ISSN 0254-380 X

No. 201
July-September 2009

Marine Fisheries Information Service

Technical and Extension Series

Central Marine Fisheries Research Institute
(Indian Council of Agricultural Research)
Post Box No. 1603, Cochin - 682 018
www.cmfri.org.in

Marine Fisheries Information Service

No. 201 * July-September, 2009

Abbreviation - *Mar. Fish. Infor. Serv., T & E Ser.*

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The Marine Fisheries Information Service : Technical and Extension Series envisages dissemination of information on marine fishery resources based on research results to the planners, industry and fish farmers, and transfer of technology from laboratory to field.

Broodstock development, breeding and seed production of selected marine food fishes and ornamental fishes

G. Gopakumar, K. Madhu*, Rema Madhu*, Boby Ignatius*, L. Krishnan* and Grace Mathew*
Mandapam Regional Centre of CMFRI, Mandapam
**Central Marine Fisheries Research Institute, Kochi*

In recent years the contribution of marine finfish in the global aquaculture production has been steadily increasing. Marine food fishes like groupers, snappers, siganids, pompano, cobia and ornamental fishes have great potential for domestic and export trade. Availability of fingerlings has been one of the most critical factors for the commercial success in marine fish farming. Marine finfish farming is yet to be commercialized in India and the major constraint is the lack of viable seed production techniques for the candidate species. Even though technological advancements in broodstock development by manipulating temperature and photoperiod and induced spawning techniques have been developed for many marine finfishes internationally, a lot of research is needed in this area in India for developing viable technologies for selected species. The major constraints for successful larviculture are identified as (i) the small mouth gape of the larvae and hence their requirement for small prey at first feed and (ii) the occurrence of high mortality at various stages of larval rearing. Hence, rearing techniques, including the advantages of 'green water', appropriate live feeds, nutritional enrichment and larval rearing protocols have to be standardized for selected species having the potential for culture. In recent years, a lucrative global marine ornamental fish trade has been developed and hatchery production methods have to be evolved for the development of a long term sustainable trade in the country. The Central Marine Fisheries Research Institute has been focusing on brood stock development and standardisation of hatchery production methods for important species of marine food fish as well as ornamental fish, a brief account of which is presented in this paper.

Food fishes

The honeycomb grouper, *Epinephelus merra*

Broodstock development, breeding and seed production trial of *E. merra* was attempted at Mandapam Regional Centre of CMFRI. One broodstock tank of 5 t capacity was set up with undergravel filter. Six pre-adult fishes were stocked in the tank and fed *ad libitum* with fresh sardines. The fishes ranged in length from 20-36 cm and in weight from 100 g to 650 g.

The fishes above 30 cm formed pair and natural spawning was obtained. During August-September 2005, seven spawnings were obtained. The periodicity of spawning ranged from 3 days to 12 days, but the interval in majority of spawnings ranged between 3 to 4 days. The approximate number of eggs in the different spawnings ranged from 11,220 to 63020. The eggs hatched on the same day of spawning. The average length of newly hatched larvae was 1.5 mm.

Successful trial of seed production of *E. merra* was also carried out. Larval rearing was conducted in 5 t capacity FRP tank. Before the introduction of larvae, the tank was filled with filtered seawater and micro-algal culture was added to make the water green ('green water technique'). Calanoid copepods were introduced into the tank at an average concentration of 500 numbers per litre. The copepods were maintained in the tank in the multiplicative phase as was noted by the availability of egg bearing copepods, nauplii and copepodites.

About 2,000 newly hatched larvae were introduced. Eighty percentage mortality occurred during 3rd and 4th day. Thereafter the availability of sufficient copepod nauplii in the rearing tank was the key factor noted for the survival of the larvae upto two weeks. Whenever there was a decline in the availability of nauplii, mortality of larvae was noted. Additional copepods were collected from the wild and added to the rearing tank to maintain the density of nauplii. The addition of rotifer to the rearing tank resulted in the blooming of rotifers with a consequent depletion of copepods in the rearing tank. This was found to increase the mortality of the larvae. Hence the maintenance of copepods in sufficient densities in the rearing tank was found to be the critical factor for the survival of the larvae. After two weeks, freshly hatched *Artemia* nauplii were also added to the rearing tank. From the 25th day onwards, in addition to *Artemia* nauplii, adult *Artemia* was also supplied as feed. The larvae started metamorphosing from the 40th day onwards and all the larvae metamorphosed by the 60th day. A total of 33 numbers of young ones were produced in this experiment. The young ones ranged in total length from 20-64 mm and the majority was in the length range 30-49 mm (Fig. 1).

Fig. 1. Juveniles of hatchery produced honeycomb grouper

Epinephelus malabaricus

At Vizhinjam, pre-adults of *E. malabaricus* weighing >1 kg and upto 2 kg were collected from April 2006 onwards and reared for developing into broodstock. They were fed enriched diet and the required hormones for sex reversal also were administered to them. Male hormone was administered by incorporating through feed, twice a week from the first week of August. The dosage of hormones was @ of 3 mg per kg body weight of the fish. Eleven numbers of broodstock of *E. malabaricus* weighing from 2.85 to 5.45 kg were developed at the mariculture laboratory at Vizhinjam (Fig. 2). Biopsy examination of the brooder was carried out in January as well as during March 2007. Two of the females were found to have the ova in the tertiary stage of vitellogenisis, measuring in size from 360 to 400 µ. Though there was no free flow of milt, sex inversion had taken place by the hormone application in the male brooders.

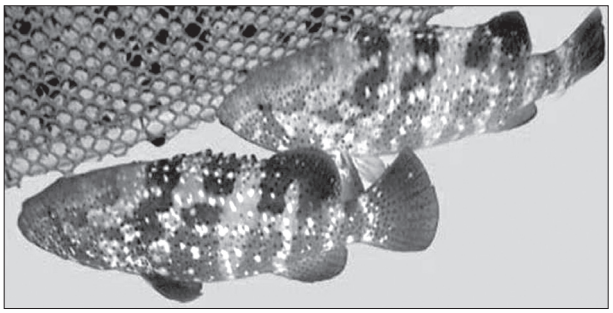

Fig. 2. Broodstock of *Epinephelus malabaricus*

Epinephelus polyphekadion

Broodstock development of *E. polyphekadion* was initiated at Mandapam. The fishes in the broodstock tank ranged in total length from 46 to 53.5 cm. Even though one spawning was obtained in February, the eggs were unfertilized. It indicated that sex reversal for male formation had not taken place.

Siganus canaliculatus

At Cochin hatchery, four pairs of broodstock of the rabbitfish *Siganus canaliculatus* were maintained in 5 t FRP tanks having *in situ* biological filters (Fig. 3 and 4). Feeding of fishes was done with chopped fish meat, prawn meat, mussels, clam meat and fish eggs. Occasionally intertidal green seaweeds like *Ulva* were also given as feed. Water exchange in this tank was done 2 -3 days before and after full/new moon days.

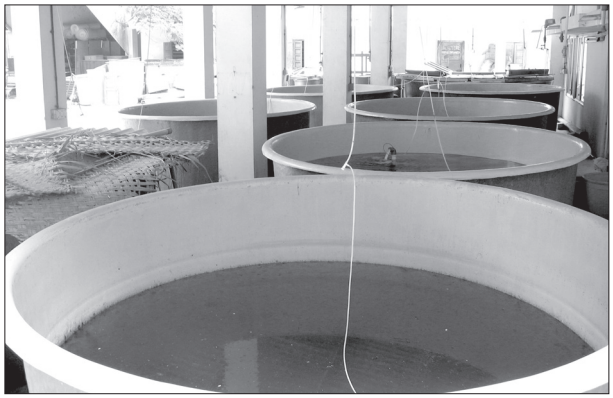

Fig. 3. Broodstock facility for marine foodfishes at Marine Research Hatchery, Kochi

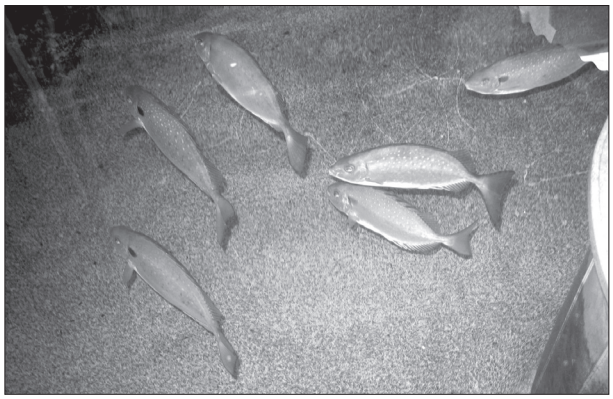

Fig. 4. Broodstock of *S. canaliculatus*

Spawning of the fishes was observed during November. Two spawnings were obtained during this month (01/11/2006 and 18/11/2006). The interval between two spawnings was 18 days. Since the fertilized eggs were demersal and adhesive in nature, collection of eggs from the tanks was not possible. So the hatched out larvae (Fig. 5) were collected next day morning and transferred to larval rearing tanks.

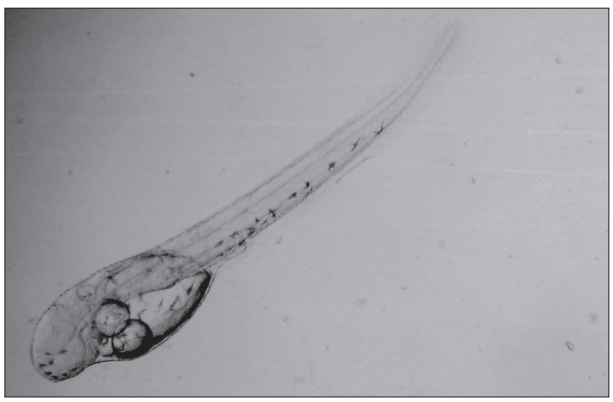

Fig. 5. Newly hatched larva of *S. canaliculatus*

The larvae collected from the tanks were stocked in 1 t FRP tank kept under roofing for further rearing. The larvae were stocked at a density of 5/l. The size of the larvae on day 2 was 2.87 mm. The mouth size of the larvae at this time was 100-125 µ (Fig. 6). Rotifers at a density of 5-10/ml were maintained as first feed. Everyday morning the bottom of the tank was siphoned out and 5-10% water was replaced with fresh seawater. The rotifer density was adjusted by adding fresh rotifers every day. To provide green water to the larvae and also as feed to rotifers, *Nanochloropsis* was added to the tanks everyday morning and evening.

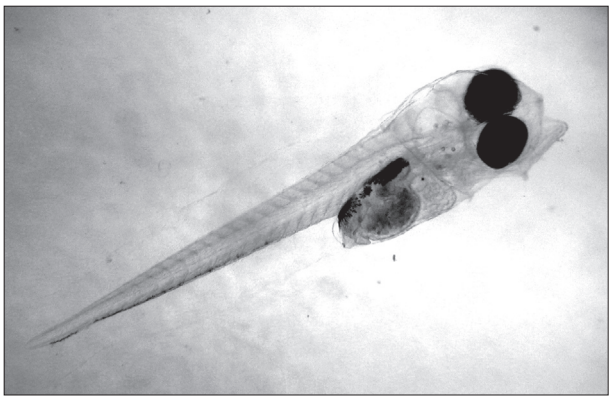

Fig. 6. Three day old larva of *S. canaliculatus*

On 4th day a slight reduction in the number of larvae was observed. On 6th day the larvae had grown to a size of 3.25 mm and mouth size increased to 150-175 µ. The gut content analysis of larvae revealed the presence of rotifers along with algae in the gut of the larvae. There was a gradual reduction in the number of larvae during succeeding days. Large reduction in the number of larvae was observed

Fig. 7. Hatchery produced juveniles of *S. canaliculatus*

between 12th – 15th day. At this time larvae reached size of 5-6 mm and were actively feeding on rotifers. On day 16, freshly hatched *Artemia* were added to the tanks as feed to the larvae. Between day 20 and 25 the larvae metamorphosed to juvenile fishes (Fig. 7). A total of 35 juveniles were produced from this tank.

Siganus javus

A 5 t capacity broodstock tank was set up for *S. javus*. A total of eight numbers of pre-adult fish were stocked in the tank. The length ranged from 20.5 to 31 cm. Two fishes died during the period. The length range (by the end of March 2006) was 29 to 35 cm. The broodstock development of *S. javus* was unsuccessful due to the incidence of severe mouth infection and consequent mortality of the fish in January 07. The biological details of the broodstock reared were as follows:

Length (cm)	Weight (g)	Sex	Maturity stage
42	850	Male	V
37	650	Male	II
36	750	Male	III
36	648	Male	III
390	760	Female	IV

Trachinotus blochii

A 5 t capacity broodstock tank was set up for *T. blochii.* A total of 11 pre-adults were stocked. At the time of stocking (May 05) the fishes ranged in length from 11 to 15 cm. The fishes were fed *ad libitum* with trash fish and squid meat. Three fishes died. Very good growth was noted during the period. However, In March 2006 the length of the broodstock ranged from 29 to 43 cm. Canulation was done during March 2006 and revealed that the fishes were maturing. The maturity condition of dead fishes from the broodstock development tank showed that fishes above 35 cm had developed gonads (stages II to III).

Marine ornamental fishes

Damsel fishes

The methods of seed production for the three species *viz., Dascyllus trimaculatus, Dascyllus aruanus* and *Pomacentrus caeruleus* were standardized during 2006 -2007 by repeated seed production trials and the protocols were standardized.

***Dascyllus trimaculatus* (Three spot damsel)**

Four successful experiments on hatchery production of three spot damsel *Dascyllus trimaculatus* was conducted during this period and the methods were standardized.

The three spot damselfish *D. trimaculatus* constitutes one among the topmost ten marine ornamental fishes in the international trade. The broodstock of the species was developed in captivity and successful breeding and larval rearing was achieved. *D. trimaculatus* is dioecious and the pair was developed in one tonne glass aquarium tanks. The mature fish ranged in total length from 9-10 cm. Breeding was observed during early morning hours. Approximately 12,000 to 15,000 eggs were present in a single spawning. The eggs were attached either to the sides of the tanks or on the substrata provided inside the broodstock tanks. The average periodicity of spawning was 2 weeks. Parental care by the male was noted. Hatching occurred on the evening of the fourth day of incubation. Larvae were altricial type with no mouth opening at the time of hatching. The average length of newly hatched larvae was 2.5 mm. The larvae were transferred to 5 t capacity circular FRP tanks in which harpacticoid copepod cultures were maintained in green water. Mouth opening appeared on the second day and the gape measured around 150 µm. The larvae started feeding on copepod nauplii from the third day of hatching. After two weeks when the average size of the larvae had reached 4 mm with average mouth gape of 450 µm, freshly hatched *Artemia* nauplii were fed *ad libitum*. The larvae started metamorphosing from 35th day of hatching and all the larvae metamorphosed by 40th day. The just metamorphosed young one measured from 12 to 13 mm in length. The average survival rate in the four rearing experiments ranged between 10-15%.

***Dascyllus aruanus* (Humbug damsel)**

Hatchery production of *Dascyllus aruanus* was also standardized. Five successful experiments were conducted during the period.

The striped damselfish *D. aruanus* constitutes one among the most sought after ornamental fishes in the international trade. The broodstock of the species was developed in captivity and successful breeding and larval rearing was achieved. *D. aruanus*

is dioecious and the pair was developed in 250 l FRP tank. Boiled and finely chopped clam meat was provided during morning and adult *Artemia* were fed during evening. Excess feed and faecal matter was removed daily and 25% water exchange was also done. The mature fish ranged in total length from 7 to 8 cm. Breeding was observed during early morning hours. Approximately 8,000-10,000 eggs were present in a single spawning. The eggs were attached either to sides of the tanks or on the substrata provided inside the broodstock tanks. The average periodicity of spawning was 2 weeks. Parental care by the male was noted. Hatching occurred on the evening of the fourth day of incubation. Larvae were altricial type with no mouth opening at the time of hatching. The average length of newly hatched larvae was 2.4 mm. The larvae were transferred to 2 t capacity rectangular FRP tanks in which calanoid/harpacticoid copepod cultures were maintained in green water. Mouth opening appeared on the second day and the gape measured around 160 µm. The larvae started feeding on copepod nauplii from the third day of hatching. After two weeks when the average size of the larvae had reached 4 mm with average mouth gape of 450 µm, freshly hatched *Artemia* nauplii were fed *ad libitum*. The larvae started metamorphosing from 25th day of hatching and all the larvae metamorphosed by the 31st day (Fig. 8).

Fig. 8. Hatchery produced *D. aruanus*

***Pomacentrus caeruleus* (Caerulean damsel)**

The methodology for the hatchery production of blue damsel was standardised. A total of five batches of about 100 numbers each was hatchery produced.

P. caeruleus is protogynous and polygamous. The broodstock was developed in 2 t capacity FRP tanks. The mature fish ranged in total length from 70-90 mm. Spawning was noted during early morning hours. Approximately 5,000-6,000 eggs were present in a single spawning. The eggs were attached on the substrata provided inside the broodstock tanks. The average periodicity of spawning ranged between 3 and 12 days. Parental care by the male was noted. The eggs were oval with an average length of 850 µ. The newly hatched larvae measured about 1.2 mm with an average mouth gape of 200 µ. The larvae were transferred to 5 t capacity FRP tanks in which green water was developed and a culture of calanoid/ harpacticoid copepods was maintained. After twelve days, freshly hatched *Artemia* nauplii were also supplemented. The larvae started metamorphosing from the 17th day and by 21st day all of them metamorphosed. The average length of just metamorphosed juvenile was 21 mm (Fig. 9).

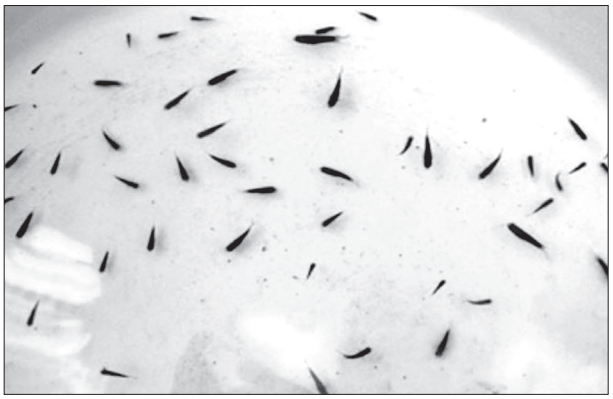

Fig. 9. Hatchery produced *P. caeruleus*

***Chromis viridis* (Blue green damsel)**

Experimental success was obtained in the broodstock development and seed production methods for the blue green damsel *Chromis viridis*.

The broodstock development of *C. viridis was* carried out in 2 t FRP tanks. Boiled and finely chopped clam meat, squid meat, earth worm and adult *Artemia* were fed to the fish. The excess feed and faecal matter was removed and about 25% water exchange was done daily.

Spawning was obtained from June 2006 onwards. The average frequency of spawning was five per month with an interval of about five days.

The egg was oval shaped with an average length of 502 µ. Hatching occurred in the evening of the fourth day of incubation. Larvae were altricial type with no mouth opening at the time of hatching. The average length of newly hatched larva was 2.25 mm. The larvae were transferred to 5 t capacity round FRP tanks in which cultures of calanoid copepod *Pseudodiaptomus serricaudatus* and the harpacticoid copepod, *Euterpina acutifrons* were maintained in green water produced by adding *Nannochloropsis* culture. Mouth opening was formed on the second day of hatching and the gape measured around 190 µ. The larvae started feeding on copepod nauplii from the third day of hatching. The average densities of egg bearing copepods, nauplii and copepodites maintained per ml in the larval rearing tank ranged between 1-13, 7-78 and 1-31 respectively for the first 20 days of larval rearing. From the 32nd day of larval rearing, freshly hatched *Artemia* nauplii was also supplemented. Metamorphosis started from 30th day and was completed by 49th day (Fig. 10). Two experiments on larval rearing were conducted and the average survival rate was about 5%.

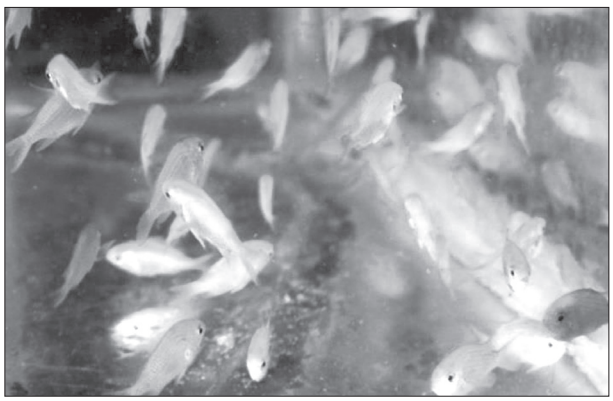

Fig. 10. Hatchery produced *C. viridis*

***Neopomacentrus nemurus* (Yellowtail damsel)**

The broodstock of the yellowtail damsel was developed in 2 t capacity FRP tanks. Spawning was obtained from April 2006 onwards. The average interval of spawning ranged from 4-5 days. The length of freshly laid egg was 870 µ. The eggs hatched on the evening of the fourth day of incubation. The freshly hatched larva measured 1.8 mm with a mouth gape of about 100 µ. The larvae were transferred to 5 t capacity FRP tanks in which mixed culture of copepods were maintained in green water produced by adding cultures of *Nannochloropsis*. The larvae started feeding on nauplii of copepods from the third day of hatching. From the 12th day onwards the larvae were also fed *ad libitum* with freshly hatched artemia nauplii. From the 16th to 21st day of hatching the larvae metamorphosed into juveniles. The length of the just metamorphosed juvenile ranged from 10 -13 mm (Fig. 11).

Fig. 11. Hatchery produced *N. nemurus*

Dascyllus carneus

Dascyllus carneus were collected from wild and brought to laboratory for further rearing and developing broodstock. These fishes were kept in 1t FRP tanks with biological filters and management protocols were same as in the case of other fishes. After a period of 2 months in the tanks, the fishes started laying eggs on to the substratum provided in the tanks. The eggs were 625 – 650 µ in length and 450 µ in width (Fig. 12). The number of eggs at single spawning were more than 5000.

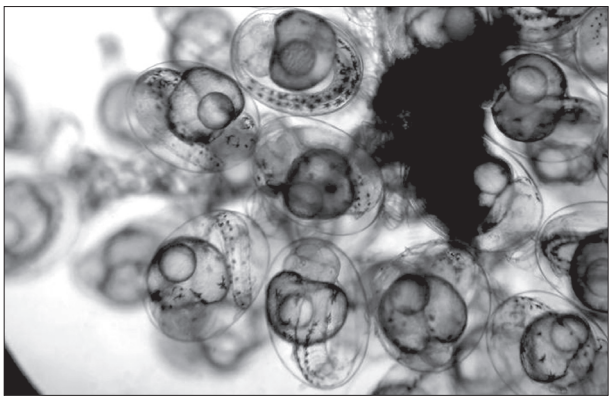

Fig. 12. Eggs of *D. carneus*

Standardistion of breeding and seed production of *Amphiprion percula* (orange clown)

Spawning of the orange clown *Amphiprion percula* was obtained and methods of hatchery production were standardised. Spawning occurred during day time (0600 -1530 hrs) and the spawning interval ranged from 14 to 18 days. The clutch size per spawning ranged from 112 to 557 eggs. Hatching was on the 8th day of incubation in the evening and the length of the newly hatched larvae ranged from 1.91 to 2.02 mm. Larviculture protocols were developed and during 19th -20th day of hatching, the larvae metamorphosed into juveniles (Fig. 13).

Fig. 13. Hatchery produced *A. percula*

***Broodstock development of Amphiprion ocellaris* (false clown) and *Premnas biaculeatus* (maroon clown)**

Pre-adults of the false clown *Amphiprion ocellaris* having total length 30 to 60 mm and spine cheek anemone fish (maroon clown) *Premnas biaculeatus* (40 to 60 mm) were collected and examination of their gonad showed that all the specimens were males. For broodstock development, six numbers of pre-adults of each species were reared in 500 l FRP tank fitted with biological filter and provided with suitable host sea anemone. Fishes were daily fed four times with meat of clam, prawn and fish egg mass at the rate of 15% of their body weight. After a period of 3 to 4 months rearing in each tank, one pair grew ahead of others and became the functional male and female. The standard length of the female varied between 89 and 100 mm and that of male varied from 40 to 60 mm in *A. ocellaris* and that of *P. biaculeatus* attained a standard length of 120 to 140 mm and 55 to 60 mm for female and male respectively. The broodstocks thus developed were then transferred to separate glass aquaria for breeding.

Breeding and seed production of *Amphiprion ocellaris*

The first pair spawned in November 2005. Thereafter spawnings were obtained at an interval of 12 to 15 days giving an average of two spawnings per month per pair. Spawning was noticed during day time between 0500 and 1530 hrs and lasted for one to one and half hour. Depending upon their size, the females spawned 300 to 1000 eggs per spawning and they deposited capsule shaped eggs in nearly round patches on the surface of earthen pots and each egg adhered to the substratum through a stalk. The newly spawned eggs were white in colour on the first day which later changed to light grey on 2nd day and as the embryo developed, these turned to black on 3rd to 6th day which later turned to silvery on 7th day of incubation (Fig. 14).

Fig. 14. Silvery eggs of *A. ocellaris* on 7th day of incubation

During the incubation period, both the parents carefully looked after the eggs (Fig. 15). The hatchling emerged on 7th day of incubation and the peak hatching took place soon after sunset at water temperature range of 27 to 29 °C. The newly hatched larvae measured 3.2 to 4.0 mm in length and each had a transparent body, large eyes, visible mouth and a small yolk sac. The larvae were initially maintained in greenwater with small rotifer *Brachionus rotundiformis* and later on with newly hatched *Artemia* nauplii. At 9-10th day of post-hatch, the larvae showed first sign of pigmentation and by 15-17th day 90 to 95% metamorphosed into juveniles and shifted from pelagic to epibenthic stage (Fig. 16 and 17).

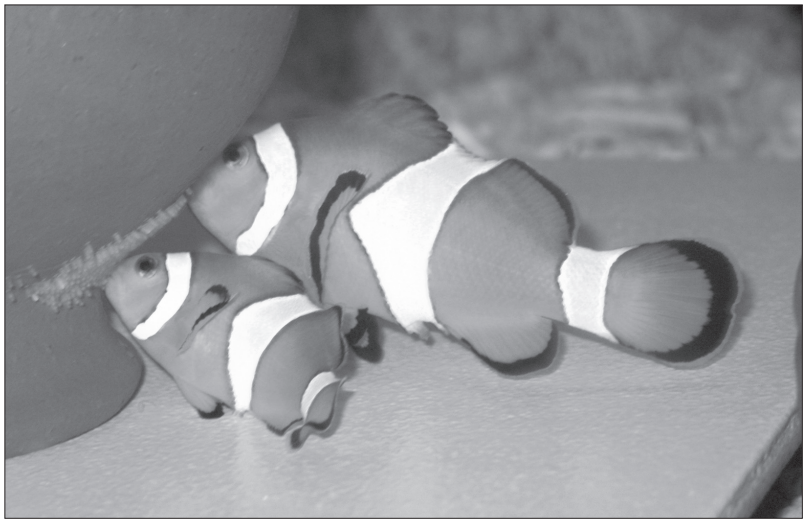

Fig. 15. A pair of *A. ocellaris* with eggs deposited on earthen pot

Fig. 16. Fifteen days old juveniles of *A. ocellaris* settling in sea anemone *Heteractis magnifica*

Breeding and seed production of *Premnas biaculeatus*

Under captive conditions, the pairs successfully bred for the first time in India on 27.07.06 and laid 115 eggs. The newly spawned eggs (Fig. 18) were bright red/brownish red/maroon in colour for the initial two days and as the embryo developed, these turned to black on 3rd to 4th day and later turned to silvery on 5th to 6th day of incubation (Fig. 19) and the glowing eyes of the developing larvae inside the egg capsule was clearly visible when viewed from a short distance. Subsequently spawning was achieved every 15 to 20 days interval giving an average of two spawnings per month per pair and laid 115 to 1000 eggs/ spawning. The fertilized eggs were elliptical shaped with size ranging from 2.8 to 3.5 mm long and 1.1 to 1.7 mm wide (Fig. 20). Early embryonic development was completed within 6 days of incubation (Fig. 21) at water temperature of 27 to 29 °C. Peak hatching took place immediately after sunset under complete darkness and the newly hatched larvae measured 2.5 to 3.6 mm in total length. Green water technique was employed for larval rearing and feeding protocols with enriched rotifers and newly hatched *Artemia* nauplii were developed. On 15th to 17th day of post-hatch, the size of the juveniles ranged from 12 to 16 mm.

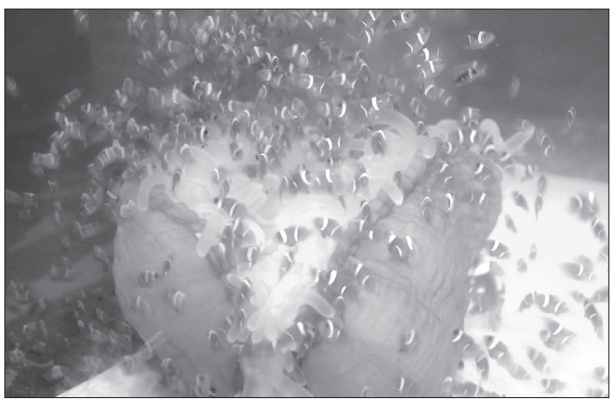

Fig. 17. One clutch of laboratory produced juveniles of *A. ocellaris*

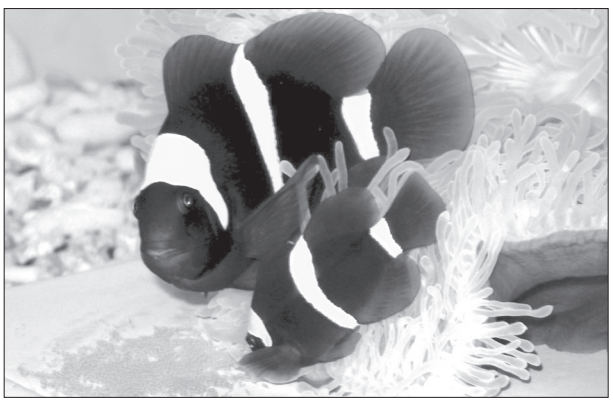

Fig. 18. A pair of *P. biaculeatus* with newly spawned eggs deposited on tiles

Fig. 19. Silvery eggs of *P. biaculeatus* on final day of incubation

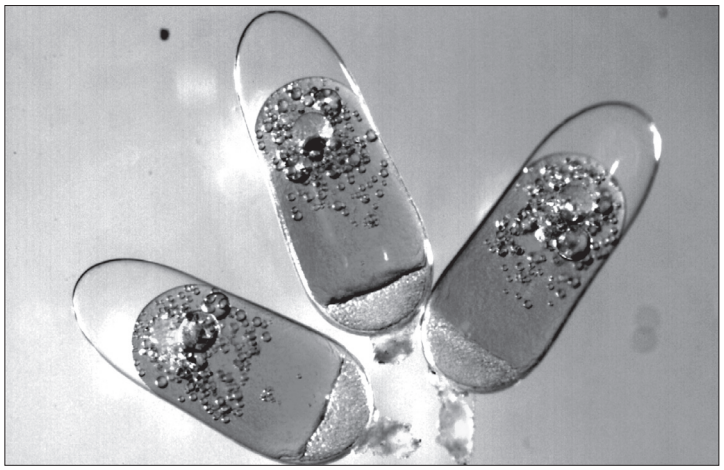

Fig. 20. Photomicrograph of capsule shaped eggs of *P. biaculeatus* after 24 h of fertilization

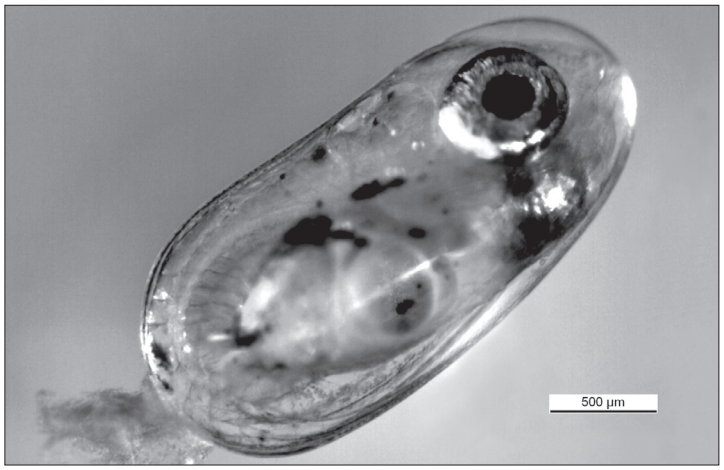

Fig. 21. Embryo of *P. biaculeatus* occupying the entire space in egg capsule on final day of incubation

Conclusion

In the context of declining returns for shrimp farming in recent years, it appears that diversification of farming practices is the only alternative to sustain mariculture production. Marine finfish farming is one of the viable options and international attention is being focused on research and development in this emerging sector. The lack of commercial scale availability of hatchery produced seed is the major bottleneck for any large scale venture of marine finfish farming in India. The availability of seeds from wild is often unpredictable and hence farming based on wild collection of seeds may not be a sustainable venture. Hence the development and standardization of seed production techniques for a few species belonging to groupers, siganids, pompano, snappers, breams and cobia should receive research priority. It is felt that the development of commercial hatcheries for ready supply of seeds is the primary step for the development and expansion of marine finfish farming in India.

The global marine ornamental species trade has grown into a multi-stakeholder industry operated almost throughout the tropics and dependent almost entirely on wild collection from coral reef habitats. However, it is well accepted that the environmentally sound way to increase the supply of marine ornamentals in order to reduce the pressure on wild population is the development of hatchery production techniques for the species which are on demand. During the past few years, the Central Marine Fisheries Research Institute has intensified research activities on breeding and culture of marine ornamental fishes which has resulted in the development of hatchery production technologies of ten species of Pomacentridae that are in good demand in the international trade. Research and development in the breeding and culture of marine ornamentals is a priority area which has to be intensified in the coming years which can result in the development of a hatchery produced marine ornamental fish trade in India.

An emerging commercial fishery of *Rachycentron canadum* (Linnaeus, 1766) at New Ferry Wharf, Mumbai

K. B. Waghmare, Sujit Sundaram and A.Y. Mestry
Mumbai Research Centre of CMFRI, Mumbai

Rachycentron canadum is commonly known as 'cobia' and locally called as 'sakla'. This species is distributed world wide in warm seas except for the eastern Pacific region. It is pelagic but is also found over shallow coral reefs and off rocky shores and occasionally found in estuaries (Fischer and Bianchi, 1984)

Though *R. canadum* has a wide distribution, it never formed a commercial fishery. But of late the landings of this species have increased considerably at New Ferry Wharf, Mumbai. Stray landings were occasionally observed but in the year 2007, the landings were considerably high wilth the estimated annual landings being 110.6 t (Fig. 1). The species was oberved throughout the year with a major peak during September - October and a minor peak in February.

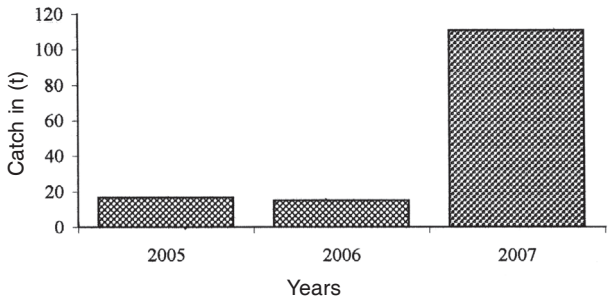

Fig. 1. Annual Landings of *Rachycentron canadum* at New Ferry Wharf

A heavy catch of approximately 2 t of large sized specimens, caught by hooks and lines was landed at New Ferry Wharf on 05.04.08 (Fig. 2). A similar landing but of a lesser magnitude with about one ton was observed on 03.05.08. These hand-operated hook and liners are from southern Tamil Nadu, who fish off Okha coast in Gujarat. Sharks are the targeted fishes using baits such as tuna, cephalopods *etc*. (Thakur Das *et al*., 2007), but the unexpected catch of this species during the year has evolved into a totally new resource of very high commercial importance. The catch was sold at the rate of Rs. 80 - 90/- per kg at the landing center generating an added income of Rs. 2,70,000/-. The species of sharks observed along with the catch were *Carcharhinus limbatus*, *Carcharhinus sorrah and Galeocerda cuvieri*.

Fig. 2. Landing or *Rachycentron canadum* at New Ferry Wharf, Mumbai

A total of 24 specimens were measured for length-frequency analysis. The total length of the fishes ranged between 123 - 205 cm with the mode in the size group 180 - 189 cm (Fig. 3). The approximate weight ranged between 29 to 95 kg. A similar high catch of the species was recorded by

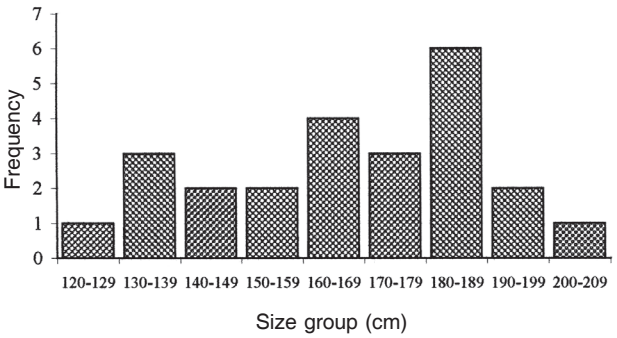

Fig. 3. Size frequency of *Rachycentron canadum*

purse seines at New Ferry Wharf earlier, but of smaller length range from 100 - 169 cm (Jadhav and Chavan, 2004).

A single specimen measuring 205 cm (Fig. 4) in the present observations seems to be the largest record from the Indian waters. Earlier instance of such large specimen was reported from Sasoon Docks that was caught by a gill-netter which measured 121 cm (Kamble *et al.*, 2004). According to Fischer and Bianchi (1984), the maximum size is 200 cm and is common in the fishery at 110 cm. The fish mainly feeds on crabs, squids and fishes.

The sudden increase in the catch of this species has generated a lot of interest among fishermen, more so because of its high commercial returns.

Fig. 4. Specimen of *Rachycentron canadum* measuring 205 cm

Due to the regular availability of this species in good numbers, hook and liners have now started targeting this resource.

Re-occurrence of oilfish in the landings of the south-west coast of India

T. S. Naomi, K. Vinod, P. M. Geetha and V. J. Thomas
Central Marine Fisheries Research Institute, Kochi

On 29.08.2008, 13 specimens of the oilfish, *Ruvettus pretiosus* Cocco, 1833 were recorded in the trawl landings along with a heavy catch of around 200 t of *Coryphaena* sp. at the Cochin fisheries harbour. The biggest specimen was 360 mm in TL with a weight of 260 g. The available literature indicates that a single specimen of *R. pretiosus* measuring 310 mm in TL and weighing 220 g collected from the continental slope off the Quilon Bank (09004'N lat. 75031'E long.) area during November 1968 is so far the only record from the south-west coast of India, besides the two specimens from Laccadives kept in the repository of the museum of Fisheries department at Kavarathi Island. The flesh of *R. pretiosus* contains more oil and hence the name oilfish. The only other gempylids recorded from the Cochin area earlier were *Neoepinnula orientalis* and *Rexea prometheoides*.

The diagnostic features of *R. pretiosus* delineate the skin as very rough, scales small and cycloid interspersed with rows of spinous bony tubercles. Ventral keel rigid and scaly on the belly between pelvic

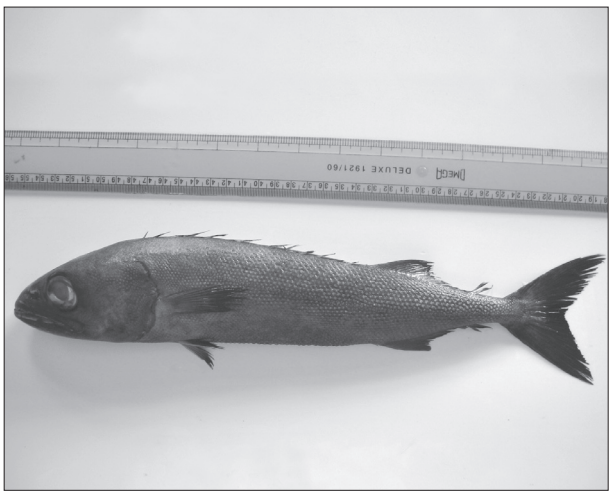

Fig. 1. *Ruvettus pretiosus* Cocco 1833

and anal fins. Body elongate and uniformly dark brown, tips of the pectoral and pelvic fins black. Lateral line single and obscure. Fang like teeth in front of upper jaw. Vertebrae 32.

Meristic counts

D_1. XV, D_2. 15 + 2; A. 17 + 2; P. 14; V. I, 5; C. 26.

Morphometric characters	(mm)
Total length (TL)	360
Standard length (SL)	310
Depth of body at origin of first dorsal fin	56.91
Depth of body at origin of anal fin	53.91
Caudal peduncle depth	16.76
Caudal peduncle length	30.34
Head length	96.45
Eye diameter	21.83
Inter-orbital width	25.29
Pre-orbital distance	32.10
Post-orbital distance	45.87
Upper jaw length	48.46
Lower jaw length	47.11
Tip of snout to origin of first dorsal	90.36
Tip of snout to origin of second dorsal	205.63
Tip of snout to origin of pectoral fin	91.11
Tip of snout to origin of pelvic fin	97.90
Tip of snout to origin of anal fin	207.95
Length of first dorsal fin base	124.56
Length of second dorsal fin base	56.28
Length of pectoral fin base	8.28
Length of pelvic fin base	2.86
Length of anal fin base	58.08
First dorsal fin length	23.24
Second dorsal fin length	37.90
Pectoral fin length	50.86
Pelvic fin length	30.62
Anal fin length	24.50
Caudal fin length	67.66
Distance between pelvic fin and anal fin bases	110.05

The oilfish grows to a large size and the maximum weight recorded is 63.5 kg and the length 200 cm TL. *R. pretiosus* is oceanodromous and bathypelagic; found in the depth range of 100 - 800 m but usually occurs in 200-500 m along the upper continental slope of Indian seas and is known to migrate to surface at night. It is widely distributed in the tropical and temperate seas of the world. The fish is rated under the category of very high vulnerability.

The species is stated to form a minor commercial fishery especially along the coast off Tuticorin in the Gulf of Mannar contributing to nearly 2% of the gempylidae family during November-December and is caught by trawls and large meshed gillnet (*Paruvalai*). The other two species of importance reported along the Tuticorin coast are *Lepidocybium flavobrunneum* and *Neoepinnula orientalis* though *Thyrsitoides marleyi* is also available sporadically in small numbers along with tuna landings. Previously *R. pretiosus* has appeared in the collections only during the post-monsoon season but recently the time of occurrence has been advanced to the monsoon season signifying its availability in deeper waters relatively more in numbers.

Record size landing of blackbanded trevally *Seriolina nigrofasciata* at Veraval

Shubhadeep Ghosh, G. Mohanraj, P. K. Asokan, H. K. Dhokia, M. S. Zala and J. P. Polara
Veraval Regional Centre of CMFRI, Veraval

On the 4th of January 2008, two giant sized female blackbanded trevally *Seriolina nigrofasciata* Ruppell caught by hooks and line were landed at Bhidiya, Veraval (Fig. 1). This is the first report on the landing of black banded trevally at Veraval. The hooks (hook no. 6) were suspended at a depth of 80 - 90 m from the trawler having overall length of 14 m and powered with 105 HP engine. The fishing area was off Jaffrabad at 100 to 110 km in the south - east direction from Veraval. The morphometrics of these two giant sized carangids are presented in Table 1. The length and weight of these two specimens were much higher than the maximum length and weight of 70 cm and 5.2 kg reported from the Persian Gulf and the Oman Sea. It is infered that this is the largest size of black banded trevally recorded so far from any part of the world.

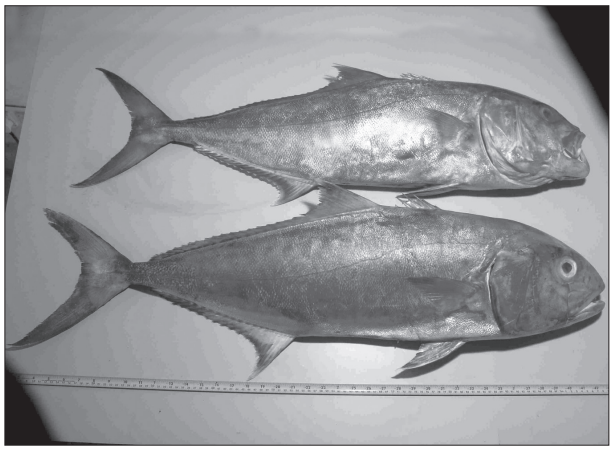

Fig. 1. Record size catch of *Seriolina nigrofasciata* by hooks and line at Veraval

Table 1. Morphometric measurements of the two giant sized carangids landed at Veraval

Morphometric parameters	Specimen 1	Specimen 2
Total length (TL) in cm	110.8	104
Fork length (FL) in cm	97	90.5
Standard length (SL) in cm	90	85
Weight (g)	9400	7400
Pre-anal length (% of TL)	52.5	50.5
Pre-dorsal length (% of TL)	31	29.1
Pre-pelvic length (% of TL)	26.4	27.5
Pre-pectoral length (% of TL)	25.7	26
Body depth (% of TL)	19	17.8
Head length (HL) (% of TL)	24.4	24.8
Eye diameter (% of HL)	15.6	14
Pre-orbital length (% of HL)	37	34.5
Aspect ratio of caudal fin	3.9	4.2

Unique landing of *Sardinella sirm* at Neendakara, Kollam

Sijo Paul
Central Marine Fisheries Research Institute, Kochi

The ring seines operating at Neendakara on 14.05.08 landed a record catch of *Sardinella sirm* (Fig. 1). Two types of crafts were operated; thanguvallams with 90 HP inboard engine and fibre boats with 19.8 HP outboard engine. The depth of operation was 32 - 44 m north-west of Neendakara. The catch range per unit of fibre boat was 800 to 1000 kg and that of thanguvallam was 2600 - 3900 kg. Due to Ekadashi, thanguvallam and fibre boats did not operate on 15.05.2008. The following day a peak was observed with all the nearby thanguvallams targetting this fishery. The depth of operation had a slight variation with a range of 38 - 56 m off north-west and west of Neendakara. The fibre boats landed about 800 - 1800 kg/unit and thanguvallam with 1800 to 3900 kg/unit. This fishery was not observed on 17.05.2008 and for the subsequent two weeks, but reappeared on

Fig. 1. *Sardinella sirm*

Fig. 2. Catch of *Sardinella sirm* at Neendakara

02.06.2008 at a depth range of 32 to 36 m north-west and west of Neendakara. The catch per unit for fibre boats was 800 - 1300 kg and for thanguvallams, 1800 to 3850 kg. On 03.06.2008 the catch in 90% of fibre boats and 40% of thanguvallams at depth range of 30 - 36 m north-west and west of Neendakara landed *S. sirm* with per unit catch of 800 to 1100 kg in fibre boats and 2800 to 3600 kg in thanguvallams (Table 1).

The price of *S. sirm* was Rs. 5-6 per kg and length ranged from 16 to 19.2 cm. The fishery dwindled after 03.06.2008 with *Sardinella lengiceps* and other lesser sardines coming in.

Table 1. Approximate landings of *Sardinella sirm* and income realisation

Date	Crafts	Average catch (kg)	No. of units	Total catch (kg)	Rate (Rs./kg)	Craft-wise income (Rs.)	Total (Rs.)
14-05-2008	Fibre boat	950	16	15200	5/kg	76,000	401000
	Thanguvallam	3250	20	65000	5	3,25,000	
16-05-2008	Fibre boat	1200	36	43200	5/kg	2,16,000	918000
	Thanguvallam	2600	54	140400	5/kg	702000	
02-06-2008	Fibre boat	1000	33	33000	6/kg	1,98,000	6,66,000
	Thanguvallam	3000	26	78000	6/kg	468000	
03-06-2008	Fibre boat	1000	18	18000	6/kg	1,08.000	185832
	Thanguvallam	3243	04	12972	6/kg	77832	

Rare occurrence of diamond back squid *Thysanoteuthis rhombus* (Troschel, 1867) off Chennai coast

Hameed Batcha, R. Thangavelu, P. Poovannan and G. Srinivasan
Madras Research Centre of CMFRI, Chennai

A single female specimen of diamond back squid *Thysanoteuthis rhombus* (Troschel, 1857) locally called 'thalan kadama' was recorded for the first time in the landings of Kasimedu Fishing Harbour on 9.7.2008. The squid was caught in the drift gill net operated off north Chennai at a depth of around 100 m. The squid was 630 mm in mantle length and weighed 6 kg. The specimen was sold for Rs.1,500/- at the landing centre. The landing of the same species with a mantle length of 700 mm in Veerapandipatinam, near Tuticorin has been reported by Kasim *et al*. (1994).

Fig. 1. Dorsal view of the squid *Thysanoteuthis rhombus*

T. rhombus is an epipelagic oceanic rhomboid squid of bright red colour having a thick cylindrical muscular mantle, wide anteriorly and tapering gradually posteriorly to a blunt end. The fins are long occupying the entire length of the mantle on lateral side. The fin is diamond shaped, being broader in the middle and tapering at both anterior and posterior ends. The head is shorter and the eyes are prominent. The outer lateral arms are the longest and the inner arms are the shortest provided with a crest like muscular projection at the base of each arm. The other arms are intermediary in length devoid of any structures. All the arms possess two

rows of suckers and sucker rings with sharp teeth. The morphometric measurements of the specimen are given in Table 1.

The squid inhabit warm tropical and partially sub-tropical waters. It occupies near surface waters during night and migrates to mid waters during day time and often occurs alone or in pairs. There is detailed information on the distribution of this species from the Atlantic, Pacific and Japanese waters.

Table 1. Morphometric measurements of the diamond back squid *Thysanoteuthis rhombus* caught off Chennai coast

Morpometric characters	Measurements (mm)
Mantle length, dorsal	630
Mantle length, ventral	610
Mantle width	550
Fin width	200
Head length	110
Width of head	150
Funnel length	75
Eye diameter	40
Tentacle length	600

Heavy landings of juvenile lizard fishes and silverbellies at Neendakara

P. K. Seetha
Central Marine Fisheries Research Institute, Kochi

On 25.2.2008, a heavy landing of lizard fish of about 1,000 kg along with silverbellies by trawlers was recorded at Neendakara (Fig. 1). The catch was from Chavara area (off Neendakara) caught from 10-20 m depth. Among the lizardfish catch, *Saurida undosquamis* and among the silverbellies, *Leiognathus elongatus* were the dominant species. The length range of *S. undosquamis* (sample size: 72) was 110-170 mm, with the modal length of 150 mm. The length range of *L. elongates* (sample size: 140) was 20-70 mm with the mode of 50 mm. Most of the specimens of *S. undosquamis* were in immature stages. Stomach of the fish was observed to be full. Since the catch mostly consisted of juveniles, it was utilized for making manure.

Fig. 1. Heavy landing of juvenile lizard fish along with silverbellies at Neendakara

Mussel resources of Andaman Islands

R. Thangavelu, R. Soundararajan and P. Poovannan
Veraval Regional Centre of CMFRI, Veraval

A variety of molluscan resources such as edible oysters, pearl oysters, clams, mussels and gastropods are distributed along the coastal area of Andaman and Nicobar islands. Among the bivalves, the distribution of green mussel *Perna viridis* was earlier known only from a small creek at Sippighat (Mahadevan, 1983). However, there is no detailed information on the extent of distribution, density of

population, the total biomass, magnitude of fishery and environmental parameters of natural beds of Andamans so far. The present report describes the ecological aspects of natural beds, the area of distribution, density of population and total biomass which could be realized from different localities. Information on the status of fishery was also collected.

A survey was conducted during April 2001 to study the distribution pattern and magnitude of mussel population in Andaman islands. The work was carried out during the low tide by examining inter and sub-tidal area of mussel beds, trekking on foot and by skin diving up to a depth of 5 m. A station was fixed in inter-tidal area, a quadrate of 0.25 m^2 (50 x 50 cm) was placed and all the mussels present inside the quadrate was removed, washed and counted. From each station three samples were collected. The specimens were collected in separate plastic bags and taken to the laboratory for further analysis. Linear measurements and weight of the mussels were taken individually. After removing the shell, sex and stage of gonadal maturity were also recorded. The meat weight was taken to represent the percentage edibility.

Ecology of mussel beds

Sippighat is a narrow tidal creek near Port Blair. The creek bifurcates into two behind newly constructed Naval office: the east 'Sippighat creek' and the 'Bimbleton creek'. During rainy months, runoff water from the surrounding elevated ground would find its way into the creek at many points. But the tidal amplitude is very well pronounced to almost 2 m height in Sippighat to neutralize, to a great extent the effect of fresh water influx and dilution. The width of the creek varies from 30 to 120 m. The bund of the creek is strengthened with granite stones with fully grown mangrove trees on either side. Bottom of the creek was loose muddy. Mussels were found attached to concrete structures of culvert, sluice gate and rocky substratum in Sippighat and on concrete structures, stones and hard muddy substratum in other areas.

The bridge with concrete culvert, sluice gate and the hard concrete bottom beneath the bridge provide a good substratum for the settlement of mussels. Adjacent to the sluice, piers have been erected to hold the freshwater pipeline and the hard substratum below this has got settlement of mussels in patches. Mussels were also found partly buried in the mud near the sluice gate and under the submerged side of the bridge.

Beyond the sluice gate on either side, the bottom was loose and slushy due to heavy deposition of silt and mussels were absent. The mussels settled on the bottom of the culvert where the tidal movement was fast, were found to be clean and brightly coloured whereas mussels settled away from the water current had heavy silt deposit. The tidal water flows with rich nutrients and plankton during high tide and slowly recedes during the low tide through the sluice gates. The water level in the mussel bed was about 20 cm or sometimes exposed during low tide and during high tide reached to 1.5 to 2 m.

Ecology of mussels in Mithaghari, Hathitope, Kadakkachan sluice, Minnie Bay and Rangat were different from the Sippighat creek. The mussels settled on the piers just below the jetty in Minnie Bay and on the hard rocky substratum or on the hard muddy bottom in Mithaghari jetty. Mussels were found in the sub-tidal region. The seawater is oceanic in character and changes in hydrological parameters during the monsoon were also negligible in these areas. Mussels were found in thin population, along with pearl oysters *Pinctada margaritifera* and *Pteria penguin*. Mussels observed in the natural habitat have shown hard and thick shells with heavy settlement of fouling organisms. The important fouling organisms which are sedentary in nature are barnacles, bryozoans, serpulids, sponges, corals, ascidians, hydroids and the transit forms are polychaetes, crabs, fishes, carideans *etc*. The turbidity was comparatively less in this area when compared to Sippighat.

Sippighat mussel bed

An account on the natural mussel bed area, density of population, size range, mean weight, sex ratio, percentage edibility and total biomass for different stations are given in Table 1. Mussels were thick in population in the form of mat underneath the bridge. The total area of the mussel bed was 250 m^2. The population of mussels per one square meter was 158. The size ranged between 35 and 118 mm with mean size of 72.3 mm and the average weight was 35.1 g. The total biomass of mussel population in

Table 1. Distribution of green mussel *Perna viridis* in Andaman Islands

Station	Area of bed (m^2)	Average number of mussels / m^2	Size range (mm)	Mean size (mm)	Mean weight (g)	Sex ratio M : F	Percentage edibility	Total biomass (kg)
Sippighat creek	250	158.0	35-118	72.3	35.1	69:31	30.2	1386.5
Bimbleton creek	200	61.3	47-136	96.7	76.3	65:35	29.9	935.4
Kalapathar	300	47.3	62-132	98.2	80.1	63:37	30.8	1139.0
Garachathra sluicegate	300	76.2	74-121	81.3	48.7	50:50	37.7	1113.3
Mitha gari	150	64.0	85-188	122.4	181.6	54:46	20.1	1743.4
Hathitope	200	84.0	87-130	111.7	131.9	70:30	29.7	2215.9
Kadakkachan sluice	200	48.0	79-109	97.1	78.6	67:33	25.6	754.6
Minnie Bay	80	17.8	99-201	149.1	272.9	54:46	24.4	3886.1
Rangat	300	73.0	71-116	78.2	47.8	60:40	25.2	1046.8
Total	1980							14221

this area was estimated as 1386.5 kg. The percentage edibility was 30.2 %. The sex ratio showed that females were dominant (31:69) in the population.

Bimbleton creek

The road bridge with sluice gate in the Bimbleton creek recorded moderate settlement of mussels. Among the four gates, two were closed with sand and gravel to prevent the flow of water. Mussels were thickly populated in all the concrete structures and underneath the sluice gate.

Mussels were sparsely distributed in the hard muddy bottom and on the granite stones. The total mussel bed area was approximately 200 m^2 and the density of population was 61.3 m^2. The size ranged between 47 and 136 mm with a mean size of 96.7 mm and weight 76.3 g. The total biomass which could be realized from this bed was 935.4 kg. The percentage edibility was 29.9 %. Females outnumbered males (35:65) in the population.

Kalapathar

This station was characterized by the presence of a black rocky area (Kalapathar) at about half a kilometer from the Bimbleton creek or just behind the newly built Naval office. It was informed that there was a rich mussel ground and people with dinghies used to go and fish several baskets of mussels to meet the local market. At present the top of the rock is devoid of mussels, but the submerged area of peripheral region harbour mussels for 3 m width. The population of mussels observed in small patches at the rate of 47.4 mussels per m^2. The size of the mussels ranged between 62 and 132 mm. The mean size and weight were 98.2 mm and 80.1 g respectively. The total biomass which could be realized from this bed was 1,139 kg in a total area of 300 m^2. Females were found to be dominant in the population (37:63) and the condition index was 30.8%.

Garacharma sluice gate

It is a bridge with one way sluice gate situated at a distance of 2 km behind Garacharma Basti. The sluice has four gates and the bottom had concrete structure harbouring mussels. The depth of water during low tide was 50 cm and the turbidity was high. On either side of the creek, fringing mangrove vegetation was present. The density of mussel population was thick underneath the bridge and with moderately small patches in outer area of the sluice. The average number of mussels per square meter in this area was 76.2 and the sizes were between 74 and 121 mm with an average weight of 48.7 g. The total biomass from 300 m^2 mussel bed could be realized at 1,113.3 kg and meat weight obtained was 37.7 %. The sex-ratio was observed in equal proportions.

Mithagari

Mithagari jetty is L shaped which is used for public navigational purpose to go to nearby islands. There are 20 vertical pillars and three longitudinal horizontal concrete beams lying just below the platform and above the water surface during the low tide. All these concrete structures have got good settlement of edible oysters *Saccostrea cucullata*, *Crassostrea rivularis* and pearl oysters *Pteria penguin* and

Pinctada margaritifera. The mussels were thickly populated and settled in clusters along with the oysters. The water depth was 2 to 5 m. The bottom was muddy with granite stones which were scattered on either side of the jetty. The mussels were found attached to the granite structures and sometimes partly buried in the hard muddy bottom. The mussels fished for market were comparatively larger in size and all the mussels were thickly deposited by the fouling organisms. The density of population per square meter was 64 and the mean weight was 181.6 g. The total mussel biomass could be realized to 1743.4 kg in 150 m^2 area of bed.

Hathitope

The creek with rocky structures on either side of the bank and the jetty with pillars provide a suitable substratum for the settlement of mussels. Mussels were observed in patches on rocks and thickly populated on piers. The density of mussels per m^2 was 84 and the size was ranging between 87 and 130 mm with a mean size of 117.7 mm. The total biomass of mussels was arrived at 2215.9 kg in a 200 m^2 area of mussel bed. The sex-ratio in the population was 30:70 and females outnumbered males. The percentage edibility was 29.7 %.

Kadakkachan sluice

The concrete structures of the sluice gate in Kadakkachan area had moderate settlement of mussels. The maximum depth near the sluice gate was 1.5 m. The average number of mussels per m^2 was 48 and the size ranged between 79 mm and 109 mm with a mean weight of 78.6 g. The estimated biomass was 754.6 kg.

Minnie Bay

The bay is 0.8 km^2 roughly, deeply curved and surrounded by isolated patches of mangroves on all three sides. The eastern entrance and the western side harboured coral stones and shallow areas got exposed during low tide. The water was turbid. The maximum depth of water in the bay was 4 m. The NIOT has constructed overhead pipeline on concrete pillars to pump seawater to their shrimp farms. The submerged part of pillars were square in shape of 45 cm thickness. The pillars were lying between 2-4 m depth. All the 50 pillars were deposited with mussels. The mussels in Minnie Bay were larger in size and the age group may be 2 to 4 years. Their distribution was scattered with a minimum density of 10 and a maximum of 26 per m^2 with an average of 17.8 mussels on these pillars. The size ranged between 99 and 201 mm with a mean size and weight of 149.1 mm and 272.9 g respectively. The total biomass estimated was at 3.886.1 kg in 80 m^2 area. Females were dominant in the population (46:54).

Rangat

Mussels were found attached to submerged rocks in a small creek confluent with the sea. The bottom was slushy with rocks. The depth of water in the mussel bed was about one meter and it got exposed during the receding tide. The mussels were in dense patches at three places and in small patches on several rocks submerged in the creek. The mussel bed area was estimated as 300 m^2. The average number was 73 per m^2 with a mean size of 78.2 mm and weight of 47.8 g. A total biomass of 1046.8 kg was estimated in Rangat area. The percentage edibility was 25.2 %. Females were dominant in the population (40:60).

Fishery

The present survey has brought to light the occurrence of mussels in nine stations. The mussels and other bivalves are fished by the local people for consumption. But, there is no organized fishery for mussels anywhere in Andaman. Fishing for mussels is undertaken in Kalapathar area and Sipphighat. Now, the above area has less density of mussels to conduct a fishery. However, there is a good demand for mussels in hotels. Local people especially bengalis and biharis around Sippighat area also collect mussels and edible oysters regularly for their consumption. Mussels were picked up in Sippighat creek, Mithagari and Hathitope by local fisherman and sold for Rs. 80/- per kg meat.

Mussel culture feasibility in Andaman

The present short-term survey has shown that the mussel population in Andaman islands has got restricted distribution on rocks, bridges, sluice gates and boat jetties in all the places studied. Large scale culture of green mussel in and around Andaman is subjected to the availability of the seed. The occurrence of seed is limited and restricted to Sippighat, Mithagari, Hathitope and Minnie Bay areas.

It is interesting to note that, during the period of survey, the mussels of uniform size occurred in Sippighat and Bimbleton creeks which might have settled in the previous season of spawning. The above two potential areas may be regularly monitored to record the mass settlement of seeds at appropriate time. The freshly settled seeds from these localities could meet the seed requirements for future culture. The calm and deeper areas available in Sippighat, Bimbleton, Mithagari, Hathitope, North Bay and Minnie Bay are found suitable for undertaking large scale mussel culture.

Visual quality testing method used in the field for grading yellowfin tuna

Prathibha Rohit and K. Rammohan
Visakhapatnam Regional Centre of CMFRI, Visakhapatnam

The yellowfin tuna (*Thunnus albacares*) popularly known as the 'chicken of the sea' is harvested along the Indian coast mainly with an eye on the export market. Though the fish meat both in fresh and canned form has a demand in domestic markets in some states, the higher value it fetches in the export market prompts the fishermen to mainly aim at exports. However, certain minimal conditions of fish quality have to be ascertained and certified before it is accepted for export. The south-east Asian countries are the main market for tunas and tuna meat is consumed both in raw as well as processed forms (canned, fish fingers, fish powder, fish sauce *etc*.)

Visakhapatnam in Andhra Pradesh is an important tuna landing centre along the east coast of India. A number of small indigenous units operating the hooks and line, especially from Lawsons Bay, Pudimadaka and Mukkam villages, fish exclusively for large sized yellowfin tuna. On an average, each unit gets three to four yellowfin tunas per trip. The fishermen who are actually engaged in the fishing activity generally do not follow any quality control measures and get the tunas to the shore as such. The local fish merchants buy the fish from the fishermen and supply the same to the processors. It is the processors who arrange for some kind of quality testing and take up immediate steps to prevent further deterioration of the tunas brought ashore.

All the tunas brought ashore are not taken up by the processor as all of them will not meet the basic standards fixed by them. The selection of fish for procurement by the processor is done by a simple visual quality testing method. The processors cum exporters here, have engaged personnel, specialized in visually testing the quality of the yellowfin tuna meat and grade them accordingly. The instrument used by these quality testers consist of a simple steel corer with a piston attached to it (Fig. 1). It is also known as 'meat browser' locally. The corer has a length of 50 cm and an inner core diameter of 2.5 mm. Fishes are graded purely on

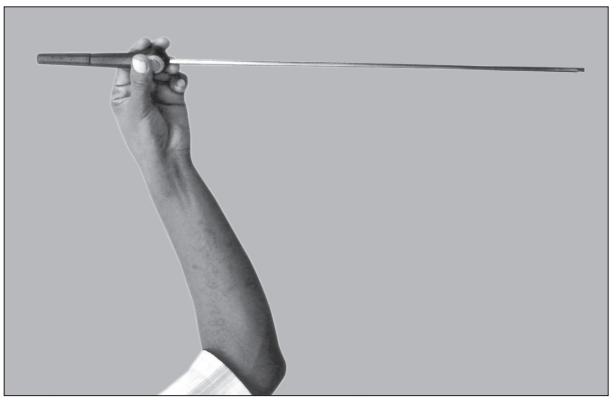

Fig. 1. Steel corer used for testing the quality of yellowfin tuna meat

the visual appearance of the meat drawn up by the corer. The corer is plunged rapidly into the body of the yellowfin tuna at the base of the first dorsal fin (Fig. 2) and a meat strip of about 15 cm long is drawn. The quality tester then places the meat strip on his palm (Fig. 3) and based on the overall visual appearance like colour, firmness and smoothness of the meat strip, grades the fish as 'a', 'b' and 'c'.

Fig. 2. Corer being plunged at the base of the first dorsal fin of yellowfin tuna

Fig. 3. Thin stip of yellow fin tuna meat drawn by the corer

Tuna meat graded as 'a' are supposed to be of the most superior quality and the meat can be used for 'sashimi'. The meat strip here is smooth, firm, unbroken and has fresh pale pinkish white colour. Tuna meat graded as 'b' and 'c' too are of good quality but does not meet the standards for consumption as 'sashimi'. The sampled meat strips here too are unbroken but has a little bit of discoloration tinged with blood at times. The colour too is a darker pink shade compared to grade 'a'. If the sampled meat is broken, not firm and bloody, the fish is rejected by the quality tester.

Fishing for yellowfin tuna at Visakhapatnam is mainly carried out by the indigenous sector. The traditional non-mechanized catamarans with huge sails mounted on them go fishing beyond the territorial waters to fish for these oceanic tunas. The tunas caught mainly by hooks and lines are just kept on the available small deck space till they return back to the landing centre in the evening. The fish is neither bled nor iced till they are brought back to the shore. At the landing centre, the buyers take charge of the fish and they supply it to the processors. The processors are interested only in the export quality fishes and employ quality testers to certify the quality of the tuna meat to assure that the fish purchased by them is of high grade. As very little quality control measures are taken up by the local fishermen, less than 0.5% of the tunas landed are given 'a' grade and 20-40% graded 'b' and 'c'. The rest of the catch is not taken by the processors. The fishes meant for export are immediately gutted, chilled and sent under chilled condition to Chennai from where they are sent to the identified country. The fishes for domestic markets are iced whole and transported by road to their respective destinations. The 'a' grade tuna are mostly exported to Japan and other south-east Asian countries. The 'b' and 'c' grades are mostly sent to the United States of America, Spain, Italy and Gulf countries. Tunas which have failed the quality test for export are used within the country. They are sent to domestic fresh fish market or processed for canning and pickling.

A few mechanized longliners have been introduced at Visakhapatnam to harvest the stock of yellowfin tunas occurring in this region. These units are well equipped and 100% of the catch is exported. The tunas are bled as soon as they are hauled onboard and chilled as per the standards laid down for export. The quality tester does not play an important role here, though random checks are performed to assure that a minimum export standard is maintained. Very few such mechanized longliner units are presently operating off Visakhapatnam and it is still the prerogative of the non-mechanized units to harvest the stock of yellowfin tunas of this region. The role of the quality tester as of now thus is very crucial in certifying and grading the tunas for export. Tunas graded for export fetch three to four times more rate than fixed for the domestic market. The fishermen should be trained in the basics of bleeding the fish soon after capture and advised to adopt some techniques to preserve the quality of the fish. This will greatly benefit the fishermen who really take great risks to travel far off into the deep sea in their small sparsely equipped crafts to catch these high value fish.

Flourishing trade of air bladders at Okha, Gujarat

Shubhadeep Ghosh, G. Mohanraj, P. K. Asokan, H. K. Dhokia, M. S. Zala and H. M. Bhint
Veraval Regional Centre of CMFRI, Veraval

The swim bladders of eels (*Muraenesox talabonoides* Bleeker), ghol (*Protonibea diacanthus* Lacepede) and koth (*Otolithoides biauritus* Cantor) are of best quality and fetch very high market price owing to the huge export demand. Fish air bladder is mainly used for making isinglass. Considerable quantity of eel, ghol and koth are landed at Okha by trawlers operating on the rocky bottom (18 m depth) off Jakhau. Around 500 trawlers having an overall length of 40 to 45 ft, powered with 80 - 105 HP engines are actively engaged in the fishing of eel, ghol and koth. The fishing trip lasts for 7 - 10 days with 4 - 6 hauls of 3 h duration per day depending on whether they fish during only day or both day and night. The trawlers carry on an average 10 to 12 nets having length of 35 - 40 m with cod end mesh size varying between 8 and 15 mm.

The merchants trading on air bladder of eel purchase the fish from boat owners at Rs. 30-35/kg. The wet weight of air bladder extracted per kg of eel range from 30 - 50 g. Generally from eels weighing around 3-6 kg, 100 - 200 g (wet weight) of bladders measuring 385 - 565 mm are extracted (Fig. 1). The bladder after extraction from the fish is immersed overnight in a chemical solution to improve its colour and texture. The bladder is then inflated by blowing air into it and sun dried on nets in raised bamboo platforms after which it is packed and exported. The swollen air bladder fetches higher price than the flat air bladder. The price of air bladders varies between Rs. 4,000 and 7,000 / kg depending on the weight of the bladder.

Ghol weighing 10 - 15 kg and 15- 25 kg yield 350-450 g and 500-700 g wet weight of bladder respectively. The length, breadth and weight of dried air bladders obtained from males ranged between 132 - 180 mm, 120 - 170 mm and 100 - 290 g

Fig. 1. Air bladders extracted from eel

respectively. For females, the length, breadth and weight of the dried air bladder varied from 155 to 190 mm, 145 to 190 mm and 180 to 400 g respectively. For koth, 400 - 600 g wet weight of bladder was extracted from fishes weighing 12 - 15 kg and 300 - 500 g wet weight of bladder was extracted from fishes weighing 7 - 12 kg. The length, breadth and weight of dried air bladders obtained from adult koth (12 - 15 kg) ranged between 293 - 340 mm, 180 - 192 mm and 400 - 460 g respectively. The air bladders extracted from juveniles of koth are however much smaller and had lengths ranging from 98 mm to 132 mm weighing around 2 g each. The air bladders after extraction from ghol and koth (Fig. 2) are trimmed and immersed overnight in the chemical solution before sun drying and packing. An interesting feature is that air bladder from male ghol fetches double the price than that of female. The price of fresh and dried bladders from koth is given in Table 1. The price of fresh and dried bladders extracted from male and females of ghol is presented in Table 2. The air bladder of eel is exported *via* Mumbai to Singapore while that of ghol and koth is exported to Hong Kong.

Fig. 2. Air bladders extracted from ghol and koth

Table 1. Price of fresh and dried air bladders extracted from koth

	Weight of bladder (g)	Price of bladder (Rs./kg)
Fresh air bladder	2200	>350
	1800	250 - 300
Dried air bladder	>200	4,500
	150-200	4,000
	100-150	3,500
	50-100	3,000

Table 2. Price of fresh and dried air bladders extracted from males and females of ghol

		Weight of bladder (g)	Price of bladder (Rs./kg)
Male	Fresh air bladder	>400	15,000
		300-400	12,000
		250-300	9,000
		200-250	6,000
		150-200	4,000
	Dried air bladder	160-200	40,000
		140-160	30,000
		120-140	25,000
		100-120	22,000
		80-100	14,000
		50-80	12,000
Female	Fresh air bladder	>500	8,500
		400-500	6,500
		300-400	5,000
		200-300	2,500
	Dried air bladder	200-250	18,500
		160-200	14,000
		130-160	11,000
		100-130	10,000
		80-100	7,000
		50-80	6,000

Trade and utilization pattern of marine fishes in Chennai Fisheries Harbour

P. S. Swathi Lekshmi and P. Thirumilu*
Mangalore Research Centre of CMFRI, Mangalore,
**Madras Research Centre of CMFRI, Chennai*

Overseas trade opened up commercial interests to the otherwise traditional type of fishery activities, whereby corporate sectors are being steadily enticed to develop modern industrial fisheries. Increasingly more varieties of fish in large quantities are in demand, to which the industry has shown positive response with organized efforts. As a result, a transformed scenario is evident all over, more obviously in urban centers, as witnessed in Chennai, a major fishing centre active with traditional as well as modern fishery, including boat building yard, fish meal plant, fish processing and export establishments.

Chennai metropolis with a population of about 4.5 million people, has a coast line stretching over a distance of 12 km, dotted with nine hamlets. The area of fishing operation from the base here, extends on the north- south axis over a coastal length of 75 km, which could even exceed further distance, especially, deep into Andhra Pradesh coast in the north on several occasions. Fishermen numbering over 7,000 in the city including all the hamlets carry out the fishing operation with about 2,250 catamarans, 700 canoes and 550 mechanized trawlers which would substantially increase in number with the addition of outstation trawlers visiting Chennai waters during peak fishing seasons. The fishery here, reaches peak during December - February and June - September with lean seasons being April, May and October-November.

The country crafts operating from the hamlets, land and sell the catch at the respective localities, while all mechanized trawlers converge to land and market the catch at Royapuram (Kasimedu) Fishery Harbour, which has the holding capacity of 550 trawlers, including 50 large trawlers. The annual landings at the city centres reach up to 35,000 t, including commercially important groups like seerfish, pomfrets, tuna, sharks, rays, cat fish, perches, threadfin breams, sciaenids, mackerels, sardines, penaeid prawns, portunid crabs and cephalopods. In addition, trawlers land huge amount of small fishes and invertebrates. Quality items are separated from trash onboard and brought invariably in bamboo baskets ready for the spot sale on landing. Detailed list on important fishery items present in the catch and the system of utilization and marketing at the Chennai fisheries harbour are presented in Table1.

Table 1. Utilization pattern of marine fishes in Chennai Fisheries Harbour

Groups	Form of utilization			Export		
	Fresh (%)	Dry (%)	Dry fish meal (%)	Fresh (%)	Dry (%)	Total
Elasmobranchs						
Sharks	50	35	2	5	8	100
Rays	70	5	25	0	0	100
Skates	3	80	17	0	0	100
Bony fishes						
Sardines and Shads	70	25	5	0	0	100
Anchovies	30	55	5	0	10	100
Wolf herrings	70	25	5	0	0	100
Lizard fishes	80	18	2	0	0	100
Cat fishes	85	15	0	0	0	100
Eels	90	10	0	0	0	100
Flying fishes	15	80	5	0	0	100
Full beaks (*Belone* sp.)	80	20	0	0	0	100
Half beaks (*Hemirhamphus* sp.)	85	15	0	0	0	100
Sea horses and Pipe fishes (*Hippocampus* sp. and *Syngnathus* sp.)	0	0	10	40	50	100
Soldlerfish and Squirrel fish (*Myripristis* sp. and *Sargocentron* sp.)	20	0	70	0	10	100
Barracudas (*Sphyraena* sp.)	75	25	0	0	0	100
Mullets	95	5	0	0	0	100
Threadfins (*Polynemus* sp.)	95	5	0	0	0	100
Sea perches (*Lates* sp. and *Ambassis* sp.)	90	10	0	0	0	100
Groupers (*Epinephelus* sp.)	80	20	0	0	0	100
Tiger perches (*Therapon* sp.)	95	5	0	0	0	100
Bull eyes (*Priacanthus* sp.)	2	0	98	0	0	100
Cardinal fishes (*Apogon* sp. and *Archamia* sp.)	80	20	0	0	0	100
Whitings (*Sillago* sp.)	90	10	0	0	0	100
White fishes (*Lactarius* sp.)	75	25	0	0	0	100
Cobia (*Rachycentron* sp.)	80	20	0	0	0	100
Carangids (*Caranx* sp., *Decapterus* sp., *Megalaspis* sp., *Scomberoides* sp.)	70	20	0	10	0	100
Black pomfrets (*Parastromateus* sp.)	70	20	0	10	0	100
Moon fish (*Mene* sp.)	0	2	98	0	0	100
Dolphin fishes (*Coryphaena* sp.)	30	70	0	0	0	100
Red baits (*Dipterygonotus* sp.)	20	80	0	0	0	100
Snappers (*Lutjanus* sp.)	65	35	0	0	0	100

Threadfin breams (*Nemipterus* sp.)	95	5	0	0	0	100
Silverbellies (*Gazza* sp., *Leiognathus* sp. and *Secutor* sp.)	20	70	10	0	0	100
Mojarrus (*Gerres* sp.)	80	20	0	0	0	100
Grunters (*Pomadasys* sp.)	95	5	0	0	0	100
Croakers (*Johnieops* sp., *Johnius* sp., *Kathala* sp., *Protonibea* sp. and *Otolithus* sp.)	90	10	0	0	0	100
Pig face breams (*Lethrinus* sp.)	80	20	0	0	0	100
Goat fishes (*Parupeneus* sp., *Upeneus* sp.)	75	25	0	0	0	100
Moony (*Monodactylus* sp.)	5	15	80	0	0	100
Spade fishes (*Ephippus* sp.)	0	10	90	0	0	100
Sickle fishes (*Drepane* sp.)	10	80	10	0	0	100
Butter fishes (*Scatophagus* sp.)	75	20	5	0	0	100
Coral fishes (*Chaetodon* sp.)	80	20	0	0	0	100
Rabbit fishes (*Siganus* sp.)	75	20	5	0	0	100
Ribbon fishes (*Eupleurogrammus* sp., *Lepturancathus* sp. and *Trichiurus* sp.)	20	80	0	0	0	100
Tunas (*Thunnus* sp., *Euthynnus* sp. and *Katsuwonus* sp.)	75	25	0	0	0	100
Mackerel (*Rastrelliger* sp.)	80	15	5	0	0	100
Seerfish (*Acanthocybium* sp. and *Scomberomorus* sp.)	80	20	0	0	0	100
Sail fishes (*Istiophorus* sp., *Makaira* sp.)	10	80	10	0	0	100
Sword fishes (*Xiphias* sp.)	5	60	35	0	0	100
Pomfrets (*Pampus* sp.)	90	10	0	0	0	100
Drift fishes (*Ariomma* sp.)	40	60	0	0	0	100
Scorpion fishes (*Pterois* sp.)	15	80	5	0	0	100
Flat heads (*Platycephalus* sp.)	40	60	0	0	0	100
Indian halibut (*Psettodes* sp.)	80	15	5	0	0	100
Flounders (*Pseudorhombus* sp.)	20	75	5	0	0	100
Tongue soles (*Cynoglossus* sp.)	60	30	10	0	0	100
Sucker fishes (*Echeneis* sp.)	2	10	88	0	0	100
Tripod fishes (*Pseudotriacanthus* sp.)	5	5	90	0	0	100
Trigger fishes (*Canthidermis* sp., *Odonus* sp. and *Sufflamen* sp.)	0	5	95	0	0	100
Box fishes (*Lactoria* sp., *Tetrosomus* sp.)	0	5	95	0	0	100
Puffer fishes (*Arothron* sp.)	1	9	90	0	0	100
Porcupine fishes (*Diodon* sp.)	0	20	80	0	0	100
Sun fishes (*Mola* sp.)	0	15	85	0	0	100
Shrimps						
a) Penaeid shrimps						
Shrimps (big size) - *Fenneropenaeus* sp. and *Metapenaeus* spp.	10	0	0	90	0	100
Shrimps (small size) - *Metapenaeus* spp., *Parapenaeopsis* spp., *Metapenaeopsis* spp., *Trachypenaeopsis* spp., *Solenocera* spp.	90	0	0	10	0	100
b) Non-peneaid shrimps						
Acetes spp.	60	20	0	20	0	100
Macrobranchium spp.	80	10	0	10	0	100
c) Other Shrimps	60	20	20	0	0	100
Lobsters						
Spiny lobsters (*Panulirus* sp.)	15	0	0	85	0	100
Sand lobsters (*Thenus* sp.)	10	0	0	90	0	100
Crabs						
a) Portunid crabs						
Charybdis spp.	95	0	5	0	0	100

Portunus spp.	80	0	0	20	0	100
Podophthalmus vigil	95	0	5	0	0	100
Thalamitta spp.	60	0	40	0	0	100
Scylla spp.	50	0	0	50	0	100
b) Other crabs	15	20	65	0	0	100
Stomatopods						
Oratosqilla spp.	2	0	98	0	0	100
Harpiosquilla spp.	2	0	98	0	0	100
Molluscs						
a) Gastropods (*Murex* sp., *Conus* sp., *Trochus* sp., *Strombus* sp.)	0	0	0	0	100	100
b) Bivalves						
Cockles (*Anadara* sp.)	85	5	10	0	0	100
Mussels	20	0	5	0	75	100
Oysters (*Meretrix* sp., *Solen* sp., *Pinna* sp.)	25	30	35	0	10	100
Others	0	0	0	0	100	100
c) Cephalapods						
Sepia sp.	40	5	0	50	5	100
Loligo sp.	60	5	0	35	0	100
Octopus sp.	0	0	100	0	0	100
Echinoderms						
Sea urchin (*Salmacis* sp., *Fibularia* sp.)	0	0	100	0	0	100
Sea stars (*Astropecten* sp.)	0	0	100	0	0	100
Sea lilies (*Tropiometra* sp., *Lamprometra* sp.)	0	0	100	0	0	100

The catch is marketed either in fresh or dry form for domestic consumption as well as export and also sold for fish meal production. Marketing of catches actually commences at the landing sites and the method of disposal varies with different components. Exportable items like larger prawns are directly procured from trawlers by agents of export houses at fixed rate, invariably with lumpsum advance payments prior to each fishing season. In the case of items like small prawns, fishes and other invertebrates, they are auctioned in divided quantities affordable by retailer and the price offered depends upon the demand and supply position of the day.

There exists an established marketing network across the sprawling city and peripheral area. Spread over the city, there are 41 organized fish markets, with facilities like over-head roofs, platform, drainages, electricity and drinking water. Among the markets, five are large whole sale trade centres and the rest are retail markets. In the wholesale market, at Chintadripet, catches are largely auctioned while catches brought from neighboring outstation centres are disposed of at other main centres, important ones being at Saidapet and Triplicane.

Of the estimated marine landings of 35000 t at the city centres, 80% and 16% are consumed in fresh and dry conditions respectively. Household consumptions account for 65 %. Hostels, restaurants and institutions together share 35 % among domestic demands. Most of the consumers of fish in fresh condition are within 20 km radius from the landing centre and only about 5% consumers are beyond 40 km distance. About 85 % of fishes purchased in fresh conditions are consumed on the same day, 14 % on the next day and only 0.5% are taken to the city. Over 15,000 t arrive from outstations, mainly from Tuticorin and Rameshwaram within Tamilnadu as well as from Kerala, Karnataka and Andhra Pradhesh. Of the dry fish stocks, about 9000 t are sold to distant towns like Villupuram, Trichy, Madurai, Salem, Vellore, Coimbatore and Erode. Dominant among dried items are sardines, ribbon fish, flying fish, silver bellies, tuna and *Acetes*. Fish meal manufacturers utilize 14 % of the catch, which include cheaper quality fishes and invertebrates. These items are sold in fresh condition or dry form to merchants for fish meal plants located nearby or periodically to wholesale merchants. Exports accounts for about 4 % of the catches. Popular export items fetching very high prices in overseas markets include penaeid prawns, lobsters and tuna.

Utilization of head and vertebrae of *Otolithoides biauritus* - a new economic resource

K. B. Waghmare, Sujit Sundaram and B. B. Chavan
Mumbai Research Centre of CMFRI, Mumbai

Otolithoides biauritus, locally called as koth is an important resource in Maharashtra. Exploited by multi-day trawlers, the resource is abundant throughout the year with peak landings during the period of October-December, at New Ferry Wharf landing centre. These trawlers are operated at a depth of 40-60 m, 80-90 km off north-west coast. The total length of the fish in trawl landings usually ranges between 90-150 cm.

Koth has emerged as a resource of high commercial value because of diversification in utilization of its body parts. Apart from air bladders, which are utilized for preparing isinglass in the beverage industry, skin of koth is used as an alternative source of leather. The flesh is cut into pieces at the landing centre itself and sold at the local market. The mature ovary of koth weighing more than 680 g fetches about Rs. 80-100 per piece. Besides, the discard of koth is also converted into fish meal.

Nowadays, head and vertebrae of koth (Fig. 1 and 2) are also being used as an alternative economic resource. The fish is cut laterally, parallel to the vertebral column to separate the flesh. The head is considered a delicacy and the vertebrae are used for the preparation of soups and they are sold at lucrative prices in the local market (Table 1).

Besides local consumption, these are also purchased by merchants in bulk and transported in trucks (Fig. 3) to Jaffrabad in Gujarat and Andhra Pradesh for processing. A small portion is also carried to Sewri in Mumbai, where they are mainly used to prepare poultry feed, mixing it up with soya bean and corn. The dried vertebrae are also exported. The annual landing of koth at New Ferry Wharf in the year 2007 was 1,911 t and the raw head and vertebrae fetched around Rs. 25-30 lakhs. These are further salted and sun-dried, after which they are further processed and made into a fine powder. This

Fig. 1. Head of *Otolithoides biauritus*

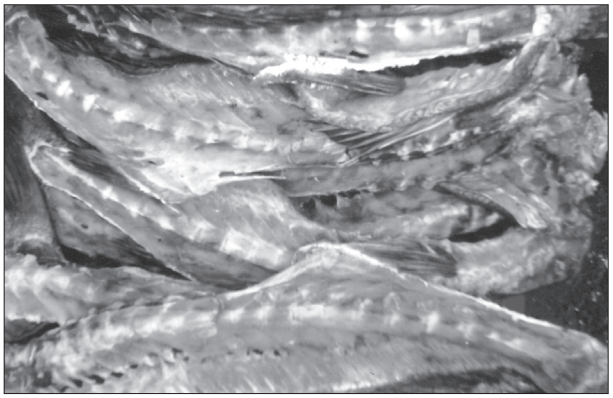

Fig. 2. Vertebrae of *Otolithoides biauritus*

Table 1. Price structure of head and bones of *Otolithoides biauritus*

Length range of fish (cm)	Weight range of fish (kg)	Weight range of head (kg)	Price range of head (Rs./piece)	Length range of vertebrae (cm)	Weight range of vertebrae (kg)	Price range of vertebrae (Rs./piece)
75-95	2.54 - 4.75	0.2 - 0.5	10 - 15	68 - 86	0.4 - 1.0	15 - 20
95-115	4.75 - 6.19	0.5 - 1.5	15 - 25	86 - 110	1.0 - 2.0	20 - 45
115-140	6.19 - 13.55	1.5 - 2.25	25 - 50	110 - 135	2.0 - 3.5	45 - 90

Fig. 3. Head and vertebrae of *Otolithoides biauritus* transported by trucks

powder, selling at Rs. 60/kg, is a rich source of calcium and protein and is used as manure especially in plantain farms. According to the information gathered, the use of this manure in plantain farms increased the yield of the crop. It is also used in the poultry industry as chicken feed.

The landings of koth at New Ferry Wharf gradually decreased over the years from 3,245 t in 2003 to 1,911 t in 2006 contributing 5.3% and 4.8% respectively to the total fish catch (Fig. 4). The pooled data for the period 2003-2007 indicated that October-November is the period of abundance for this species (Fig. 5). It is during this period, the head and vertebrae are mainly transported to Gujarat.

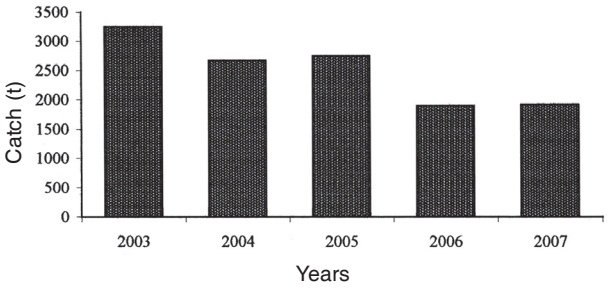

Fig. 4. Landings of *Otolithoides biauritus* at New Ferry Wharf

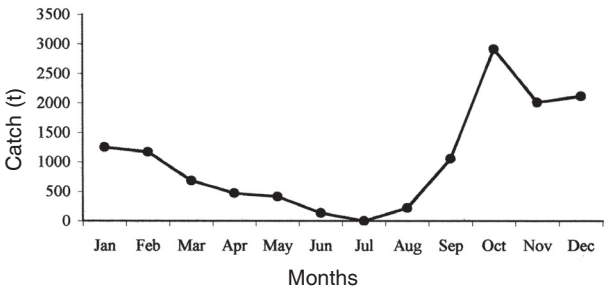

Fig. 5. Seasonal abundance of *Otolithoides biauritus* (2003-2007)

Lagocephalus inermis catch at Kollam - a new source of income to fishermen

K. Sasidharan Pillai
Central Marine Fisheries Research Institute, Kochi

The pufferfish, *Lagocephalus inermis*, which was considered as a menace by the fishermen has now become a source of income for them. The fish cut through the gears during hauling and consume the catch, especially cephalopods. However, of late this fish is found edible by certain people and hence it is caught and brought by the trawlers operating off Neendakara and Sakthikulangara.

The fish is generally caught at a depth range of 40 - 110 m by the trawlers. Earlier the catch used to be discarded but after realizing the demand, at present is brought to the harbour for auction and fetches about Rs. 5 to 8 per kg. During May 2008, multi-day trawlers brought about 20 -50 kg/unit and single day trawlers brought around 15 -20 kg/unit.

The fish is marketed in two ways: i) marketed fresh after beheading, peeling off the skin and removing the visceral parts or (ii) marketed after salt curing, in the internal markets. The approximate price per kg in market is Rs.35-45/-. The size of *L. inermis* in demand varies from 20 to 40 cm.

Fishes of smaller size still continue to be a menace for the fishermen operating gears such as gill nets, ring seines *etc*.

Occurrence of the deep sea crab, *Thalamita crenata* in shallow water gillnet (mural valai) operation at Tharuvaikulam, north of Tuticorin

M. Manickaraja and T. Balasubramanian
Tuticorin Research Centre of CMFRI, Tuticorin

The deep sea crab, *Thalamita crenata* mostly inhabit only deeper waters (>100 m) and occur in deep sea gillnet operations along with fishes like hemiramphids, belonids and *Exocetus* spp. as stray catches. It never formed a fishery and did not gain any economical importance.

However, occurrence of, *T. crenata* was noticed at 20 m depth in mural valai, a type of drift gill net having mesh size of 50 mm at a catch rate of 75 to 100 kg per unit at Tharuvaikulam, north of Tuticorin. Generally, the fishermen leave during night between 20 00 and 24 00 hrs and return to the shore around 12 00 hrs, the following day. At Tharuvaikulam, around 40 - 60 units of mural valai, are being operated every day except on Sundays with a manpower of 4 - 5 per unit. During January - July, they undertake this type of operation up to a depth of 200 m and bring good amount of hemiraphids, belonids, *Exocetus* spp. barracuda, scomberoids, chirocentrids, small sized groupers, lethrinids, lutjanids and *Coryphaena* spp. However, in the month of August 2003, the weather being unfavourable, the fishermen did not venture into the deeper waters; instead they restricted operations within 20 m depth. To their surprise, *T. crenata* alone were caught in huge quantity. The size of these crabs ranged from 50 - 52 mm for males and 45 - 47 mm for females weighing 10 - 20 g per crab.

Despite having no commercial value, they do cause lot of damage to the fishing gear by way of cutting the net using their chelae, which renders financial loss to fishermen. Once the gear is noticed during the course of fishing operation with the said crab in huge quantity, immediately the gear will be hauled up and with the help of wooden sticks these crabs will be broken into pieces and removed. Otherwise the entire gear will be dashed up, against the sides of the boat systematically so as to break the crab shell in order to overcome the damage which can be caused by these crabs to the gear.

On some occasions, even the fishing is likely to be suspended for few days for the fear of damage to the gear by these crabs. Exact reason for their migration from deeper waters to inshore waters is not known. The migration might have taken place due to the sudden changes in the environment or they may be searching better feeding ground which is yet to be confirmed.

Unusual occurrence of *Pempheris moluca* (moluccan sweeper) at Azhikode, Kerala

K. G. Baby
Central Marine Fisheries Research Institute, Kochi

On 05.07.2008, five units of double nets (mini trawl) landed at Azhikode landing centre in Thrissur district, Kerala during 0600 - 1200 hrs. Two units landed *Pempheris moluca*, a rare variety available in the Kerala waters, along with prawns, croakers, silverbellies and anchovies. Out of 620 kg landed, 41 kg were *P. moluca* in the above two units. This came around 7% of the total landings of the two units.

Fig. 1. *Pempheris moluca*

These units were operated at a depth of 5 m. Average length of fishes was 10 cm and average weight was 20 g. Landing centre price of the species was Rs.15/- per kg.

Pempheris moluca comes under the family *Pempheridae* (sweepers). It generally lives among the coral reefs in rocky areas and feeds mainly on crustaceans.

A report on the olive ridely turtle eggs found at Janjira Murud region of Raigad, Maharashtra

Ramesh B. Rao
Alibag Field Centre of CMFRI, Alibag

The olive ridley (*Lepidochelys olivacea*) is one of the smallest species of sea turtles. They have a high domed shell, with carapace having a dark olive green colour with yellowish underside. The carapace margins are smooth and is made up of five pairs of costal scutes, with occurrence of up to 6-9 divisions per side. The head is large.

The ridley turtles have a peculiar habit of mass arrival to the shore known as "arribada" (arrival). They make four to seven nests having a large number of eggs per nesting season. A recent case of poaching on turtle eggs was noticed in Janjira Murud region of Raigad district of Maharashtra, where one out of three number of nests each bearing about 100 -115 eggs, was destroyed overnight (Fig. 1). Conservation efforts by the local NGOs of Janjira Murud and Chiplun region of Ratnagiri District, helped to protect the remaining nests by erecting wooden fence and mounting nylon nets on them. These NGOs are also taking care of other endangered reptiles and marine mammals like dolphins and whales in that area. The plight of the olive ridley and other sea turtles has been recognized around the world, and many organizations and governments are working to preserve these ancient creatures.

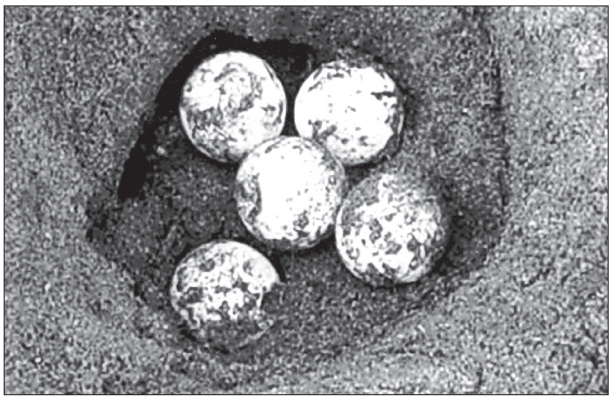

Fig. 1. Eggs of the Olive ridley turtle, *Lepidochelys olivacea* at Janjira Murud, Maharashtra

Unusal landings of *Xancus pyrum* in trawlers at Sakthikulangara, Kollam

K. Sasidharan Pillai
Central Marine Fisheries Research Institute, Kochi

A unique catch of *Xanus pyrum* was observed on 13.06.2008 at Sakthikulangara during morning landings. The catch of *X. pyrum* was exceptionally high ranging from 15 to 150 kg per unit. The trawlers (multi-day) targeted for cephalopods had a surprise catch of *X. pyrum* at a depth range of 60-240 m. The catch was auctioned and the lowest price obtained was Rs. 7,000/unit and the highest was Rs. 17,000/unit. The catch range of multi-day trawlers were 70-140 kg/unit and that of single day trawlers were 15-150 kg/unit.

Baleen whale washed ashore at Dona Paula, Goa

Shetty Prakashan, C. K. Dinesh, V. S. Kakati and Miriam Paul Sreeram
Karwar Research Centre of CMFRI, Karwar

A baleen whale measuring 12.12 m was found washed ashore on Dona Paula Beach, Goa on 18th June 2008 in a highly putrefied condition. The carcass was towed to deeper waters and disposed off by the Panjim Corporation as the foul smell was a deterrent to tourism at this popular beach.

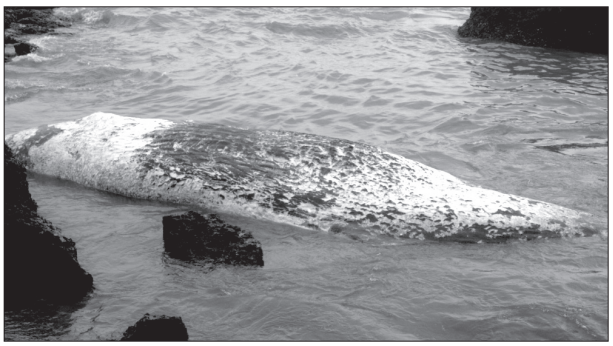

Fig. 1. Baleen Whale washed ashore at Dona Paula, Goa

Stranding of a baleen whale (*Balaenoptera* sp.) at Thalikulam Landing Centre, Thrissur District, Kerala

K. G. Baby
Central Marine Fisheries Research Institute, Kochi

A baleen whale was found washed ashore at Thalikulam Landing Centre (Thrissur District, Kerala) on 23.04.2009. Total length was 14.5 m and weight was approximately 10 t. Since the whale was in highly putrified condition, other morphometric measurements could not be taken.

Total length (snout to caudal fluke)	-	14.5 m
Length of flipper	-	1.8 m
Caudal fluke	-	2.6 m

Carcass of stranded baleen whale at Thalikkulam Landing Centre