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Lanternfishes (Myctophids): by-catch of deepsea shrimp trawlers operated off Kollam, south-west coast of India

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Introduction

By-catch and discards have received a great deal of scientific attention, their minimisation being a goal of marine fisheries management (Powers, 2006). The Nordic workshop (Nordic Council of Ministers, 2003) defined by-catch as “the proportion of the catch which is taken on the board, or brought to the surface by the vessel and which is subsequently thrown back to sea, dead or dying or likely to die”. Most of the earlier studies dealt with optimisation of fishing efficiency and minimisation of fishing impact, but by-catch and discards data have rarely been used to learn about the distribution, abundance and biology of the incidental species being caught, although several recent studies have indicated the informative value of by-catch concerning food habits (Koen Alonso et al., 2001), feeding ecology (Rheeder and Sauer, 1998) and recruitment indices (Payne et al., 2005).

According to FAO discard database, during 1992 - 2001, yearly average discards were estimated as 7.3 million t of which Indian Ocean accounted for about 9%. Mesopelagic fishes are common by-catch in many of the world’s fisheries targeting deepsea shrimp species. Shrimp trawl fisheries generate a higher proportion of discards than any other fishery type (Alverson et al., 1994) and account for more than one third of the estimated total global discards from fisheries (Pascoe, 1997). In most cases, the weight of the by-catch exceeds that of the shrimp catch and is comprised of tens or hundreds of species of fish and invertebrates (Stobutzki et al., 2001; Steele et al., 2002). In the past, most of the mesopelagic fish catches were discarded without being properly recorded.

The mesopelagic zone has been defined in different ways based on depth, temperature and light regimes. Depth seems to be the best criterion and mesopelagic fish can be defined as fishes that live in the mesopelagic zone i.e., between 200 and 1000 m depth. Beebe (1935) was the first fishery biologist to observe myctophid fishes in the mesopelagic zone of the ocean. Many fish families fall within this definition, but generally the Myctophidae, Neoscopilidae and Gonostomatidae are dominant. Sternoptychidae, Bathylagidae, Chiasmodontidae, Trichiuridae, Nomeidae and others seem to be fairly important in some areas. In the present paper, the main emphasis has been given to the family Myctophidae.

Myctophids are the most species-rich family of mesopelagic communities in the world’s oceans (Gjøsaeter and Kawaguchi, 1980), with an estimated biomass of about 70–200 million t (Lubimova et al., 1987). Family Myctophidae comprises 32 genera with at least 240 species (Nelson, 2006), found in all oceans from near surface to deep waters. They are thought to migrate to the productive epipelagic zone, which contributes to their abundance in the open sea (Watanabe et al., 2002). About 55 species of myctophids are known from the Arabian Sea including its southern part of the Indian Ocean (Komilova and Tsarin, 1993; Tsarin, 1993), with an estimated biomass of 100 million t of Benthosema pterotum (US GLOBEC, 1993). Karuppasamy et al. (2006) reported 27 species of myctophids from Indian EEZ. Somvanshi et al. (2009) reported five species of myctophids from south-west coast of India. Gopakumar et al. (1983) studied the fatty acid composition of B. pterotum and Lekshmi Nair et al. (1983) carried out nutritional evaluation of the fish meal and fish hydrolysates of B. pterotum from Gulf of Oman and found them to be of good quality, which could be used as a protein supplement in animal feeds.

The present report describes the myctophid by-catch along with other mesopelagic fish catch by deepsea shrimp trawlers operating in the
Quilon bank (8° N -11° N and 74° E -76° E), Kerala coast. Regular observations were made in the two major fish landing centres, Saktikulangara, Kollam and Cochin Fisheries Harbour from December, 2008 to May, 2009 and subsamples of by-catch were collected to identify the myctophid species in the deepsea trawl fisheries. The trawlers operating from Neendakara and Cochin Fisheries Harbours have an OAL of 13-16 m with an engine power of 100 to 120 HP and fitted with echosounders, GPS etc. (Fig. 1). The shrimp trawls have mesh sizes ranging from 40 mm (in the front part) to 28 mm (in the codend). Based on the usual catches of bottom trawl operation, it was found that shrimps mostly inhabited the uneven bottom surface. The trawlers specifically targeted Aristeus alcockii, Heterocarpus woodmasoni, Heterocarpus gibbosus, Plesionika spinipes and Metapenaeopsis andamanensis. These trawlers stay back at sea for 9 to 15 days and operate at a depth range of 350 to 450 m. Trawling operations are mainly carried out during early morning as well as late evening and the catches were dominated by deepsea shrimps. The trawling operations extend from 4 to 6 h at a towing speed of 2 knots. Normally in each operation, by-catch contributes about 20 to 40% along with targeted species. Sometimes the by-catch exceeded more than 80% and was discarded without being taken onboard the vessel. So far there is no mechanism to make a reasonable estimate of these discards. Identification of fish species was carried out following Smith and Heemstra (1986) and Fischer and Bianchi (1984).

The major components in the by-catch belonged to the families Rhinorhinaeidae, Echinorhincidae, Centrophoridae, Squalidae, Stomiidae, Sternoptychidae, Gonostomatidae, Ateleopodidae, Chlorophthalmidae, Ipnopidae, Evermannellidae, Neoscoelidae and Myctophidae. The identified species are listed in the Table 1.

By-catch comprised considerable quantity of small shrimps and non-conventional deepsea fishes of marketable size (Fig. 2). After onboard sorting, they were brought to the landing centres and sold for nominal price, to be mainly used in fishmeal production (Fig. 3). Of late, due to heavy demand for fish and high cost, some of the species are being used for human consumption, fetching about Rs. 30-45/- per kg. All large sized chondrichthyanys belonging to families like Rhinorhinidae, Echinorhincidae, Centrophoridae and Squalidae are getting high values in the landing centres.

Among the lanternfishes, benthopelagic myctophids dominated followed by Neoscoelids. Diaphus was the most abundant genus followed by
<table>
<thead>
<tr>
<th>Family</th>
<th>Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rhinorhinaeidae</td>
<td><em>Neoharriotta pinnata</em> (Schnakenbeck, 1931)</td>
</tr>
<tr>
<td>Echinochirinaeidae</td>
<td><em>Echinorhinus brucus</em> (Bonnaterre, 1788)</td>
</tr>
<tr>
<td>Centrophoridae</td>
<td><em>Centrophorus</em> sp.</td>
</tr>
<tr>
<td>Squalidae</td>
<td><em>Squalus</em> spp.</td>
</tr>
<tr>
<td>Rajidae</td>
<td><em>Dipturus</em> sp.</td>
</tr>
<tr>
<td>Notacanthidae</td>
<td><em>Notacanthus</em> sp.</td>
</tr>
<tr>
<td>Congridae</td>
<td><em>Bathyuroconger vicinus</em> (Vaillant, 1888)</td>
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<tr>
<td>Nemichthyidae</td>
<td><em>Nemichthys scolopaceus</em> Richardson, 1848</td>
</tr>
<tr>
<td>Alepocephalidae</td>
<td><em>Alepocephalus</em> spp.</td>
</tr>
<tr>
<td>Stomiidae</td>
<td><em>Astronesthes indicus</em> Brauer, 1902</td>
</tr>
<tr>
<td>Sternoptychidae</td>
<td><em>Polyipnus indicus</em> Schultz, 1961</td>
</tr>
<tr>
<td>Phosichthyidae</td>
<td><em>Vinciguerria</em> sp.</td>
</tr>
<tr>
<td>Ateleopodidae</td>
<td><em>Ateleopus indicus</em> Alcock, 1891</td>
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<tr>
<td>Chlorophthalmidae</td>
<td><em>Chlorophthalmus bicornis</em> Norman, 1840</td>
</tr>
<tr>
<td>Ipnopidae</td>
<td><em>Bathypterois atricolor</em> Alcock, 1896</td>
</tr>
<tr>
<td>Evermannellidae</td>
<td><em>Evermannella indica</em> Brauer, 1906</td>
</tr>
<tr>
<td>Neosocpelidae</td>
<td><em>Neosocpelus microchir</em> (Matsubara, 1943)</td>
</tr>
<tr>
<td>Myctophidae</td>
<td><em>Myctophum obtusirostre</em> Tåning, 1928</td>
</tr>
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<td></td>
<td><em>Diaphus thiolieri</em> Fowler, 1934</td>
</tr>
<tr>
<td></td>
<td><em>Diaphus watasei</em> Jordan &amp; Starks, 1904</td>
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<tr>
<td>Macrouridae</td>
<td><em>Malacocephalus laevis</em> (Lowe, 1843)</td>
</tr>
<tr>
<td>Moridae</td>
<td><em>Physiculus roseus</em> Alcock, 1891</td>
</tr>
<tr>
<td>Ophidiidae</td>
<td><em>Dicrolene multifilis</em> (Alcock, 1889)</td>
</tr>
<tr>
<td></td>
<td><em>Glyptophidium argenteum</em> Alcock, 1889</td>
</tr>
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<td></td>
<td><em>Glyptophidium</em> sp.</td>
</tr>
<tr>
<td>Acropomatidae</td>
<td><em>Synagrops</em> spp.</td>
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<tr>
<td>Lophidae</td>
<td><em>Lophomus setigerus</em> (Vahl, 1797)</td>
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<tr>
<td>Trachichthyidae</td>
<td><em>Gephyroberyx darwinii</em> (Johnson, 1866)</td>
</tr>
<tr>
<td>Berycidae</td>
<td><em>Beryx splendens</em> Lowe, 1834</td>
</tr>
<tr>
<td>Zeidae</td>
<td><em>Zenopsis conchifer</em> (Lowe, 1852)</td>
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<tr>
<td>Setarchidae</td>
<td><em>Setarches guentheri</em> Johnson, 1862</td>
</tr>
<tr>
<td>Scorpaenidae</td>
<td><em>Pontinus nigerimum</em> Eschmeyer, 1983</td>
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<tr>
<td>Trigidae</td>
<td><em>Pterygotrigla hemisticta</em> (Temminck &amp; Schlegel, 1843)</td>
</tr>
<tr>
<td>Priacanthidae</td>
<td><em>Priacanthus hamrur</em> (Forsskål, 1775)</td>
</tr>
<tr>
<td></td>
<td><em>Heteropriacanthus</em> sp.</td>
</tr>
<tr>
<td>Centrophophidae</td>
<td><em>Psenopsis cyanea</em> (Alcock, 1890)</td>
</tr>
<tr>
<td>Trichiuridae</td>
<td><em>Trichiurus auriga</em> Klunzinger, 1884</td>
</tr>
<tr>
<td>Bathyclupeidae</td>
<td><em>Bathyclupea</em> sp.</td>
</tr>
<tr>
<td>Gempylidae</td>
<td><em>Neopinnula orientalis</em> (Gilchrist &amp; von Bonde, 1924)</td>
</tr>
<tr>
<td>Polymixidae</td>
<td><em>Polymixia japonica</em> Günther, 1877</td>
</tr>
<tr>
<td>Arionmatidae</td>
<td><em>Arionma indica</em> (Day, 1871)</td>
</tr>
<tr>
<td>Nomeidae</td>
<td><em>Cubiceps whiteleggi</em> (Waite, 1894)</td>
</tr>
<tr>
<td></td>
<td><em>Cubiceps</em> sp.</td>
</tr>
<tr>
<td>Percophidae</td>
<td><em>Bembrops caudimacula</em> Steinbachner, 1876</td>
</tr>
<tr>
<td>Peristediidae</td>
<td><em>Peristedion miniatum</em> Goode, 1880</td>
</tr>
<tr>
<td>Bothidae</td>
<td><em>Chascanopsetta lugubris</em> Alcock, 1894</td>
</tr>
<tr>
<td>Samaridae</td>
<td><em>Samaris cristatus</em> Gray, 1831</td>
</tr>
<tr>
<td>Cynoglossidae</td>
<td><em>Cynoglossus arel</em> (Bloch &amp; Schneider, 1801)</td>
</tr>
</tbody>
</table>
**Myctophum** in the family Myctophidae. Among the myctophids, *Diaphus watasei* was the most dominant species. *Diaphus garmani* was recorded for the first time from the Indian waters (Fig. 4). The identified species of the family Myctophidae includes *D. watasei, D. thiolierei, D. garmani, Myctophum obtusirostre* and *M. fissunovi*. Length frequency studies of *D. watasei* was carried out. A total of 90 samples of *D. watasei* were examined and the \( S_L \) ranged from 7 to 13 cm with a prominent mode at 10 cm. Gut content analysis of *D. watasei* \((n = 86)\) revealed that stomach of most of the fishes were empty.

In the present study, information on landings of myctophids as a major component in the by-catch of deepsea shrimp trawlers was confirmed. Most of the species obtained were bentopelagic and are available significantly during early morning and late evening which provide information on biology and species compositions. *D. watasei* was the most dominant species observed during the study. Based on the observations of the present study, it is suggested that bottom trawling survey along with midwater trawling should be carried out in order to estimate the actual biomass of myctophids in the Arabian Sea.

**Fig. 4. Diaphus garmani, 54 mm LS**

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**Preliminary studies on the growth in captivity of *Spirastrella inconstans* (Dendy) collected from the intertidal region of Palk Bay, south-east coast of India**

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Marine sponges are rich sources of bioactive metabolites that can be used as lead compounds to treat various diseases. Although concerted efforts resulted in the development of many new bioactive compounds from marine sponges, only very few compounds have reached the clinical trial stage. One of the reasons for this, as cited by many workers is that many of the sponge bioactive metabolites are highly toxic, thus leading to a low therapeutic index. However, the second major reason is the ‘supply problem’. Collection of large quantities of sponge biomass from the wild becomes a pre-requisite for obtaining sufficient amounts of metabolites from natural populations. Consequently, the natural populations may not be able to sustain such heavy exploitation.

Although chemical synthesis of the target compounds is a more direct method to overcome the issue of over-exploitation of wild population, many natural products are not amenable to chemical synthesis due to the complexity of their chemical structure. Therefore, the second option is to produce large quantities of the target species through suitable aquaculture techniques which would ensure a steady supply of material. This would also ensure the protection of depleting natural stocks.

In India, studies on sponge aquaculture is still at infancy. Preliminary studies on the growth of selected species would provide baseline information for future strategic research planning to develop innovative culture techniques for potential marine sponges.

In this backdrop, an attempt was made to understand the growth behaviour of one of the potential sponge species, *Spirastrella inconstans* which is found distributed in the Gulf of Mannar and Palk Bay,
south-east coast of India. Studies by earlier workers have proved that *S. inconstans* from Krusadi Island exhibited diuretic activity. They have also shown that *S. inconstans* var. *digitata* from Rameswaram exhibited antiviral activity against *Encephalomyocarditis* virus.

**Systematic position of the candidate species**

*Phylum*: Porifera  
*Class*: Demospongiae  
*Order*: Hadromerida  
*Family*: Spirastrellidae  
*Genus and Species*: *Spirastrella inconstans* (Dendy)

**Salient characteristic features of *Spirastrella inconstans* selected for study**

*Spirastrella inconstans* is found commonly distributed in the intertidal region of Palk Bay and Gulf of Mannar. The colonies of the same species look morphologically different. Some are massive, while others are digitate forms having finger-like projections. The basal portion is found partly buried in sand and during extreme low tides, the upper portion of the animal often lie exposed (Fig. 1). The colouration is pale yellow internally and brown externally, when alive. In massive forms, the oscules are found scattered, while in digitate forms, the oscules are found mainly in the terminal portion. The diameter of the oscules range from 1.5 to 3.0 mm.

**Collection and identification**

The specimens of *S. inconstans* were collected from Palk Bay (Mandapam region) in July 2007 and transported live to Cochin. The spicule characteristics from different regions of sponge body were studied in detail for confirming the species identity. The analysis revealed the presence of two types of spicules viz., i) Tylostyles: 150.01–567.86 µm x 2.04–21.92 µm and ii) Spirasters: 6.86–24.81 µm x 0.81–3.36 µm (Fig. 2).

**Growth in captivity**

Three live specimens of *S. inconstans* (designated here as A, B and C) were maintained live in 2 t capacity FRP tanks. Filtered seawater having a salinity of 33-35 ppt was used. Water temperature ranged from 26.0–29.7 ºC while pH ranged from 7.78 to 7.96. Microalgae was provided once a day in the morning hours. All the three specimens were found to survive well in captivity and showed good growth. The growth increment for a period of one month from 15th September to 15th October, 2007 is presented in this paper. The growth in terms of increment in height is mentioned. Specimen A showed an increase in growth from 149 mm to 175 mm in a span of one month (Fig. 3), while specimen B showed a growth increment of 12 mm (104 to 116 mm) (Fig. 4) during the same period. Specimen C showed an increase in growth from 121 to 132 mm in one month period (Fig. 5).
The present study demonstrated that some of the sponges can thrive well in culture systems, which is a pre-requisite for any propagation programme. There is a need to develop suitable cost-effective culture techniques for large biomass production of potential sponge species which would enable a steady supply of materials required for pharmaceutical industries. Farming of potential species would also minimise the pressure of over-harvest from the wild.
Mariculture of marine sponges for drug development: bioactivity potentials of cultured sponges, *Callyspongia subarmigera* (Ridley) and *Echinodictyum gorgonoides* (Dendy)

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Among all metazoan phyla, marine sponges are considered as the richest source of biologically and pharmacologically active chemicals. More than 5,300 different products are recorded from sponges and their associated microorganisms. Every year, about 200 new metabolites are reported from sponges. Considering the emerging diseases and the rapid development of disease resistance among microbes, the detection of novel metabolites from sponges gains importance and also provides scope for developing new drugs against disease causing bacteria, virus, fungi and parasites. In nature, the chemical interactions in the marine habitat of sponges suggest that products from them function as defense tools to protect them against predators including fish. Sponge product ara-A (vidarabine), the anti-viral drug used against the *Herpes simplex encephalitis* virus has advanced to the late stages of clinical trials. Others such as manzamine A (activity against malaria, tuberculosis, HIV and others), lasonolides (antifungal activity) and psammaplin A (antibacterial activity) are considered as promising leads. However, most sponges contain only trace quantity of the bioactive molecules. The increasing demand for initial experimental trials, possible success and subsequent industrial use for scaling up will lead to severe pressure on the wild population and hence the possible overexploitation and extinction of the target species as such. In view of the limited availability of larger quantities of defined source material (the so-called ‘supply problem’), and to cater to the requirements without loss of bioactive potential, mariculture could be considered as one of the best options. Hence, mariculture of two species *viz.*, *Callyspongia subarmigera* (Ridley) and *Echinodictyum gorgonoides* (Dendy) was attempted at Vizhinjam Research Centre of CMFRI. The salient findings of the experimental culture of these two species of sponge by two methods *viz.*, culture in re-circulatory semi-enclosed aquaria and culture in open sea together with their bioactivity potential during culture conditions are presented.

**Sponge culture in the offshore laboratory conditions**

All-glass aquarium tanks of 60x45x30 cm fitted with filtration unit and perforated perspex panels served as bioreactors for sponge culture in the laboratory. Compressed air with air–water lift was provided for re-circulating seawater and for development of ammonia oxidising bacteria in the bioreactor.

**Explant preparation and culture**

Freshly collected sponge *Echinodictyum gorgonoides* from Kanyakumari were washed and explants of about 5 ± 1 g size were prepared by cutting with a sharp surface-sterilised knife. Individual explant was weighed and kept in seawater without allowing them to dry. The explants were fixed to the perspex panel as could be seen from Fig. 1.
Feeding of sponge explants in the laboratory culture system

The sponge explants fixed in perspex sheet in the aquarium were fed with microalgae *Nanochloropsis* sp. at the rate of $3.5 \times 10^6$ cells initially. The cell density was increased gradually and the algal feed was provided twice per day. The wastes remaining in the culture system were removed every day and water was exchanged on alternate days. At different intervals of time, sponge tissues from the bioreactor were aseptically removed for evaluating the bioactivity using standard microbiological and other bioassay methods.

Sponge culture in the open sea

Experiments were conducted to evaluate the growth and bioactivity performance of sponges cultured in open sea conditions. For this set of experiments, sponges *C. subarmigera*, *E. gorgonoides* and *C. diffusa* collected off Kanyakumari and Vizhinjam were used. The sponge masses were cleaned with fresh seawater, placed in plastic circular fruit baskets (closed) and held at varying depths of seawater at Vizhinjam Bay, Trivandrum coast. They were tied one above the other at 1 m depth intervals and suspended in the vertical plane and hung in the vicinity of the open sea cage farming site of the Central Marine Fisheries Research Institute, Vizhinjam Bay with proper anchoring. Fouling organisms attached to the baskets were periodically removed. The average pH of the water in the Vizhinjam Bay varied between 7.60 and 8.10. The dissolved oxygen content ranged from 3.6 to 4.17 mg/l; while the salinity was between 29.5 and 35 ppt. Fig. 2 and 3 depict the sponge culture method and growth of *C. subarmigera*.

Harvesting of sponges cultured in the open sea and testing bioactivity

The initial results indicated that in the open sea culture conditions, among three species, only *C. subarmigera* survived. Portions from the sponge were aseptically removed for bioactivity tests. The excised sponge tissues were macerated with methanol and after requisite period of incubation, the methanol was evaporated and extracts were prepared for different assays. The bioactivity was tested as per the standard microbiological and other bioassay methods. The bioactivity of harvested sponge biomass at each harvested date was evaluated to compare and determine whether repeated harvesting affected the bioactivity of sponge tissue.

Fig. 2. Baskets containing sponges

Fig. 3. *Callyspongia subarmigera* cultured in Vizhinjam Bay

In laboratory conditions in the aquaria, *E. gorgonoides* survived the experimentation period of 80 days. Though the growth was low, bioactivities such as antibiotic activity as well as the cytotoxicity were retained. The experimental results are furnished in Table 1 and 2.

In the open sea culture conditions, *C. subarmigera* grew at an average rate of 88.94 mg per day. The overall growth was 93.37% compared to the initially stocked sponge tissue. Retention of bioactivity was noticed through the repeated harvests, though there was reduction in the bioactivity. The details of bioactivity of extract before and after culture are presented in Table 3 and 4.
The results of sponge culture experiments and the data regarding bioactivity suggest that sponge species that produce bioactive compounds can be cultivated in the laboratory with seawater re-circulatory system as well as in open sea mariculture conditions. In both the systems, the sponges retained their health state to a large extent and also their potency to produce bioactive compounds. This is the first experimental results based report of culture of sponges for bioactivity in tropical conditions prevailing in the Indian subcontinent.

Table 1. Antibacterial activity of fresh and laboratory cultured Echinodictyum gorgonoides extract

<table>
<thead>
<tr>
<th>Test Bacteria (fish pathogenic bacteria)</th>
<th>Callyspongia extract (%)</th>
<th>Zone of Inhibition (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fresh extract</td>
<td>Activity after 40 d culture</td>
</tr>
<tr>
<td><strong>Pseudomonas aeruginosa</strong></td>
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<td></td>
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<tr>
<td>0.1</td>
<td>7</td>
<td>7</td>
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<tr>
<td>1.0</td>
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<td><strong>Vibrio harveyi</strong></td>
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<td>0.1</td>
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<td><strong>Vibrio alginolyticus</strong></td>
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<td>1.0</td>
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<td><strong>Vibrio pelagius</strong></td>
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<td>0.1</td>
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<td>1.0</td>
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</table>

Table 2. Brine shrimp cytotoxicity of cultured Echinodictyum gorgonoides

<table>
<thead>
<tr>
<th>Extract (%)</th>
<th>Lethality (%) in the extract of sponge before introduction for culture (Fresh)</th>
<th>Lethality (%) in sponge extract after 40 d culture</th>
<th>Lethality (%) in sponge extract after 75 d culture</th>
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<tbody>
<tr>
<td>Control</td>
<td>-</td>
<td>-</td>
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<tr>
<td>0.1</td>
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<td>10</td>
<td>25</td>
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</table>

Table 3. Antibacterial activity of extract of Callyspongia subarmigera cultured in the open sea

<table>
<thead>
<tr>
<th>Test bacteria (fish pathogenic bacteria)</th>
<th>Callyspongia extract (%)</th>
<th>Zone of Inhibition (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fresh extract</td>
<td>Activity after 40 d culture</td>
</tr>
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<tr>
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<td>7</td>
</tr>
<tr>
<td>1.0</td>
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</tr>
<tr>
<td><strong>Vibrio harveyi</strong></td>
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</tr>
<tr>
<td>0.1</td>
<td>7</td>
<td>-</td>
</tr>
<tr>
<td>1.0</td>
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<td>7</td>
</tr>
<tr>
<td><strong>Vibrio alginolyticus</strong></td>
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<tr>
<td>0.1</td>
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<td>-</td>
</tr>
<tr>
<td>1.0</td>
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<td>9</td>
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<tr>
<td><strong>Vibrio pelagius</strong></td>
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<tr>
<td>0.1</td>
<td>11</td>
<td>8</td>
</tr>
<tr>
<td>1.0</td>
<td>19</td>
<td>14</td>
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Table 4. Brine shrimp cytotoxicity of Callyspongia subarmigera cultured in the open sea conditions

<table>
<thead>
<tr>
<th>Extract (%)</th>
<th>Lethality (%) in sponge extract before introduction for culture (Fresh)</th>
<th>Lethality (%) in sponge extract after 40 d culture</th>
<th>Lethality (%) in sponge extract after 75 d culture</th>
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<td>Control</td>
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<td>-</td>
<td>-</td>
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<td>20</td>
<td>20</td>
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<tr>
<td>1</td>
<td>50</td>
<td>35</td>
<td>20</td>
</tr>
<tr>
<td>10</td>
<td>70</td>
<td>50</td>
<td>35</td>
</tr>
</tbody>
</table>
An overview of marine fish landings in India during 2005 - 2006

J. Srinivasan, P. L. Ammini, K. Ramani and S. Haja Najeemudeen
Central Marine Fisheries Research Institute, Kochi

The estimated all India total marine fish landings during the year 2006 was 2.71 million t compared to 2.30 million t in 2005 which showed 18.1% increase. The sector-wise contributions in 2005 were, 69.5%, 25.9% and 4.6% by the mechanised, motorised and non-motorised sectors respectively and in 2006 it was 71.1%, 24.1% and 4.8% respectively (Table 1). Trawl nets, gillnets, dol/bagnets and seine nets are the important gears operating along the Indian coasts. During 2005, south-west region comprising of Kerala, Karnataka and Goa contributed 36% of the total landings, north-west region comprising of Maharashtra and Gujarat 31%, south-east region comprising of Andhra Pradesh, Tamil Nadu and Puducherry (Pondicherry) 20% and north-east region comprising of West Bengal and Orissa contributed 13%. During 2006, the contributions from the above regions were 35%, 33%, 22% and 10% respectively (Fig. 1).

<table>
<thead>
<tr>
<th>Sector</th>
<th>Catch / Effort</th>
<th>2005</th>
<th>2006</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanised</td>
<td>Landings ('000 t)</td>
<td>1595</td>
<td>1928</td>
</tr>
<tr>
<td></td>
<td>Units (x 000)</td>
<td>2389</td>
<td>2664</td>
</tr>
<tr>
<td>Motorised</td>
<td>Landings ('000 t)</td>
<td>594</td>
<td>652</td>
</tr>
<tr>
<td></td>
<td>Units (x 000)</td>
<td>4650</td>
<td>5547</td>
</tr>
<tr>
<td>Traditional</td>
<td>Landings ('000 t)</td>
<td>106</td>
<td>130</td>
</tr>
<tr>
<td></td>
<td>Units (x 000)</td>
<td>3161</td>
<td>3025</td>
</tr>
<tr>
<td>Total</td>
<td>Landings ('000 t)</td>
<td>2295</td>
<td>2711</td>
</tr>
<tr>
<td></td>
<td>Units (x 000)</td>
<td>10199</td>
<td>11236</td>
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towards the total marine fish landings of the years 2006 and 2005 (Table 2; Fig. 2). Trawl landings from north-west, south-west, south-east and north-east regions were 18%, 13%, 9% and 4% respectively during 2005 while the same during 2006 were 19%, 13%, 9% and 3% of the total landings. Ring seine and purse seine are the two important gears operating in the south-west region in addition to trawl net and gillnet. Ring seine landings in this region were nearly 14% in 2005 and 10.4% in 2006 and purse-seine landings 4.8% and 5.7% in 2005 and 2006 respectively. Dolnet is an important gear operating in the north-west region in addition to trawl nets. The contribution of dolnet was 8.5% during 2005 and 9.7% during 2006. Fourth quarter was the most productive period with contribution of 40% and 36% of the all India landings during 2005 and 2006, respectively.

Table 2. Landings of the major resources (in tonnes) in India during 2005 and 2006

<table>
<thead>
<tr>
<th>Group</th>
<th>1 QR</th>
<th>2 QR</th>
<th>3 QR</th>
<th>4 QR</th>
<th>Total</th>
<th>1 QR</th>
<th>2 QR</th>
<th>3 QR</th>
<th>4 QR</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oilsardine</td>
<td>80477</td>
<td>51492</td>
<td>75819</td>
<td>127074</td>
<td>334862</td>
<td>96219</td>
<td>83976</td>
<td>72662</td>
<td>141541</td>
<td>394598</td>
</tr>
<tr>
<td>Penaeid prawns</td>
<td>45402</td>
<td>29664</td>
<td>44999</td>
<td>52034</td>
<td>172099</td>
<td>52168</td>
<td>36503</td>
<td>27016</td>
<td>56773</td>
<td>172460</td>
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<tr>
<td>Indian mackerel</td>
<td>19717</td>
<td>24494</td>
<td>38884</td>
<td>42329</td>
<td>125424</td>
<td>32140</td>
<td>27488</td>
<td>33940</td>
<td>48350</td>
<td>141918</td>
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<tr>
<td>Bombayduck</td>
<td>25691</td>
<td>9992</td>
<td>12569</td>
<td>74101</td>
<td>122353</td>
<td>39016</td>
<td>10121</td>
<td>23314</td>
<td>46056</td>
<td>118507</td>
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<tr>
<td>Non-penaeid prawns</td>
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<td>23432</td>
<td>5428</td>
<td>58359</td>
<td>121107</td>
<td>50953</td>
<td>45415</td>
<td>10186</td>
<td>64233</td>
<td>170787</td>
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<tr>
<td>Croakers</td>
<td>31424</td>
<td>15434</td>
<td>18021</td>
<td>50658</td>
<td>115537</td>
<td>32946</td>
<td>19699</td>
<td>17973</td>
<td>48787</td>
<td>119405</td>
</tr>
<tr>
<td>Ribbonfishes</td>
<td>20821</td>
<td>8427</td>
<td>8247</td>
<td>76620</td>
<td>141115</td>
<td>35341</td>
<td>17919</td>
<td>55845</td>
<td>125940</td>
<td>230545</td>
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<tr>
<td>Cephalopods</td>
<td>18742</td>
<td>20978</td>
<td>20116</td>
<td>37233</td>
<td>97069</td>
<td>28522</td>
<td>20662</td>
<td>39435</td>
<td>45292</td>
<td>136041</td>
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<td>Threadfin breams</td>
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<td>33094</td>
<td>14373</td>
<td>17133</td>
<td>88367</td>
<td>29924</td>
<td>23452</td>
<td>30569</td>
<td>27372</td>
<td>111317</td>
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<tr>
<td>Silverbellies</td>
<td>8570</td>
<td>12034</td>
<td>22443</td>
<td>15799</td>
<td>58846</td>
<td>16729</td>
<td>10450</td>
<td>17559</td>
<td>19888</td>
<td>64626</td>
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<tr>
<td>Carangids</td>
<td>17304</td>
<td>3489</td>
<td>44333</td>
<td>47680</td>
<td>142956</td>
<td>24953</td>
<td>28974</td>
<td>32500</td>
<td>35459</td>
<td>121936</td>
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<tr>
<td>Others</td>
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<td>158940</td>
<td>322897</td>
<td>802755</td>
<td>282657</td>
<td>148040</td>
<td>186982</td>
<td>306669</td>
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<td>464172</td>
<td>922067</td>
<td>2295490</td>
<td>721298</td>
<td>475099</td>
<td>548231</td>
<td>966360</td>
<td>2710988</td>
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</tbody>
</table>

QR: Quarter

Fig. 2. Landings of major fishery resources in India during 2005 and 2006

Region-wise landings

North-east

North-east region with a coastal length of about 638 km has 101 landing centres, 987 fishing villages, 1.40 lakh fishermen families and 7.20 lakh fisherfolk population (Marine Fisheries Census, 2005). The estimated marine fish landings of this region was 2.99 lakh t during 2005. In 2006, the estimated marine fish landings was 2.73 lakh t registering 8.5% decrease compared to 2005 (Table 3). The most productive season was fourth quarter with a landings of 1.72 lakh t during 2005 whereas the first quarter with 1.04 lakh t was the most productive season during 2006. Second quarter landings showed a decrease of about 122 thousand t and third quarter showed an increase of about 59.7 thousand t during 2006 as compared to 2005. Bombayduck, catfishes, other clupeids such as *Hilsa* spp., croakers, prawns, carangids, ribbonfishes, pomfrets and anchovies were the important resources. Except catfishes and hilsa shads, other resources showed a decrease in the landings during the year 2006 (Fig. 3). Seventy two percentage of the landings was by mechanised sector, 24% by motorised sector and 4% by traditional sector during the year 2005 and it was 70%, 26% and 4% respectively during 2006. Gillnet landings in this region dominated with 44%, followed by trawl net with 43.5% of the mechanised landings during 2005. It was 43.3% and 38.6% respectively during the year 2006 (Table 4). Catch per unit effort (CPUE) for mechanised trawl net (MTN) was 2377 (kg/unit) with...
South-east region

This region spreads over a coastal length of 2050 km and has 649 landing centres, 1107 fishing villages, 3.33 lakh fishermen families and 13.43 lakh fisher folk population. The estimated marine fish landings of this region was 4.50 lakh t during 2005. The landings during 2006 showed an increase of 31.7% with 5.93 lakh t. Except the second quarter, the landings of the other three quarters recorded an increase in the fish landings during the year 2006 when compared to 2005, with more productive seasons in first and fourth quarters. Oilsardine, other sardines, silverbellies, ribbonfishes, croakers, carangids, mackerels and penaeid prawns were the major exploited resources in this region (Table 5; Fig. 4). Oilsardine and other sardines landings showed an increase of about 37,000 t during 2006 compared to 2005. Silverbellies landings was about 51,000 t which showed an increase of about 9,000 t during 2006. Other resources also showed reasonable catch per hour (CPH) 39 kg/h during 2005 and the same was 2496 kg/unit and 48 kg/h respectively during 2006. CPH was more with 46 kg/h and 57 kg/h in the landings of mechanised bag net (MBN) during 2005 and 2006 respectively.

Table 3. Landings of the major resources (in tonnes) in the north-east region during 2005 and 2006

<table>
<thead>
<tr>
<th>Group</th>
<th>1 QR</th>
<th>2 QR</th>
<th>3 QR</th>
<th>4 QR</th>
<th>Total</th>
<th>1 QR</th>
<th>2 QR</th>
<th>3 QR</th>
<th>4 QR</th>
<th>Total</th>
</tr>
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<tr>
<td>Bombayduck</td>
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<td>1014</td>
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<td>18734</td>
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<td>15240</td>
<td>913</td>
<td>6781</td>
<td>13875</td>
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<td>Hilsa shad</td>
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<td>4645</td>
<td>7363</td>
<td>18513</td>
<td>31244</td>
<td>4955</td>
<td>341</td>
<td>2036</td>
<td>2110</td>
<td>36722</td>
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<td>Other clupeids</td>
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<td>1212</td>
<td>3439</td>
<td>19861</td>
<td>30536</td>
<td>10548</td>
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<td>7831</td>
<td>1439</td>
<td>3232</td>
<td>11668</td>
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<td>600</td>
<td>13162</td>
<td>22725</td>
<td>14442</td>
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<td>136</td>
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<td>14428</td>
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<td>8576</td>
<td>577</td>
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<td>8493</td>
<td>15693</td>
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<td>16630</td>
<td>5677</td>
<td>416</td>
<td>1150</td>
<td>8968</td>
<td>16211</td>
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<td>705</td>
<td>3432</td>
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<td>15704</td>
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<td>799</td>
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<td>8288</td>
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<td>4485</td>
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<td>501</td>
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<td>7988</td>
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<td>43946</td>
<td>17234</td>
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<td>5893</td>
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</table>

Table 4. Marine fish landings of major gears of different sectors with catch rates in the north-east region during 2005 and 2006

<table>
<thead>
<tr>
<th>Sector</th>
<th>Gear</th>
<th>2005 (landings '000 t)</th>
<th>Effort (x000)</th>
<th>CPUE (kg/unit)</th>
<th>CPH (kg/h)</th>
<th>2006 (landings '000 t)</th>
<th>Effort (x000)</th>
<th>CPUE (kg/unit)</th>
<th>CPH (kg/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanised</td>
<td>MTN</td>
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<td>39</td>
<td>2410</td>
<td>2377</td>
<td>39</td>
<td>74</td>
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<td>1538</td>
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<td></td>
<td>MGN</td>
<td>95</td>
<td>125</td>
<td>5671</td>
<td>762</td>
<td>17</td>
<td>83</td>
<td>91</td>
<td>4229</td>
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<td></td>
<td>MBN</td>
<td>25</td>
<td>60</td>
<td>532</td>
<td>410</td>
<td>46</td>
<td>34</td>
<td>61</td>
<td>589</td>
</tr>
<tr>
<td>Motorised</td>
<td>OBGN</td>
<td>38</td>
<td>350</td>
<td>1279</td>
<td>108</td>
<td>29</td>
<td>37</td>
<td>324</td>
<td>1363</td>
</tr>
<tr>
<td></td>
<td>OBBN</td>
<td>31</td>
<td>105</td>
<td>555</td>
<td>295</td>
<td>55</td>
<td>23</td>
<td>117</td>
<td>605</td>
</tr>
<tr>
<td>Traditional</td>
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<td>972</td>
<td>42</td>
<td>13</td>
<td>12</td>
<td>266</td>
<td>954</td>
</tr>
</tbody>
</table>

MTN: Mechanised trawl net; MGN: Mechanised gillnet; MBN: Mechanised bag net; OBGN: Outboard gillnet; OBBN: Outboard bag net; NM: Non-mechanised, AFH: Actual fishing hours
increase in the landings during 2006. The mechanised sector contributed 48% and motorised sector 35% to the total landings of the year 2005. In 2006, the contributions were 44% and 41% respectively (Table 6). The major gears operating in this region were trawl nets, gillnets and hooks and line. Trawl net contributed 94.5% and 92% of the total landings in the mechanised sector during 2005 and 2006 respectively. Motorised sector in this region contributed 35% and 41% during the years 2005 and 2006 respectively. The maximum contribution of 77% by the motorised sector landings was from outboard driftnet/gillnets. Traditional sector contributed 17% and 15% respectively during the year 2005 and 2006.

Table 5. Landings of the major resources (in tonnes) in the south-east region during 2005 and 2006

<table>
<thead>
<tr>
<th>Group</th>
<th>2005</th>
<th>2006</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 QR</td>
<td>2 QR</td>
</tr>
<tr>
<td>Other sardines</td>
<td>9392</td>
<td>10191</td>
</tr>
<tr>
<td>Silverbellies</td>
<td>6241</td>
<td>9810</td>
</tr>
<tr>
<td>Perches</td>
<td>5491</td>
<td>10679</td>
</tr>
<tr>
<td>Indian mackerel</td>
<td>9039</td>
<td>12700</td>
</tr>
<tr>
<td>Carangids</td>
<td>5599</td>
<td>8809</td>
</tr>
<tr>
<td>Oilsardine</td>
<td>1587</td>
<td>5427</td>
</tr>
<tr>
<td>Penaeid prawns</td>
<td>5399</td>
<td>6022</td>
</tr>
<tr>
<td>Crabs</td>
<td>2860</td>
<td>3689</td>
</tr>
<tr>
<td>Elasmobranchs</td>
<td>3553</td>
<td>3951</td>
</tr>
<tr>
<td>Croakers</td>
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<td>2363</td>
</tr>
<tr>
<td>Goatfishes</td>
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<td>4440</td>
</tr>
<tr>
<td>Cephalopods</td>
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<td>2432</td>
</tr>
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<td>476</td>
</tr>
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<td>24034</td>
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<tr>
<td>Total</td>
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<td>104663</td>
</tr>
</tbody>
</table>

Table 6. Marine fish landings of major gears of different sectors with catch rates during 2005 and 2006 in the south-east region

<table>
<thead>
<tr>
<th>Sector</th>
<th>Gear</th>
<th>Total (landings '000 t)</th>
<th>Effort (x000) Units</th>
<th>CPUE (kg/unit)</th>
<th>CPH (kg/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanised</td>
<td>MTN</td>
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<td>6890</td>
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<td>MGN</td>
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<td>104</td>
<td>620</td>
<td>84</td>
</tr>
<tr>
<td>Motorised</td>
<td>OBGN</td>
<td>121</td>
<td>1989</td>
<td>8743</td>
<td>61</td>
</tr>
<tr>
<td></td>
<td>OBHL</td>
<td>15</td>
<td>252</td>
<td>1146</td>
<td>60</td>
</tr>
<tr>
<td>Traditional</td>
<td>NM</td>
<td>77</td>
<td>2077</td>
<td>10380</td>
<td>37</td>
</tr>
</tbody>
</table>

South-west region

South-west region has a coastal length of 994 km, 300 landing centres, 417 fishing villages, 1.53 lakh fishermen families and 7.84 lakh fisherfolk population. This region ranks first in the fish production with 9.38 lakh t and its contribution was 35% of the total fish production of India during the year 2006. The region recorded 11.5% increase in the landings during 2006 as compared to 2005, the estimated landings being 8.42 lakh t. Oilsardine formed major portion of the fish landings in this region.
with 3.03 and 3.43 lakh t during 2005 and 2006 respectively. Oilsardine catch recorded an increase of 13\% during 2006 compared to 2005. Fourth quarter was the most productive period in both the years. The major resources viz., mackerel, ribbonfishes, threadfinbreams, cephalopods and stomatopods showed increase in the landings while the commercially important resources like penaeid prawns and carangids showed decrease in the landings during 2006 compared to 2005 (Table 7; Fig. 5).

### Table 7. Landings of major resources (in tonnes) during 2005 and 2006 in the south-west region

<table>
<thead>
<tr>
<th>Group</th>
<th>2005</th>
<th>2006</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 QR</td>
<td>2 QR</td>
</tr>
<tr>
<td>Oilsardine</td>
<td>77928</td>
<td>45267</td>
</tr>
<tr>
<td>Indian mackerel</td>
<td>7608</td>
<td>11062</td>
</tr>
<tr>
<td>Carangids</td>
<td>4313</td>
<td>20464</td>
</tr>
<tr>
<td>Perches</td>
<td>12726</td>
<td>25781</td>
</tr>
<tr>
<td>Peneaid prawns</td>
<td>15181</td>
<td>11267</td>
</tr>
<tr>
<td>Other clupeids</td>
<td>10512</td>
<td>7054</td>
</tr>
<tr>
<td>Cephalopods</td>
<td>5383</td>
<td>12228</td>
</tr>
<tr>
<td>Ribbonfishes</td>
<td>2918</td>
<td>1757</td>
</tr>
<tr>
<td>Soles</td>
<td>10857</td>
<td>4393</td>
</tr>
<tr>
<td>Tunnies</td>
<td>2420</td>
<td>2650</td>
</tr>
<tr>
<td>Others</td>
<td>22910</td>
<td>24666</td>
</tr>
<tr>
<td>Total</td>
<td>172756</td>
<td>166591</td>
</tr>
</tbody>
</table>

Fig. 5. Landings of major resources in the south-west region during 2005 and 2006

Mechanised sector contributed 60\% and motorised sector 38\% of the total landings in 2005 while their contribution was 68\% and 30\% respectively in 2006 (Table 8). Trawl nets contributed 57\% and 53\% of the landings of the mechanised sector during 2005 and 2006 respectively. Outboard ringseines (OBRS) contributed more, with 67\% and 54\% of the landings of the motorised sector during 2005 and 2006 respectively. Mechanised ringseines (MRS) showed higher CPUE of 2,646 kg/unit, CPH being 1,322 kg/h during 2005 while the CPUE of purseseines (MPS) was higher with 2,696 kg/unit and CPH with 1,204 kg/h during 2006. In the motorised sector the CPUE and CPH of ringseines were higher than that of purseseines.

### Table 8. Marine fish landings of major gears of different sectors with catch rates in the south-west region during 2005 and 2006

<table>
<thead>
<tr>
<th>Sector</th>
<th>Gear</th>
<th>2005</th>
<th>2006</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>(landings '000 t)</td>
<td>Effort (x000)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Units</td>
<td>AFH</td>
</tr>
<tr>
<td>Mechanised</td>
<td>MTN</td>
<td>291</td>
<td>468</td>
</tr>
<tr>
<td></td>
<td>MPS</td>
<td>109</td>
<td>68</td>
</tr>
<tr>
<td></td>
<td>MRS</td>
<td>102</td>
<td>39</td>
</tr>
<tr>
<td>Motorised</td>
<td>OBG</td>
<td>74</td>
<td>685</td>
</tr>
<tr>
<td></td>
<td>OBR</td>
<td>215</td>
<td>196</td>
</tr>
<tr>
<td>Traditional</td>
<td>NM</td>
<td>13</td>
<td>613</td>
</tr>
</tbody>
</table>

MTN: Mechanised trawl net; MPS: Mechanised purseseine; MRS: Mechanised ringseine; OBG: Outboard gillnet; OBR: Outboard ringseine; NM: Non-mechanised
with 1,096 kg/unit and 592 kg/h during 2005 and 1,017 kg/unit and 600 kg/h during 2006.

**North-west region**

North-west region has 2320 km coastal length, 282 landing centres, 691 fishing villages, 1.30 lakh fishermen families and 6.72 lakh fisherfolk population. It ranked second in the fish production during 2006 with fish landings of 9.06 lakh t which showed an increase of 28.6% over the landings in 2005. Fourth quarter recorded the highest landings (44%) followed by first quarter (25%) and the least landings of 14% registered in the third quarter during the year 2006. Prawns, ribbonfishes, Bombayduck, cephalopods, croakers, threadfin breams and catfishes were the major exploited resources in this region (Table 9; Fig. 6).

The contribution of the mechanised sector were 93% and 92% during 2005 and 2006 respectively (Table 10). Trawlers contributed 63% and 61% in the mechanised sector landings during 2005 and 2006 respectively. Contribution of mechanised dolnet was also significant with 30% and 31% of the mechanised landings during 2005 and 2006 respectively. The contribution in the motorised sector were 6% and 7% of the total landings during 2005 and 2006 respectively. In the motorised sector, the contribution from the outboard driftnet/gillnets was higher with 93% and 97% during 2005 and 2006 respectively. The CPUE of mechanised purseseine was higher with 2,314 kg/unit and CPH was 296 kg/h during 2005 while the CPUE and CPH were 2,396 kg/unit and 214 kg/h respectively during 2006.
A report on swimbladder disorder in the honeycomb grouper, *Epinephelus merra*

S. R. Krupesha Sharma, M. K. Anil and A. Udayakumar

*Vizhinjam Research Centre of CMFRI, Vizhinjam*

Swimbladder or airbladder is a thin layered epithelial sac filled with air, lying above the alimentary canal of bony fishes that regulates buoyancy of the fish so that the specific gravity of the fish always matches the depth at which it is swimming. Swimbladder disorder (SBD) is a condition caused by sudden temperature changes impacted stomach resulting from improper feeding or due to bacterial or viral infections of the bladder characterised by inability of the fish to keep a normal upright position in water. Normally gold fishes suffer from SBD due to their globoid body shape. Fish with SBD may float on their side or their back, swim in circles or take head-down posture.

A honeycomb grouper (*Epinephelus merra*) maintained at Marine Aquarium of Vizhinjam Research Centre of CMFRI was found to float with head-down position (Fig. 1). The fish was not feeding for two days. On careful examination, a swelling of about 2 cm diameter was found on the abdomen anterior to vent. Based on the signs, the condition was diagnosed as SBD which could have developed due to impacted stomach pressing on the swimbladder. The fish was relieved of the ailment by inserting a 23 gauge sterile hypodermic needle fitted to a 2 ml syringe into the bladder and aspirating the gas by taking extreme care not to pierce the intestine or the kidneys. The suspected condition was relieved by injecting 1 ml of soap solution into the vent using a sterile tuberculin syringe without the needle. The fish showed normal movements within 30 min and started feeding after 24 h (Fig. 2).

The recommended treatment regime for SBD includes fasting for 2 or 3 days, increasing the tank temperature, avoiding dry floating feeds and deflating the swim bladder. SBD can be prevented by good tank husbandry. The reason for development of SBD in the present case can be attributed to impaction in the alimentary canal probably due to overfeeding. By aspirating the air, the swimbladder was deflated. A lavage with lubricant could break the impaction facilitating the exchange of gases making the fish move normally.

<table>
<thead>
<tr>
<th>Sector</th>
<th>Gear</th>
<th>2005</th>
<th>2006</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Total (landings '000 t)</td>
<td>Effort (x000)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Units AFH</td>
<td></td>
</tr>
<tr>
<td>Mechanised</td>
<td>MTN</td>
<td>411</td>
<td>270</td>
</tr>
<tr>
<td></td>
<td>MPS</td>
<td>9</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>MDOL</td>
<td>194</td>
<td>542</td>
</tr>
<tr>
<td></td>
<td>MGN</td>
<td>39</td>
<td>205</td>
</tr>
<tr>
<td></td>
<td>MHL</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>Motorised</td>
<td>OBGN</td>
<td>41</td>
<td>562</td>
</tr>
<tr>
<td>Traditional</td>
<td>NM</td>
<td>4</td>
<td>179</td>
</tr>
</tbody>
</table>

MTN: Mechanised trawlnet; MPH: Mechanised purseseine; MDOC: Mechanised dolnet; MGN: Mechanised gillnet; MHL: Mechanised hook and line, OBGN: Outboard gillnet; NM: Non-mechanised
Rare occurrence of the bramble shark *Echinorhinus brucus* (Bonnaterre, 1788) along the Veraval coast

R. Thangavelu, Shubhadeep Ghosh, Gulshad Mohammed, M. S. Zala, H. K. Dhokia, R. Avinash and Mahendra Fofandi
Veraval Regional Centre of CMFRI, Veraval

A spiny shark or bramble shark *Echinorhinus brucus* (Bonnaterre, 1788) was caught in trawl operated near Pakistan border off Veraval coast (Fig. 1). *E. brucus* is exclusively marine, inhabiting deep waters. It is also called sluggish bottom shark, sometimes occurring in shallow waters, especially on the continental and insular shelves and upper slopes upto 900 m depth.

Bramble sharks have dorso-ventrally compressed head (Fig. 2) and the body is long cylindrical, covered with scattered, large protruding thorn-like denticles two small spineless dorsal fins placed far back on the body just before the tail and five pairs of gill slits (Fig. 3). It has no anal fin and has thick caudal peduncle (tail stalk). Teeth are star-cusped and similar in both the jaws. The skin of its back and sides is sparsely strewn in large scales with either one or two sharp points. The colour of the species is dark grey with metallic reflections without darker blotches. They can reach a maximum length of 3.94 m (13 ft) and weigh 500 lbs (227 kg). There are records on the occurrence of this species in the Western Atlantic, Mediterranean, Pacific Ocean, Australia and New Zealand. The phylogenic position of this species is as follows:

<table>
<thead>
<tr>
<th>Phylum</th>
<th>Chordata</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class</td>
<td>Chondrichthys</td>
</tr>
<tr>
<td>Subclass</td>
<td>Elasmobranchii</td>
</tr>
<tr>
<td>Order</td>
<td>Squaliformes</td>
</tr>
<tr>
<td>Family</td>
<td>Echinorhinidae</td>
</tr>
<tr>
<td>Genus</td>
<td>Echinorhinus</td>
</tr>
<tr>
<td>Species</td>
<td><em>E. brucus</em></td>
</tr>
</tbody>
</table>

Fig. 1. Spiny shark, *Echinorhinus brucus* caught by trawlers at Veraval

Fig. 2. Dorso-ventrally compressed head of *Echinorhinus brucus* with denticles

Fig. 3. Body of bramble shark covered with denticles
Occurrence of a large cornet fish, *Fistularia petimba* in trawl catches of Veraval coast, Gujarat

*Veraval Regional Centre of CMFRI, Veraval*

A large cornet fish (*Fistularia petimba*) belonging to the family fistulariidae was collected on 3rd February 2009 from the Bidiya Fish Landing Centre, caught by trawler off Veraval coast at a depth of 60 m (Fig. 1). The body of the fish was elongate having depressed mouth at the end of a long tubular snout which was hexagonal in cross section and teeth in jaws with small ridges on snout with antrorse serrations, the upper ridges diverging anteriorly and the inter-orbital space flat. Dorsal and anal fins were short-based and opposite with 15 rays and 15 dorsal segmented rays; pectoral fins with 15 rays; pelvic fins small and abdominal with 6 rays. Lateral line was arched, running anteriorly almost along the middle of back and then bending down to side and continuing posteriorly to an elongate filament produced by the middle of two caudal fin rays. Posterior lateral line was ossified without spines. The colour of the fish was brown, becoming lighter to silvery below. Dorsal and anal fins were with orange cast becoming transparent at base and caudal filament white. The following are the morphometric and mertistic characters:

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total length</td>
<td>1480 mm</td>
</tr>
<tr>
<td>Total weight</td>
<td>2529 g</td>
</tr>
<tr>
<td>Length from snout to 1st dorsal</td>
<td>1155 mm</td>
</tr>
<tr>
<td>Opercular length</td>
<td>100 mm</td>
</tr>
<tr>
<td>First dorsal to furcal</td>
<td>210 mm</td>
</tr>
<tr>
<td>Pelvic to pectoral</td>
<td>185 mm</td>
</tr>
<tr>
<td>Pelvic to anal</td>
<td>460 mm</td>
</tr>
<tr>
<td>Eye diameter</td>
<td>20 mm</td>
</tr>
<tr>
<td>Dorsal rays</td>
<td>15</td>
</tr>
<tr>
<td>Anal rays</td>
<td>15</td>
</tr>
<tr>
<td>Pelvic rays</td>
<td>6</td>
</tr>
<tr>
<td>Pectoral rays</td>
<td>15</td>
</tr>
<tr>
<td>Brancheostegal rays</td>
<td>8</td>
</tr>
<tr>
<td>Length of prolonged caudal fin ray</td>
<td>200 mm</td>
</tr>
</tbody>
</table>

**Length measurements of bramble shark landed at Veraval:**

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total length</td>
<td>87.5 cm</td>
</tr>
<tr>
<td>Total weight</td>
<td>2.63 kg</td>
</tr>
<tr>
<td>Length from snout to 1st dorsal</td>
<td>52.5 cm</td>
</tr>
<tr>
<td>Snout to pelvic</td>
<td>49.5 cm</td>
</tr>
<tr>
<td>Snout to orbit</td>
<td>7 cm</td>
</tr>
<tr>
<td>1st dorsal to 2nd dorsal</td>
<td>4.5 cm</td>
</tr>
<tr>
<td>Pelvic to pectoral</td>
<td>18.5 cm</td>
</tr>
<tr>
<td>Pelvic to 1st dorsal</td>
<td>24 cm</td>
</tr>
<tr>
<td>Pelvic to tail notch</td>
<td>11.5 cm</td>
</tr>
<tr>
<td>Pelvic to caudal end</td>
<td>31 cm</td>
</tr>
<tr>
<td>Eye diameter (dorso-ventral)</td>
<td>1.9 cm</td>
</tr>
<tr>
<td>Intra-orbital length</td>
<td>8.5 cm</td>
</tr>
</tbody>
</table>

**Fig. 1.** *Fistularia petimba* caught by trawlers at Veraval