. longipes longipes*. The distinguishing characters are that the antennular plate has two principal spines in addition to three to five spinules in front and four to eight behind. The median spine of the fused coxicerites of the antennae is equal to or slightly larger than the lateral ones. There are three to four small spinules in between the median and lateral spines. The second and the third maxillipeds have a distinct flagellum. The abdominal somites have an interrupted or uninterrupted transverse groove, the anterior margin of which is non-crenulate and with setae.

The colouration varies from dark brown to reddish brown with a violaceous tinge and there are numerous bright and dull white spots. A conspicuous white spot on top of the 'plate D'. A similar spot on either side in addition to a pair on the dorsal side of the abdominal somites II to VI. Walking legs have conspicuous white spots.

***Puerulus sewelli* Ramadan @**

Synonyms

- Panulirus angulatus* Alcock
- Puerulus angulatus* Calman

The lateral margins of the carapace are cut into three teeth which decrease in length posteriorly. The posterior tooth is not far in advance of the cervical groove. The infra-orbital spine is large and has below and anterior to it a prominence which is half as long as the spine and cut into two teeth and behind this there are two other teeth. The abdominal somites are carinated, the carina of the sixth segment being double. The second to fifth somites are transversely grooved near the posterior edge. The antennular peduncle is more than half as long as carapace and the basal segment is longer than the second and third joints together. The antennal peduncle is spinose on its outer margin in adult specimens. The external maxillipeds reach the middle of the second segment of the antennular peduncle, its exopodite reaches the middle of the carpus.

**Palinustus mossambicus** Barnard

Synonym

*Palinustus mossambicus* Barnard

Carapace prismatic, covered with tubercles which are fringed with stiff setae. The anterior margin of the carapace between the supraorbital processes is straight and provided with 4 to 6 spinules of different size and stronger median spines are absent. Each orbit is fringed by the supraocular process, three forwardly directed strong spines and by some small spinules. Cervical groove distinct and behind this groove a posteriorly converging double row of three or four small spinules are present in the median region of the carapace. The first abdominal segment has an uninterrupted transverse groove which has a row of setae along the anterior margin. The second to fifth abdominal segments are provided with uninterrupted anterior transverse groove and a posterior groove which is interrupted in the middle by a short longitudinal carina. Antennular segments with four spines in the median part anteriorly tapering and the antennal peduncles have about five longitudinal rows of strong spines. All the three maxillipeds have an exopod with a flagellum in the first and second maxillipeds.

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# PROSPECTS OF PRAWN CULTURE IN SALT PAN AREAS.

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## Introduction

The Central Marine Fisheries Research Institute has been undertaking several investigations in recent years to improve the existing aquaculture practices in the country, and has evolved new indigenous techniques for farming prawn on modern scientific lines. One of the major objectives of the Institute is to disseminate the findings at different levels through extension services. The present work is one such contribution. An awareness has recently been created along the southeast coast of Tamil Nadu for the utilisation of saline fallow coastal lands including salt pan areas for culture practices. The land and water in the low lying areas adjacent to salt pan areas along the coast of Gulf of Mannar between Pinnakayal in the south and Valinokkam in the north, have been assessed for their suitability for prawn farming.

Based on the resource potentials, Nair *et al.* (1974) have observed the possibilities of marine fish and prawn culture in salt pan areas at Tuticorin. Suseelan (1975) reported on the prawn culture practices in salt pan reservoirs of Cape Comorin region. A number of published accounts of seed resources and culture of prawns in salt pan areas are available now (Rao and Narasimham, 1978; Mohamed *et al.*, 1980; Marichamy and Rajapackiyam, 1982; Victor and Venkatesan, 1982). Information on the preliminary experiments in semi-intensive culture of prawns in salt pan areas at Veppalodai has been presented elsewhere (Marichamy, 1986). Several improvements have been made subsequently to enhance the production potential under intensive culture system and the present account describes the various aspects including the strategies evolved and economics of this profitable venture, highlighting the prospects of prawn culture in high saline waters.

## Location, construction and preparation of ponds

About 800 hectares of land on the northern side of Kallar river are used as salt pans by M/s Veppalodai Salt Corporation at Veppalodai, north of Tuticorin in Chidambaranar District, Tamil Nadu. The salt pan reservoirs support a variety of fish and prawn resources. Water and soil characteristics are suitable for culture practices within the factory area but the major constraint is predation by migratory birds as the depth of water in the ponds is very low. In addition to this, predatory crabs and snakes present in the surrounding water logged area enter the reservoirs. Another factor for not considering the existing ponds for culture is that the addition of inorganic or organic fertilizers for raising plankton bloom in intensive culture practices, may affect the quality of salt produced. Considering all these factors a new site adjacent to the salt industry was developed exclusively for prawn farming. Soon after completing the preliminary experimental culture in a limited area, 3.3 ha of derelict land on the southern side of the river was converted into ponds for intensive prawn farming. Full advantage of the existing natural conditions was taken while preparing the lay-out for the farm. The ponds are located 50 m away from the main river. The mud excavated from the draining trenches and catching pit of the rearing ponds was used for raising bunds without scraping the top fertile soil too much. The bottom of the ponds was levelled by a tractor. Gradient slope was given towards the catching pit and draining sluices. The ponds were ploughed well for making the soil soft to promote algal development. Ponds are rectangular in size and provided with three inlets and three outlets of PVC pipe of 30 cm diameter in the bunds of opposite sides. At the western end, one 5 HP motor with a specially designed Vedaranyam type of pump set (with the motor kept at a higher level than the pump and a delivery pipe of 25 cm diameter),

having a high rate of pumping efficiency was fitted and this was sufficient to meet the water requirements for three ponds of the area of 2 ha. On the eastern side, a separate 5 HP oil engine was used to feed water for two ponds of the area of 1.3 ha. Since the ponds are constructed at an elevated place, water is lifted from the creek to a height of 2.5 m. This arrangement helps to drain the ponds perfectly at the time of harvesting. The system further helps for sun drying/baking the ponds so that all organic matter is completely oxidized. The sea water was properly screened and the entry of major organisms was prevented by fitting fine meshed velon screens at the inlets and outlets of the pumps. An average water depth of 0.4-0.7 m, was maintained in the rearing ponds. Lime treatment was not made since the soil pH was optimal at 7.5. After completing the tilling works, organic manure (dried poultry dung or cow dung) was spread in the ponds at the rate of 750 kg/ha. Water level was gradually increased and the development of bloom of phytoplankters or 'green water' was noticed on the fourth day after fertili-

zation. The common nanoplankters were, *Synechocystis*, *Nanochloris* and *Chlorella* spp. The phytoflagellates were *Chlamydomonas* spp. and *Platymonas*. The benthic diatoms such as *Pleurosigma*, *Navicula*, *Mastogloia*, *Amphora* and *Oscillatoria salinarum* were also seen.

#### Culture experiments and stocking operation

The culture experiments were designed according to the availability of natural seed. February-May and August-October are the best periods for maximum collection of seed of *Penaeus indicus* from this region. The first set of culture experiments was carried out in one hectare area during August, 1985-January, 1986 and the second set during February, 1986-August/October 1986. The second crop normally covers longer period due to high salinity and slow rate of growth. A short interval of 20-25 days are available in between the culture experiments for preparing the ponds for subsequent stocking.

Table 1. The results of culture experiments for *P. indicus*

Particulars	Ponds			
	1	2	3	4
Size of ponds (m)	116.2 x 44.8	151.8 x 62.4	143.7 x 63.6	128.1 x 28.5
Area of ponds (ha)	0.5205	0.9472	0.9139	0.3677
Average water depth (m)	0.7	0.5	0.4	0.4
Date of stocking	1-3-1986	20-2-1986	25-3-1986	1-4-1986
Date of harvest	10-10-1986	10-10-1986	13-9-1986	13-9-1986
Days of culture	224	232	172	166
Size at stocking (mm)	22	15	25	25
Size at harvest (mm/g)	123.5/13.2	116/11	106/8	108/8.2
Rate of growth (mm/g/month)	13.6/1.7	14.4/1.4	14.1/1.4	15/1.5
No. of prawn seed stocked	66,500	1,15,000	1,35,000	55,000
Rate of stocking (per ha)	1,27,762	1,21,410	1,47,718	1,49,578
No. of prawn harvested	63,460	1,06,380	1,00,625	40,260
Percentage of survival	95.4	92.5	74.5	73.2
Total production (kg)	835	1,169	805	330
Rate of production(kg/ha/crop)	1,604	1,234	881	897
Total food supplied (kg)	5,945	7,592	4,347	2,372

The salt industry maintains continuous pumping of sea water from the adjoining creek and about 32 ha of salt pan reservoirs available within the Salt Corporation area formed the resourceful bed for the collection of required seed of *P. indicus* for farming. Wild seed were also collected from tidal pools and inlets

of Tuticorin Bay and transported to the site by employing simple methods as described by Unnithan (1985). Collection and stocking operations of prawn seed were carried out in the morning hours since the rate of mortality increased with increase in water temperature. The particulars of stocking operations are given in Table 1.

**Table 2.** Hydrology of prawn culture ponds

Ponds	Period	Water temp. at 0800 hrs (°C)		Salinity (‰)		Dissolved oxygen (ml/l)		pH		Productivity mg C/m <sup>2</sup> /day	
		Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean
1.	Feb.-Oct. '86	27.1-32.2	28.4	38.00-49.30	43.28	2.69-4.48	3.60	7.72-8.36	8.04	390-2,213	986
2.	-do-	26.8-32.5	28.5	38.74-48.65	42.53	2.08-5.01	3.63	7.70-8.20	8.03	325-2,045	858
3.	Mar.-Sep. '86	27.0-32.5	28.7	37.27-49.00	43.98	2.55-4.85	3.77	7.60-8.25	7.94	244-1,055	702
4.	April-Sep. '86	27.0-32.5	28.9	39.20-50.03	45.37	2.66-5.09	3.59	7.60-8.43	7.86	266-835	564

**Table 3.** The trend of growth in *P. indicus* cultured in salt pan area

No. of days after stocking	Pond 1		Growth rate		Pond 2		Growth rate		Pond 3		Growth rate		Pond 4		Growth rate		
	Average size mm	g	mm	g	Average size mm	g	mm	g	Average size mm	g	mm	g	Average size mm	g	mm	g	
0	22.0	0.3	...	...	15.0	0.2	...	...	25.0	0.3	...	...	25.0	0.3	...	...	
15	37.0	0.8	30.0	1.0	30.0	0.5	30.0	0.6	40.0	0.8	30.0	0.1	44.0	1.2	38.0	1.7	
30	54.5	1.5	32.5	1.2	41.5	0.9	26.5	0.7	56.0	1.3	31.0	1.0	58.0	2.0	33.0	1.6	
45	66.0	2.1	29.3	1.2	54.5	1.3	26.3	0.7	60.5	1.7	23.7	0.9	66.0	2.7	27.3	1.6	
60	77.0	3.2	27.5	1.4	63.5	1.5	24.3	0.6	65.0	2.1	20.0	0.9	71.0	2.8	23.0	1.2	
75	77.0	3.4	22.0	1.2	67.0	1.9	20.8	0.7	67.0	2.3	16.8	0.8	74.5	2.9	19.8	1.9	
90	79.0	3.5	19.0	1.1	70.5	2.3	18.5	0.7	75.0	2.6	16.7	0.8	85.0	3.4	6.8	20.0	1.0
105	81.0	3.6	16.9	0.9	73.0	2.5	16.6	0.7	81.0	3.4	16.0	0.9	92.0	3.6	19.1	0.9	
120	86.0	5.0	16.0	1.2	80.5	3.1	16.4	0.7	93.0	5.2	17.0	1.2	99.0	6.2	18.5	1.5	
135	98.0	6.8	16.9	1.4	90.0	4.8	16.2	1.0	97.0	5.6	16.0	1.2	103.0	6.5	17.3	1.4	
150	103.0	8.2	16.2	1.6	95.0	5.7	16.0	1.1	100.0	6.2	15.0	1.2	106.0	7.2	16.2	1.4	
165	106.0	8.7	15.3	1.5	98.0	6.2	15.1	1.1	104.0	7.4	14.4	1.3	108.0	7.8	15.1	1.4	
180	110.0	9.2	14.7	1.5	101.5	6.5	14.4	1.0	...	...	...	...	...	...	...	...	
195	114.0	10.8	14.2	1.6	104.5	7.6	13.8	1.1	...	...	...	...	...	...	...	...	
210	117.0	12.0	13.6	1.7	110.0	9.0	13.6	1.3	...	...	...	...	...	...	...	...	
225	124.0	13.2	13.6	1.7	114.0	10.4	13.2	1.4	...	...	...	...	...	...	...	...	

Intensive stocking was made in ponds 1–4. The size of the ponds varies from 0.37 ha to 0.95 ha. The average size of seed at stocking measured 15–25 mm and the rate of stocking varied between 1.2–1.5 lakhs/ha. Stocking operations were completed in four ponds during February–March, 1986. A maximum of 55,000 seed were released in the 0.37 ha pond on 1–4–1986. Stocking at high rate was purposely designed to see its effect on survival, growth and production when compared to low stocking density experiments completed earlier in the same environment. The seed were released directly into the rearing ponds and there was no need to acclimatize them because of the identical water characteristics at the collection centre and grow-out ponds.

### Farm management

Water samples from culture ponds were analysed at weekly intervals. About one fifth of the volume of water was flushed daily for maintaining the quality of water and the rate of exchange was increased gradually during later phases of culture. As far as possible draining and pumping were arranged in the cool hours of the day. Water depth was 0.7 m in pond 1 and the average depth in rest of the ponds was 0.4–0.5 m only. Velon screen tied to water inlets and outlets were kept clean. The observations on essential water qualities are presented in Table 2.

Water temperature at the surface was 26.8–32.5°C with a monthly mean value of 28.4–28.9°C around 0800 hours. The salinity in the rearing ponds was always well above 38 ppt and reached maximum values of around 45–50 ppt on most of the days during April–June, 1986 due to increased evaporation as well as the closure of bar mouth frequently. The dissolved oxygen content varied from 3.59 to 3.79 ml/l and the pH measured around 8.00. The productivity of the ponds (measured by light and dark bottle method) was recorded in the range 244–2,213 mg C/m<sup>3</sup>/day and a minimum level of 500 mgC/m<sup>3</sup>/day was maintained on most of the days; under such conditions the colour of water was light green or blue green. Whenever there was a change in colour (transparent or pale brown) a fall in productivity values was noticed and quick arrangements were made to add organic manure at the rate of 20 kg/ha and inorganic fertilizers like urea and superphosphate, each at 5 kg/ha along the water edge of pond

instead of spraying all over the pond. This was necessary for the development of the bloom. Excessive growth of algae was controlled by flushing as much



Fig. 1. Sea water being lifted from the creek.

quantity of water as possible. The presence of natural food in the form of microalgae and zooplankters in the ponds meet the food requirements of young prawns during the first three weeks after stocking. Thereafter, the pelletized feed obtained from TOMCO (through arrangements made by Marine Products Export Development Authority at subsidised rates) was given twice a day, at dawn and dusk at the rate of 7–10% of body weight. The food requirement was determined by assessing the percentage of stock surviving, by random sampling method and the progress of growth in weight of the prawns. The food was kept in trays at intervals of every 10 m at the bottom of the pond a little away from the bunds. Broadcasting the feed was avoided in order to avoid wastage. Because of the delay in getting the pelletized food from the company, supplementary feed consisting of fish meal, shrimp head, rice bran, ground nut oil cake, tapioca and minerals was given during June–July, 1986. Predatory birds were kept away by firing crackers and by keeping 'scare-crow.'

### Growth assessment

The progress of growth of prawns was assessed by taking fortnightly random samples with castnet at different points of the pond and the results are presented in Table 3. Based on the actual observations made, an estimated average growth rate of the stock from all four ponds are tabulated for comparison. During the first month the rate of growth was more or less the same in all ponds. The overall growth rate varied from 13.6 mm (1.4 g) to 15 mm (1.7 g) depending upon the period of culture in different ponds (Table 1). The

maximum gain in weight was seen with prawn stocked in pond 1. Prawn seed of average 22 mm released on 1-3-1986 have grown to 123.5 mm (13.2 g) in the course of 224 days, whereas the stock in pond 2 attained a size of only 116 mm (11 g), and it had taken more number of days. The rate of growth was affected during May-June, 1986 when the supply of pelleted feed was interrupted. In ponds 3 and 4, the stock reached a size of 106-108 mm with an average weight of 8 g in the course of 5 1/2 months. The rate of growth was generally poor when compared to earlier experiments carried out in the same environment with lower stocking density. It may be mentioned that the earlier crop during August, 1985 - January, 1986, took only five months to attain the size of 138 mm (19.8 g) because of the conducive hydrological factors and optimum stocking density at 44,000/ha (Marichamy, 1986).

### Harvest and production

Harvest arrangements were made after ascertaining the quotations of competitive price from buyers on the basis of samples given. The slope of the pond bottom and trenches facilitated quick draining through outlets during night hours. Harvesting was made easy by spreading a net exactly on the floor of the catching pit (area 15 m x 15 m) before draining commenced. As the water receded, bulk of the prawns assembled in this limited water area and were harvested by lifting the net from four sides. The rest of the stock was collected by using a cast net and finally by hand picking after expelling the remaining water with a small pump. Harvesting operations were over before 1000 hours and the time factor was considered important to avoid spoilage of the prawns as water temperature increased towards noon.

In ponds 3 and 4, prawns started swimming near the surface in distress due to oxygen deficiency, particularly in the early morning hours and instances of stray mortality were noticed in September, 1986. Prawns were harvested from these ponds on 13-9-1986. The production details are given in Table 1. 805 kg of prawns with an average size of 106 mm (8 g) at survival rate of 74.5% were harvested from pond 3 and 330 kg from pond 4. The rate of production was more or less the same, being 881 kg/ha/172 days in pond 3 and 897 kg/ha/166 days in pond 4. The actual production in pond 2 (0.95 ha) was 1,169 kg and the rate of production amounted to 1,234 kg/ha/232 days. Better production was attained from pond 1 as the rate of growth was comparatively good with high rate of survival (95.4%). The rate of production was 1,604 kg/ha/224 days. No

predators were noticed in ponds 3 and 4 and the low survival cannot be ascribed to this problem. Two or three fish, *Lates calcarifer* and *Elops* were noticed in the catches made from pond 2. *Nematalosa nasus* occurred in large numbers (40 kg) in this pond; though it is not a predator, it was a competitor for food and space.

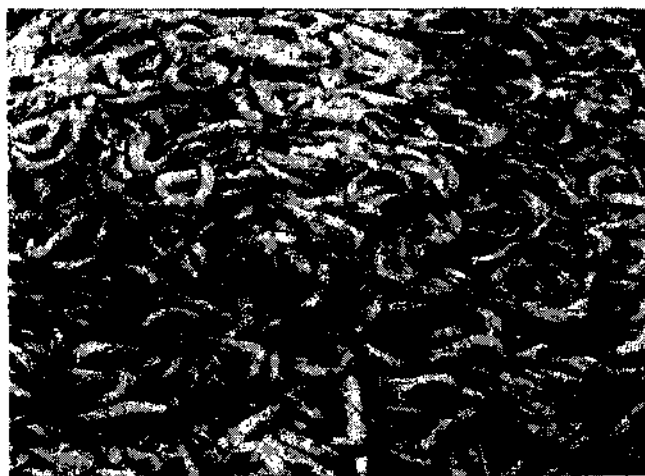


Fig. 2. Part of the harvested prawns.

### Marketing and economic aspects

The Century Cold Storage Ltd., Palayakayal a leading shrimp exporter offered the best price for the cultured prawns. The catches were disposed off on the spot. Prawns from pond 1 fetched better price of Rs. 46.25/kg (head-on count 76/kg). The rate for prawns from pond 2 was Rs. 36.75/kg since the head-on count was 91/kg. The catches from the last two ponds were sold at Rs. 22.00/kg as the count was 123/kg. The total yield of 2,930 kg of prawns produced from four ponds of 2.75 ha was sold for Rs. 1,00,537. This works



Fig. 3. The catch being weighed for disposal.

out to the average income of Rs. 36,558 per ha/7 months. The cost of fixing of sluice pipes, and the recurring expenditure such as wages for watchman, cost of supplementary food, fertilizers, fuel and energy, preparation of pond by tilling, harvesting and marketing and miscellaneous expenditure came approximately to 50–60% of the income. The capital expenditure involved in the construction works and installation of pump sets can be recovered in four crops at the rate of 25% of the profit. The income can be substantially increased by proper management, particularly by curtailing the expenditure on excess feeding which has happened in the present experiment.

### General remarks

The occurrence of seed of *P. indicus* in two seasons in a year during February–May and August–December facilitates designing the culture programme accordingly. Out of the two crops raised in a year, the summer crop from February/March onwards was continued upto August/September covering a maximum of six to seven months and the next crop started from September onwards could be limited to four to five months, because of the prevalence of conducive environmental factors. Maintenance of phytoplankton bloom in the rearing ponds by manuring the water, forms an important aspect in prawn culture. Culturists in Japan endeavour to grow phytoplankton in ponds particularly in summer when the prawns grow at a fast rate (Shigueno, 1972). Since the growth and production of prawns in the pond vary according to the level of primary production, the productivity was maintained at moderate levels of 500–1,000 mg C/m<sup>3</sup> / day in culture pond.

Suseelan (1975) estimated the average growth attainment upto 135 mm (24.7 mm/month in the summer crop and 19–21 mm in the later monsoon) for crops raised in salt pan area of Manakkudy, where the salinity varied from 10.55 to 28.10 ppt only. Sultan *et al.* (1973) indicated an average growth rate of 25.8 mm/month eventhough the culture area was brackishwater. In the preliminary experiments carried out in the present environment, Marichamy (1986) observed a better rate of growth of 21.6 mm (3.8 g) / month in the monsoon crop raised during August, 1985–January, 1986 when the salinity was recorded around 35 ppt during most of the days. The growth rate in the present summer crop was in the range of 13.6 mm (1.7 g) to 15 mm

(1.5 g) / month, because of the prevalence of high salinity around 45 ppt in most of the days. Muthu (1980) observed the ideal salinity range for the culture of *P. indicus* as 10–35 ppt.

High stocking density may be another factor affecting the growth rate as seen in the present experiment. The growth rate in ponds 3 and 4 was extremely low because of the maximum stocking rate of 4.5 lakh/ha whereas the earlier experiment made in the same season with the stocking density of 80,000/ha revealed better growth rate. The influence of the stocking density on the growth rate has been studied earlier. Mohamed *et al.* (1980) recorded a high growth rate of 1.0–1.1 mm/day till the size of 125 mm in *P. indicus* in a similar environment with low stocking rate of 27,000/ha. Venkatesan *et al.* (1982) reported the maximum growth and production of *P. monodon* at a stocking density of 25,000/ha even in brackishwater ponds and considerably low values when the density was increased to 40,000/ha. Sriraman and Ananthanarayanan (1986) opined that the ideal stocking density was 30,000 to 45,000/ha for good production of *P. indicus*. Based on the two sets of experiments covered so far in the salt pan areas of Veppalodai, it may be stated that 50,000–70,000/ha would be the optimum stocking density as per the productivity of the ponds. The depth of water as well as the rate of exchange in rearing ponds play a key role in the ecological conditions to promote the growth and survival rates. The poor results observed in the last two ponds may be attributed also to the low depth of water and inadequate water exchange. The rate of production in the present experiment was comparatively better than the results published from different areas. The recent experiments on *P. monodon* carried out in Pulicat Lake gave maximum production of 1,157 kg/ha/crop (Sanjeeva Raj, Keynote address in Nat. Symp. Estuarine Biology, Parangipettai, October, 1986). Suseelan (1975) recorded a maximum production of 1,134 kg/ha/year. The maximum production of 1,200–1,600 kg/ha/crop obtained in the present work appears to be the best so far reported under such conditions. The present efforts in the salt pan area have shown that the project is a profitable venture.

Eventhough the hydrological conditions are not so conducive in the present experiments, the results have shown that farming can be organised for still better yields by resorting to management practices particularly

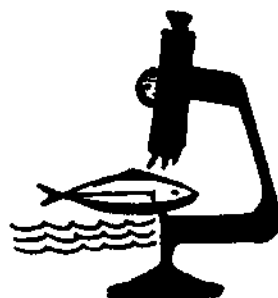
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by limiting the stocking density to about 70,000/ha. Improvements in flushing system, increase in the water depth, steady supply of nutritive food, provision of 'water blender' to avoid oxygen depletion are some of the suggestions for more effective implementation and higher production. The peak summer period may be avoided for stocking and the duration of culture can also be reduced to realise a better economic return from the yield.

In Japan 70 percent of the prawn ponds are converted salt pans. About 1,20,000 ha of brackishwaters in the form of disused salt pans and low lying coastal areas are available for culture purposes in Tamil Nadu. The Government of India has already cleared a project for the development of 150 ha of brackishwater area for farming in Thondikadu in Tanjore District, Valinokkam in Ramanathapuram District and Pinnakayal in Tirunelveli District or in Puficat Lake (Dixitulu, 1986). Realising their commercial value, a number of private farmers have just started prawn culture practices in salt pan areas in Palayakayal, Pinnakayal, Vaipar and Vembar. With the available technology in prawn farming, the salt pan areas can be profitably utilised for prawn culture in the near future.

The authors are grateful to Dr. P.S.B.R. James, Director, Central Marine Fisheries Research Institute, Cochin for his keen interest and encouragement given to this work. Thanks are due to the Marine Products Export Development Authority for the supply of pelletized food at subsidised rates. The Manager of the farm wishes to record his sincere thanks to Dr. M. Sakthivel, Director, M.P.E.D.A. for all co-operation and help offered by visiting personally the culture site. Enthusiastic support given by Shri K. Nagappan Nair, Officer-in-Charge, Tuticorin Research Centre of CMFRI is gratefully acknowledged.

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## EXPERIMENTS ON THE CULTURE OF *PENAEUS INDICUS* IN POLYETHYLENE FILM-LINED PONDS AT CALICUT\*

The possibilities of converting extensive areas of sandy shores into productive aquaculture ponds by providing polyethylene film-lining have been reported by Mohan and Nandakumaran (*Mar. Fish. Infor. Serv., T & E Ser., No. 26: 6-8, 1980 and Proc. Symp. Coastal Aquaculture, 1: 409-412, 1982*) based on the experiments conducted at Calicut by the Central Marine Fisheries Research Institute. Following the above study another set of experiments were conducted from April to September, 1981 with the seeds of the prawn *P. indicus*, produced at the Narakkal Prawn Culture Laboratory of the Institute and transported to Calicut in oxygen filled bags. The average length of the seed was 18 mm. They were stocked in three polyethylene film-lined ponds viz., ponds A (192 m<sup>2</sup>), B (63 m<sup>2</sup>) and C (123 m<sup>2</sup>) at stocking densities of 14.6, 38.0 and 30.5 /m<sup>2</sup> respectively on 25-4-1981. Some of the seed were grown separately in a nursery and when they attained an average size of 46.6 mm and 84 mm they were stocked in ponds D and E (70 m<sup>2</sup> each) at densities of 6.4/m<sup>2</sup> and 7.1/m<sup>2</sup> respectively on 12-5-1981 and 23-7-1981.

Sample measurements of length and weight of the stocked prawns were taken once in a fortnight. Environmental parameters such as salinity and dissolved oxygen were estimated weekly and also at the time of taking prawn sample for measurements. Temperature was noted twice daily at 10 A.M. and 3 P.M. Pelleted prawn feed (proximate composition: crude protein 30.68%, lipid 3.40%, ash 22.55%, carbohydrate 41.27% and moisture 2.10%) prepared at the Narakkal Prawn Culture Laboratory of the CMFRI was given as food up to the second week of August at a rate of 10% of the body weight. Afterwards the prawns were fed at the same rate with moist dough made out of equal quantities of wheat powder, coconut oil cake, rice and fish meal, as the feed from the above laboratory was not available for feeding. The stocking details, environmental data and the results obtained are given in Table 1.

Temperature ranged between 27.3° and 35.5°C and the maximum was observed in pond D during May and

**Table 1.** Stocking and harvest details of *P. indicus* and the environmental data

Particulars	Ponds				
	A	B	C	D	E
Area of pond (m <sup>2</sup> )	192	63	123	70	70
Date of stocking	25-4-81	25-4-81	25-4-81	12-5-81	23-7-81
Date of harvest	5-9-81	18-8-81	17-8-81	18-7-81	8-9-81
Duration of the experiment (days)	133	115	114	67	47
Mean length at stocking (mm)	18.0	18.0	18.0	46.6	84.0
Mean weight at stocking (g)	0.1	0.1	0.1	0.7	3.6
No. stocked	2,800	2,400	3,750	450	500
Stocking density (no./m <sup>2</sup> )	14.6	38.0	30.5	6.4	7.1
No. harvested	535	190	134	390	449
Survival rate (%)	19.1	7.9	3.6	86.7	89.8
Count per kg	160	76	108	100	145
Mean length at harvest (mm)	102.1	124.3	111.8	116.0	100.9
Mean weight at harvest (g)	6.6	13.3	10.1	10.4	6.9
Daily length increment (mm)	0.60	0.92	0.82	1.02	0.35
Daily weight gain (g)	0.05	0.11	0.09	0.14	0.07
Temperature (range in °C)	28.1-34.3	27.3-35.3	28.9-34.3	29.0-35.5	29.2-31.8
Salinity (range in ppt)	1.1-29.4	4.2-25.8	5.8-28.7	6.0-29.3	11.8-31.1
Dissolved oxygen (range in ml/l)	3.0-4.8	4.0-4.8	3.5-5.6	3.2-4.7	3.7-4.7

\*Prepared by S. Lazarus & K. Nandakumaran, Calicut Research Centre of CMFRI, Calicut and K. H. Mohamed & M. S. Muthu, CMFRI, Cochin.

the minimum was recorded in pond B in August. In general the temperature was high during April–May period and low during June–August period. Salinity had a high range of fluctuation in the ponds. It varied from 1.1 to 31.1 ppt, and the minimum was observed in pond A and the maximum in pond E. Though salinity in the ponds ranged between 18.3 and 29.3 ppt in April/May except in pond E, it started declining towards the end of May due to the onset of monsoon and reached a low value at the end of June. Dissolved oxygen level varied within a narrow range of 3.0–4.8, 4.0–4.8, 3.5–5.6, 3.2–4.7 and 3.7–4.7 ml/l in ponds A, B, C, D and E respectively. Normally the low values were observed towards the end of the experiment.

Good growth rate was seen in pond D where the stocking density was 6.4/m<sup>2</sup> (Fig. 1). The mean size (46.6 mm) of the prawn on stocking was also high when compared with other ponds in which it was 18 mm except pond E in which it was 84.0 mm. Comparatively better results were obtained in pond B and C. In pond B rapid growth was observed upto the 32nd day with an average daily increase of 1.7 mm. Afterwards it was only 0.6 mm per day which was much less than the average for the pond. But weight increment was very slow up to the 17th day and afterwards the increase was steady till the 105th day. In pond C also an almost similar trend was observed except that the weight remained stationary from 75th to 89th day and then increased again. The length increase was rapid during the first 17 days and thereafter it slowed down very gradually. In pond A the overall performance of the prawns was poor when compared to the prawns in the other ponds. The growth rate and weight increment observed were respectively 0.86 mm and 0.47 g per day upto 75th day of the experiment and from 89th to 121st day they were 0.55 mm and 0.1 g. The mean size and mean weight were found to be stationary at 84 mm and 3.6 g respectively from 75th day to 89th day.

The foregoing observations clearly show that stocking density plays an important role in the growth of prawns cultured in the polyethylene film-lined ponds. In pond D where the stocking density was less, the growth was

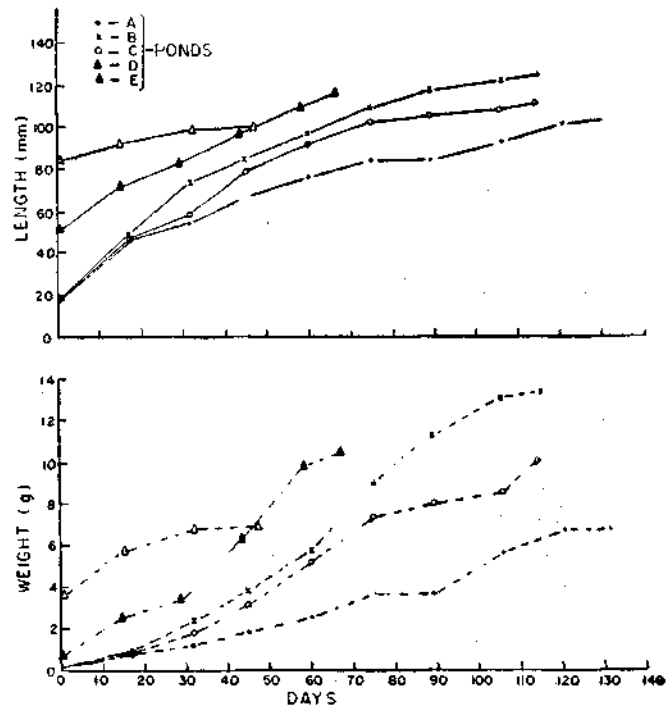


Fig. 1. Growth of *P. indicus* in the different ponds.

observed to be very good. The fast growth rate found in pond B and C may be due to high initial mortality of the fry soon after their stocking thereby thinning the population. This is further evidenced by the low survival rate and better size of the prawns at harvest observed in these two ponds.

The above experiments also show that the size at stocking has a bearing on the survival rate of the prawns. In ponds A, B and C the prawns were stocked at a smaller size (18 mm) and the survival rates were respectively 18.4%, 7.9% and 3.6%. But in pond E the stocking size was 46.6 mm and in pond D it was 84.0 mm and the survival rates were respectively 86.7% and 89.8%. The greater survival rates in ponds E and D could also be due to the shorter duration of the experiment in these ponds, where the prawns were reared for only 67 and 47 days respectively. In ponds A, B and C the prawns were kept for more than 100 days. Along with good survival rates, ponds D and E yielded good harvests (Table 1).



## SOME RECENT OBSERVATIONS ON SMALL-SCALE FISHERY IN THE VICINITY OF MADRAS\*

Madras zone is one of the important fishing centres on the east coast of India. The city has several landing centres, from where different types of indigenous gears are being operated in addition to trawls and gill nets by mechanised vessels. To understand the fish landings from different gears in Madras, three landing centres, viz., Kasimedu, Triplicane and Nochikuppam were selected. Kasimedu is about 8 km north of Triplicane and Nochikuppam is about 2 km south of Triplicane. Though these centres are nearer to each other, they were selected because of the variety of indigenous gears operated from these centres. Kasimedu supports mechanised fishing also but the present data relate only to the indigenous catch.

Data collected on indigenous gears for a four year period from 1980 to 1983 were analysed and presented

in this account. Biweekly observations were made on catch, effort and catch composition of each gear separately for the three landing centres from 6 A.M. to 6 P.M. and the data collected were weighted for the month. Indigenous gear landings occur only during day time in these centres. Principally, two types of bag net ('Eda valai' and 'Madha valai'), three types of gill net ('Kavala valai', 'Ara valai' and 'Trukka valai'), hooks & line, boat seine ('Thuri valai') and shore seine are operated in the three landing centres. In addition to these eight gears, three more gears ('Retta aruppa valai', 'Thatta kavala valai' and 'Kolamaram') are operated but they are not considered in this account since these gears are operated rarely and the catch from these gears formed only about 0.1% of the total catch.

**Table 1.** Gearwise estimated average annual effort (number of units), catch (tonnes), and CPUE (kg/unit) in three landing centres in Madras for the years 1980-'83

Gear		Kasimedu	Triplicane	Nochikuppam	Total
'Eda valai' (Bag net)	Effort	1,306	381	...	1,687
	Catch	152.2	20.7	...	172.9
	CPUE	116.6	54.4	...	102.5
'Madha valai' (Bag net)	Effort	46	231	90	367
	Catch	3.5	9.6	9.4	22.5
	CPUE	76.5	41.4	104.9	61.4
'Kavala valai' (Gill net)	Effort	973	473	6,894	8,340
	Catch	23.7	13.5	232.9	270.2
	CPUE	24.4	28.5	33.8	32.4
'Ara valai' (Gill net)	Effort	423	2,165	2,023	4,611
	Catch	3.8	19.4	18.6	41.7
	CPUE	8.9	9.0	9.2	9.1
'Trukka valai' (Gill net)	Effort	2	...	547	549
	Catch	0.1	...	16.0	16.0
	CPUE	50.0	...	29.2	29.2
Hooks & line	Effort	1,179	15	1,039	2,233
	Catch	45.2	0.4	9.3	54.9
	CPUE	38.3	26.7	8.9	24.6
'Thuri valai' (Boat seine)	Effort	71	2,317	...	2,388
	Catch	1.1	21.9	...	23.0
	CPUE	15.3	9.4	...	9.6
Shore seine	Effort	...	258	176	434
	Catch	...	5.2	9.3	14.5
	CPUE	...	20.2	52.9	33.5
<b>TOTAL</b>		<b>229.6</b>	<b>90.7</b>	<b>295.5</b>	<b>615.7</b>

\*Prepared by E. Vivekanandan, S. K. Balakumar and R. Soundararajan. Basic data collected by S. Chandrasekar, P. Thirumilu, S. Mohan, T. Dhandapani and S. K. Balakumar, Madras Research Centre of CMFRI, Madras.

**Table 2.** Percentage contribution of important fish groups (data based on average annual landings by the indigenous gears) in the three landing centres in Madras for the years 1980-'83

Groups	'Eda valai'	'Madha valai'	'Kavala valai'	'Ara valai'	'Irukka valai'	Hooks & line	'Thuri valai'	Shore seine	Annual average (t)	% in total catch
Lesser sardines	8.9	0.2	88.9	0.1	...	...	...	1.9	250.3	40.7
<i>Hilsa</i>	99.7	0.3	...	...	...	...	...	...	64.9	10.5
<i>Caranx</i>	3.5	23.9	10.5	19.4	5.2	32.7	1.7	3.2	42.5	6.9
Mackerel	53.8	5.5	9.2	27.2	...	...	...	4.2	33.5	5.4
<i>Ilisha</i>	100.0	...	...	...	...	...	...	...	32.0	5.2
<i>Thryssa</i>	3.5	...	74.7	13.7	...	...	7.1	0.8	20.1	3.3
Sharks	...	...	...	...	10.7	89.3	...	...	19.5	3.2
<i>Scomberomorus</i>	...	...	...	17.8	25.9	54.7	...	1.3	17.2	2.8
<i>Dussumieria</i>	...	...	100.0	...	...	...	...	...	17.2	2.8
Mullet	97.5	1.9	...	...	...	...	...	0.6	17.1	2.8
Silverbellies	12.9	5.0	19.4	27.4	...	...	23.2	12.1	10.6	1.7
<i>Decapterus</i>	...	99.0	...	...	...	...	...	1.0	7.9	1.3
<i>Trichiurus</i>	...	...	...	...	...	...	100.0	...	7.7	1.3
Prawn	62.9	...	3.0	11.9	1.4	...	19.7	1.1	7.2	1.2
Miscellaneous	12.7	2.8	8.7	16.2	10.3	26.9	13.2	9.0	68.0	11.0
<b>TOTAL</b>	<b>28.1</b>	<b>3.7</b>	<b>43.9</b>	<b>6.8</b>	<b>2.6</b>	<b>8.9</b>	<b>3.7</b>	<b>2.4</b>	<b>615.7</b>	<b>100.0</b>

The annual average catch from the eight gears in the three landing centres was 615.7 tonnes (Table 1). 'Kavala valai' and 'Eda valai' contributed 43.9% and 28.1% of the total catch, respectively. Maximum effort was employed in 'Kavala valai' (8,340 units/year) and 'Ara valai' (4,611 units/year) but the maximum catch per unit effort was realised from the bag nets, viz., 'Eda valai' (102.5 kg/unit) and 'Madha valai' (61.4 kg/unit).

In the three landing centres, lesser sardines constituted 40.7% of the annual average landings of 615.7 tonnes. About 89% of the sardine catch was realised from 'Kavala valai' (Table 2), which is a specialised net for catching the sardines. *Hilsa*, which formed 10.5% of the total catch was landed exclusively from the bag nets. Large fishes like sharks and seerfish were landed mainly by Hooks & lines and 'Irukka valai' (which has

a larger mesh size than the other gill nets). Prawns, which formed 1.2% of the total catch, were landed by most of the eight gears, with major contribution (about 63%) from 'Eda valai.'

The traditional gears operating in Madras concentrate mainly on pelagic and mid-water fishes, as evidenced in this study. At present nearly 400 trawlers operate demersal trawl net off Madras and land about 6,200 tonnes every year. The major catch components from the demersal trawls of this area are silver bellies, thread-fin breams, sciaenids, lizardfish, prawns, squids and cuttlefish. These groups are landed in a meagre quantity by the traditional gears, thus maintaining compatibility between mechanised and non-mechanised gears in the exploitation of fishery resources off Madras.



## SOME OBSERVATIONS ON MARINE TURTLES LANDED ALONG MAHARASHTRA COAST \*

There have been instances of landing of marine turtles along the Maharashtra coast. The landing of three out of the five species of turtles found in the Indian seas is reported here. Of these species, the leathery or leatherback turtle (*Dermochelys coriacea*) locally known as 'Kuruma kasav' (Fig. 1) is the rarest and the largest while the other two namely olive ridley



Fig. 1. Latero-dorsal view of the leatherback turtle, washed ashore at Devbag (Near Malwan), Maharashtra coast.

(*Lepidochelys olivacea*) (Fig. 2) and green turtle (*Chelonia mydas*) locally known as 'Kasav' and 'Hirwa

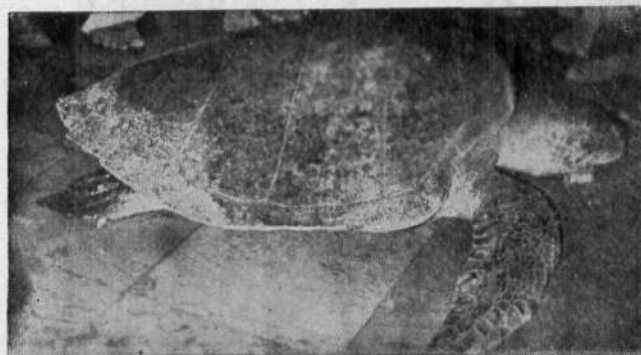


Fig. 2. Dorso-lateral view of olive ridley landed at Vasai, Thane District.

kasav' respectively are relatively common. All were taken as incidental catches in the fishing net. The following are the salient measurements and other details of the turtles landed at different places along the Maharashtra coast during 1984-'85 period (Table 1).

**Table 1.** Catch particulars and morphometric data of marine turtles landed along Maharashtra coast

Particulars	Leathery turtle		Olive ridley		Green turtle	
	Dev Bag (Sindudung Dist.)	New Ferry Wharf (Greater Bombay)	Vasai (Thane Dist.)	Pawas (Ratnagiri Dist.)	Vasai (Thane Dist.)	
Date of landing	5-4-1985	1-4-1984	18-9-1984	30-12-1985	19-4-1984	
Type of gear	Bottom set gill net	Trawl net	Bag net	Trawl net	Bag net	
Type of craft	...	Trawler	Mechanised 'dol' netter	Trawler	Mechanised 'dol' netter	
Depth of fishing (m)	...	35	42	36	35	
Length of carapace (cm)	149.8	63.0	75.0	51.2	66.5	
Width of carapace (cm)	109.0	60.0	59.0	44.0	56.8	
Length of plastron (cm)	142.5	50.5	52.0	...	51.2	
Width of plastron (cm)	72.5	48.0	49.1	...	47.2	
Width of head (cm)	28.9	...	...	...	...	
Length of anterior flipper (cm)	105.2	...	...	...	...	
Length of posterior flipper (cm)	72.1	...	...	...	...	
Sex	Male	Male	Female	Male	Female	
Total weight (kg)	100.0	48.0	54.5	38.0	42.8	

\*Prepared by J. P. Karbhari, A. Prosper, C. J. Josekutty and J. R. Dias, Bombay Research Centre of CMFRI, Bombay

## HEAVY TAR BALL DEPOSITION ALONG VERAVAL COAST IN JULY, 1985\*

Tar balls first seen in 1970 and increasing to 3-5 times since 1971, are becoming a common sight on the beaches of Veraval, particularly during the monsoon months. During late June, 1985, tar balls were seen washed ashore and in the first week of July, after the spring tide, the entire coast line of Veraval was strewn with large quantity of tar balls (Fig. 1). The average density of tar balls, as measured from the five distant sites along the beach was found to be 2.511 kg/m<sup>2</sup> which is far more than the density of 0.165 kg/m<sup>2</sup> recorded earlier by Dwivedi *et al.* (*Mahasagar*, 7 (1 & 2): 91-94, 1974) at Veraval but comparable with 2.375 kg/m<sup>2</sup> at Ghosabara, near Porbundar. However, their observations were subsequent to an oil tanker disaster which



Fig. 1. Tar balls washed at Veraval beach.

occurred near Porbundar, spilling 18,000 tonnes of oil in June, 1973. No such large scale accident or spillage has been reported during the past few years near Veraval.

\*Prepared by V. D. Deshmukh, Bombay Research Centre of CMFRI, Bombay and S. G. Raje, Veraval Research Centre of CMFRI, Veraval.

Most of the tar balls were 2-20 mm in diameter but some were large sized lumps measuring 100-120 mm in diameter. These large sized lumps were found with dense growth of epizoic goose barnacle *Lepas* sp. (60-135 *Lepas*/tar balls) ranging from 2 to 14.5 mm suggesting that these tar balls have been around long enough to become a substratum. Interestingly, associated with the tar balls were white, soft, disc shaped circular beads of plastic like material. Similar material was also found by Dwivedi *et al.* (but the chemical nature and probable origin of them are, however, unknown).

Although the tar balls are the nonvolatile residual part of the oil, and generally nontoxic, as seen by the profuse growth of the goose barnacles, their presence in the sea water affected the fishing activity at Veraval.

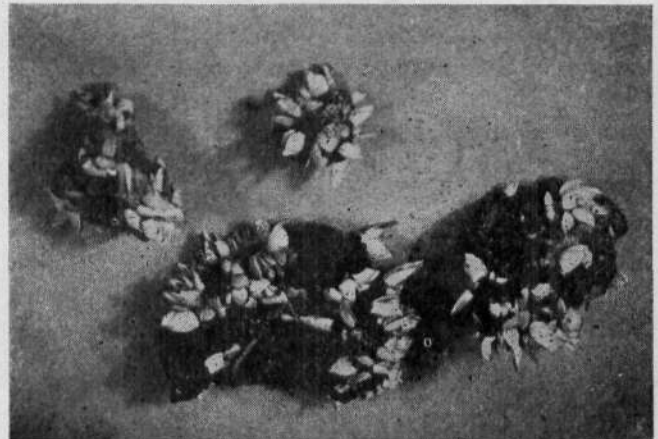


Fig. 2. Tar balls with goose barnacle *Lepas* sp.

During monsoon months the only fishing activity at Veraval is occasional gill-net fishing in the near shore waters during the day time but due to delayed monsoon during 1985 quite a few fishermen were regularly operating gill nets particularly for pomfrets. While fishing,

the floating tar balls got entangled in the surface gill-nets and when the nets were hauled up they were found blackened and unserviceable due to sticky melting tar. This caused considerable nuisance to the fishermen and most of them suspended fishing until the floating tar balls disappeared from the sea. The tar balls, spread on the beach also caused discomfort to the people visiting the sea shore.

Since no tanker accidents were reported along Gujarat coast and the quantity of tar balls is too large to account for any intertidal discharges or natural seepages, it is probable that these tar balls had arisen as a consequence of increased tanker traffic which passes from the Persian Gulf across the Arabian Sea and thus causing an environmental concern to the people associated with the marine activities at Veraval.



## WIND-MILL PRODUCED ELECTRICITY FOR LIGHTING FISH-FARM SHED AT MANDAPAM \*

The concept of using wind energy for producing electricity is not new, though its application in India is of recent origin. Denmark, Norway, England and U.S.A. utilise the wind energy for power generation from early part of this century. Our coastal areas are rich in wind energy. But this replenishable energy source is not well utilised.

A low cost wind-mill battery charger was erected at Pillaimadam lagoon about 5 km from Mandapam Camp, on the southeast coast of India to produce electricity. The electricity thus generated is being utilised to light the still hut built in the Pillaimadam lagoon in connection with the culture of fishes.

A suitably modified 12 volt-dynamo was fitted at the top of a 8 m long palmyrah trunk planted 100 m from the shore in the Pillaimadam lagoon. A teak wood plank measuring 3 m long, 10 cm wide and 3 cm thick was used as the blade of the wind-mill. It was chiselled on opposite sides and fitted to the shaft of the dynamo so that maximum rotation was obtained. The blade and the dynamo could rotate as the wind direction changed. The dynamo was connected to a 12 volt battery with 18 plates kept in the lagoon hut.

The wind rotated the blade of the wind-mill to about 800-1000 R.P.M., activating the dynamo which in turn charged the battery. A cut out (Regulator 15 ohms) was connected to the battery which automatically disconnected the dynamo and the battery when more electricity was generated. Two or three batteries could be recharged using the same wind-mill. The system could

be used to light 4 or 5 numbers of 6 volts bulbs. The direct current produced can be converted into alternate current by using a converter.



Fig. 1. The wind-mill erected at the fishfarm at Mandapam.

The total cost of the device was about Rs. 3,000/- but this can be reduced by 40% if reconditioned

\*Prepared by R. S. Lal Mohan, Calicut Research Centre of CMFRI, Calicut.

materials are used instead of new ones as in the present case. The details of the cost incurred for the assembly is given below (1984 rates):

1. Palmyrah trunk 8 m	Rs. 400.00
2. Battery 12 volts (18 plates)	Rs. 1200.00
3. Dynamo 12 volts	Rs. 750.00
4. Regulator (cut out)	Rs. 75.00
5. Wire, bulbs, holder etc.	Rs. 50.00
6. Nuts and bolts	Rs. 25.00
7. Other accessories	Rs. 150.00

8. Paint	Rs. 25.00
9. Labour and transport	Rs. 300.00
Total	<u>Rs. 2975.00</u>

The wind velocity of the coastal area normally ranges from 0-10 km/h. During the northeast and southwest monsoon periods it may exceed 60 km/h. But the normal wind speed is sufficient to attain a R. P. M. of 300-600 which is sufficient to produce electricity.



## ON THE UNUSUAL CATCH OF *PROTONIBEA DIACANTHUS* (LACÉPEDÉ) AT VERSOVA, BOMBAY\*

*Protonibea diacanthus* (Lacépedé) locally known as 'Ghol' is one of the most commercially important fishes of northwest coast of India. In Bombay it is landed by both 'dol' netters and trawlers. Versova which is one of the major landing centres for 'dol' (bag) net boats, recorded a bumper catch of about five and a half tonnes

of this fish. The catch was unloaded on 5th November, 1984 at about 0800 hrs from by a vessel named 'Jal Vihar' Details of the operation are given below.



Fig. 1. 'Ghol' being landed by 'Jal Vihar' at Versova landing centre.



Fig. 2. 'Ghol' kept in the cold storage at Versova.

The boat which departed for fishing on 2-11-'84 stayed offshore for about four days. The catch of the first three days was brought by another carrier boat. The bumper catch of 'Ghol' was obtained only on the fourth day.

Sixteen 'Kodis' of 'Ghol' (one Kodi = 22 Nos.) were caught totalling 352 in number. The length frequency study showed that the size varied from 70 to

Name of the vessel	Gross tonnage	No. of nets operated	Depth of operation (m)	Time net shot (hr)	Time net hauled (hr)	Total catch (kg)	Catch per hour (kg)
Jal Vihar	11	2	30	2030	0100	5,432	1,207

\*Prepared by S.K. Chakraborty and J.R. Dias, Bombay Research Centre of C.M.F.R.I., Bombay.

90 cm with an average weight of 15.43 kg. Majority of the fishes had their stomach gorged out. Other biological studies could not be done as the fishes were immediately despatched to Crawford Market where they were sold at a price ranging from Rs. 60 to 80 per fish realising about Rs. 4 to 5 a kg.

A very good fishery existed for 'Ghol' earlier which was declined sharply in the seventies.

The sudden appearance of bigger sized 'Ghol' off Bombay in relatively shallow water suggests the possibility of a potential bed in this area.



## SUCCESSFUL LONG DISTANCE ROAD TRANSPORT OF GREEN MUSSEL FROM CALICUT TO PORT OKHA\*

The seeds of green mussel were collected from coastal areas at Elathur (north of Calicut) in the morning hours of 26-11-'83, and after cleaning them thoroughly with sea water, without any prior conditioning, were kept in HDPE tanks of about 300-400 litre capacity. A total of 9,000 seeds were thus collected and transported to Port Okha.

A few seeds were transported in polythene bags with sea water kept in empty kerosene tins in the same manner as inland fish seeds are transported, with periodic oxygenation.

Oxygen was given for 5-7 minutes once in every 3-4 hrs of day time journey in HDPE tanks and once in every 24 hrs for the seeds packed in polythene bags. No journey was performed between 2000 hrs to 0600 hrs. At night, the faecal material was removed from all the containers by sieve, so that the debris was at a minimal level in the water. During the whole night period, the polythene bags were kept open and just before the commencement of the day time journey oxygen was supplied. An inverted funnel type of cover was specially fabricated to cover the HDPE tanks to minimise the spillage of water during the transport.

It was found that during transportation the mussels used to remain attached in groups to the tanks or one another by the byssus threads.

\* Prepared by C. R. Trivedi, M. Bhaskaran, D. J. Wadher and F. D. Khhaya, Dept. of Fisheries, Okha, Gujarat.

In HDPE containers the density of mussel was 3-4/l and in polythene bags kept in kerosene tins it was 25/l. The latter type of packing seemed to be good as far as general condition and economics of transport were concerned. The journey started from Calicut on 26-11-'83 at 1000 hrs and ended at Port Okha on 1-12-'83 at 0230 hrs covering a linear distance of 2,300 km. The average size was 24.4 mm in length, 4.6 g in wet weight, 12.8 mm in width and 7.7 mm in breadth, and the transport used was a closed body insulated 10 tonner truck. Water was not changed during the entire journey period from Calicut to Okha.

On arrival at the destination, the mussel seeds were immediately kept in a collapsible 12 footer tank filled with seawater and allowed to rest for two days, after which a dozen or two of them were allowed to attach on separate coral stones. Very few of them tried to avoid the stones, though on second attempt they readily attached to them. The stones were then transported in a vessel and implanted in Gulf of Kutch Islands.

The experience gained in the process of transportation can go a long way in mass transplantation of mussel seeds or allied fish/shellfish seeds in the future.

We are thankful to Shri M. Kumaran and other scientists of Calicut Research Centre of CMFRI for the manifold help extended to us in this connection.



## REPORT ON BALEEN WHALE STRANDED ALONG MALLIPATINAM COAST, TANJORE DISTRICT \*

A whale was reported to have been washed ashore on 18-5-'85 at 1530 hours along Pudupatinam sea shore near Adhiramapatinam (10° 16'N latitude; 79° 19'E longitude). It was possible to reach the place only on 28th as the information reached rather late.

At the time of the inspection most of the flesh had been either removed or in a semi putrified condition. Even on the day of stranding, the fishermen reported that the animal was badly wounded and in a decaying condition. The presence of baleen plates indicated that it was a species of *Balaenoptera* (Baleen whale). The approximate weight of the whale stranded was estimated as 3,000 kg. The animal (snout to tip of caudal) measured 930 cm with a maximum of 151 cm of body height and 112 cm depth near the head region.

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\*Reported by C. Kasinathan, Regional Centre of C.M.F.R.I., Mandapam Camp.



## NEWS - INDIA AND OVERSEAS

### NATIONAL SYMPOSIUM ON RESEARCH AND DEVELOPMENT IN MARINE FISHERIES

As part of the celebrations of forty years (1947-1987) of dedicated and fruitful work in marine fisheries research, the Central Marine Fisheries Research Institute, Cochin is organising a National Symposium on Research and Development in Marine Fisheries from 24-26 June, 1987 at Mandapam Camp, Ramnad District, Tamil Nadu. Those engaged in fisheries planning, programme implementation, research, education, extension, legislation and industry may send experience papers which are critical and pointedly relevant to the theme of the symposium.

The theme of the symposium is

- National fisheries policy, objectives and plans
- Research in marine fisheries management and development
- Capture and culture fisheries
- Marine fisheries development in the Central, State and Private sectors
- Fisheries technology
- Fisheries education, training and extension
- Management and conservation of marine fisheries resources

- Fisheries Acts, rules and regulations
- Marine fisheries development - an outlook for 21st century.

The authors may register the titles of the papers by 15th April, 1987 in the prescribed registration form and also enclose the abstract in duplicate, not exceeding one page. Full papers in duplicate, may be sent so as to reach by 15th May, 1987. For more details write to the General Convener, National Symposium on Research and Development in Marine Fisheries, Central Marine Fisheries Research Institute, P. B. No. 2704, Cochin - 682 031.

### AQUACULTURE EUROPE 1987

The European Aquaculture Society (formerly European Mariculture Society), proposes to hold an International Aquaculture Conference and Trade Exhibition, 'AQUACULTURE EUROPE 1987' at Amsterdam, Netherlands from 2-5 June, 1987. The programme encompasses invited review papers, oral and poster presentation, panel sessions as well as session devoted to aquaculture film/slide shows. For further details please contact, EAS, Prinses, Elisabethlaan 69, B-8401 Bredene, Belgium.

