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Sonali S Mhaddolkar
Karwar Research Centre of Central Marine Fisheries Research Institute, Karwar, Uttara kannada, Karnataka, India

Jayasree Loka
Karwar Research Centre of Central Marine Fisheries Research Institute, Karwar, Uttara kannada, Karnataka, India

KK Philipose
Karwar Research Centre of Central Marine Fisheries Research Institute, Karwar, Uttara kannada, Karnataka, India

AP Dineshbabu
Mangalore Research Centre of Central Marine Fisheries Research Institute, Hoige Bazar, Mangalore, Karnataka, India

Correspondence
Sonali S Mhaddolkar
Karwar Research Centre of Central Marine Fisheries Research Institute, Karwar, Uttara kannada, Karnataka, India

Experimental studies on Macro fouling communities on net panels at marine cage farm of Karwar, India

Sonali S Mhaddolkar, Jayasree Loka, KK Philipose and AP Dineshbabu

Abstract
A study was undertaken on the fouling pattern, monthly settlement and species dominance at marine cage culture during the year 2014-2015. The net panels deployed at three different depths during December 2014 and the study was carried out for seven months. The study revealed wide variations in colonization of the bio-foulers, the density varied between 2-260/cm^2. The overall density was found to be more in bottom panels (6mt) compared to the top (1mt) and middle panels (3mt). The overall dominant species were hydroids and barnacles throughout the culture period. In the top panels, hydroids were dominant (91.67%) during December, followed by barnacles and amphipods. Additionally, complete dominance of barnacles was observed in the middle panel during May. Barnacles were found dominant (93.75%) on the bottom panels during March, followed by hydroids and crabs. The study underscored that barnacles formed a major contribution of the fouling organisms throughout the culture period. Significant variation in the occurrence and abundance of fouling organisms was observed, between the depths at cage site.

Keywords: Bio-foulers, cage farm, density, dominance

1. Introduction
Cage Bio-foulers are the organisms which are responsible for the degradation of cage accessories such as cage frame, nets, barrels, ballast and ropes. The growth of fouling organisms severely affects the net of cages and so the culture activities. Worldwide many authors [1, 2] made significant contributions on species composition of fouling organisms on mariculture cages. In India, cage culture of marine finfish and shellfish has been initiated in 2007 by Central Marine Fisheries Research Institute and successfully cultured Asian sea bass. CMFRI has developed a Marine farm at, off Karwar bay for culturing Finishes and shell fishes. During the study period there were 25 cages in the marine farm culturing Cobia (*Rachycentron canadum*), Pompano (*Trachinotus blochii*), Seabass (*Lates calcarifer*) and red snapper (*Lutjanus argentimaculatus*). Very little work has been carried out in India on biofouling communities on marine cages [3]. Therefore, the present study has undertaken at marine farm of Karwar, to assess the fouling pattern, monthly settlement and species dominance in cage culture site of west coast of India during the period of 2014-2015.

2. Materials and Methods
The marine farm of CMFRI is located at N 14º48.406', E 074º06.664' in the west coast of India (fig.1). The net panels (100mmx100mm) of mesh size 22mm were deployed in cage at 3 different depths during December 2014 and the field and laboratory studies were carried out for a period of seven months during the culture period. The panels were submerged for one month and replaced with new panels after every sampling. Duplicate panels were put at three depths (1m, 3m and 6m) based on transects made vertically for cage depth. The panels were tied to the floating frames of the cage farm at the selected points. Monthly data was collected and the species were counted by number of individual organisms per cm^2. The fouling organisms on the panels were brought to the laboratory in sea water, washed with sterile sea water and the fouling organisms are sieved in 200 micron sieve, and the fouling samples were preserved in Rose Bengal and 5% formaldehyde solution for further identification. Smaller organisms were observed under 5x magnifications in AXIO, Zeiss (Scope-A1) microscope. Identifications up to possible lowest taxonomical rank were done by using World register of marine species [4].

Fig 1: Marine cage farm at Karwar, west coast of India

3. Results and discussion:

Totally 7 phyla were found on the cage panel nets, viz. Porifera, Coelenterata, Mollusca, Annelida, Arthropoda, Echinodermata, Chordata. A total of 21 macrofouling organisms were identified from the marine cage farm during the study period (Table 1).This number is similar to the earlier literature of fouling communities on net panel in Norwegian fish farm [5] where as 28 species were identified during seven-months period at 3 different depths.

Table 1: Macro-fouling organisms identified from the marine cage farm

Macrofouling organisms	Species identified	Phylum
Bryozoans	*Bugula neritina*	Bryozoa
Hydroids	*Obelia* sp.	Coelentrata
Sea anemone	*Bunodosoma* sp.	Cnidaria
Gastropod	*Oliva inspidula*	Mollusca
Green mussel	*Perna viridis*	Mollusca
Modiolus	*Modiolus* sp.	Mollusca
Oyster	*Crassostrea madrasensis, Saccostrea cucullata*	Mollusca
Polychaete worms	*Platynereis* sp.	Annelida
Flat worm	*Leptoplana* sp.	Annelida
Amphipod	*Hyperia* sp. *Caprella* sp.	Arthropoda
Barnacles	*Balanus* sp.	Arthropoda
Crabs	*Grapsus albolineatus, Schizophrys aspera, Ozius rugulosus, Medaeus granulosus, Plagusia squamosa*	Arthropoda
Isopods	*Idotea* sp.	Arthropoda
Sea urchin	*Stomopneustes variolaris*	Echinodermata
Ascidia	*Ascidia* sp.	Chordata

Among the fouling organisms recorded during the study period, amphipods, barnacles, crabs, gastropods, hydroids, modiolus, polychaete worms and sea urchin were found to be common from all the three depths. It was found that barnacles dominated in the middle and bottom panels whereas, hydroids dominated the top panels.

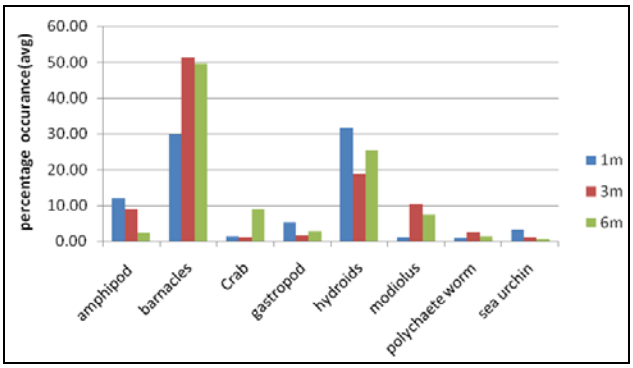

Fig 2: Showing the Macro fouling organisms recorded from the panels of 3 depths in marine farm.

Hydroids were abundant during in December and January months in all the three panels, earlier studies of fouling showed that there are serious problems of fouling of hydroid dominance on culture nets from the month of July to November in Norwegian waters [6, 7, 5]. Carl [6] reported that according to survey conducted by him, fouling colonisation showed a shift starting from top to bottom and bottom to top. In the present Investigation, most of the organisms recorded in the fouling communities are sediment dwelling and rock dwelling communities and this could be due to the sheltered rocky environment where the marine farm is situated. The similar results were obtained in the earlier works [5] in the Norwegian waters.

3.1 Top Penal (1mt)

On the top panel, a total of 15 macro-fouling organisms viz., amphipods, ascidians, barnacles, gastropods, green mussels, bryozoans, hydroids, crabs, isopods, modiolus, oysters, flatworms, polychaetes, sea anemone and sea urchins were recorded during the culture period. Month wise percentage of dominant species was recorded (Fig.3.). Overall, hydroids (31.56%) were found to be the dominant species on the top panels followed by barnacles 29.74% dominated during March, May, June, and July. Sea anemones were least dominant species on the top penal. The highest percentage was of hydroids (91.67%) in the month of December followed by barnacles (83%) in July and amphipods (70%) in February.

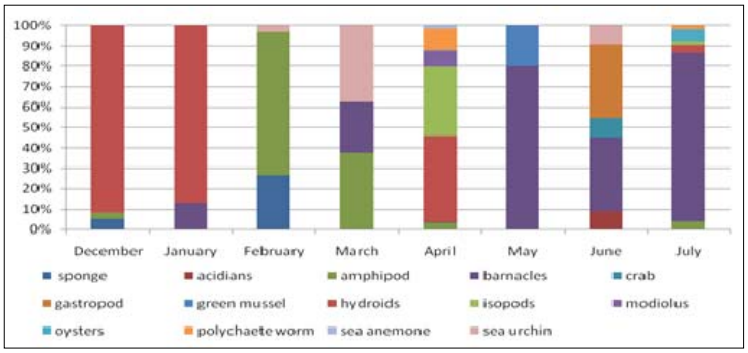

Fig 3: Showing the percentage of macrofouling organisms on the top penal.

3.2 Middle Panel (3mt)

In the middle panel, 13 macro fouling organisms namely amphipods, barnacles, crabs, sponge, gastropods, hydroids, flat worms, caprellids, green mussel, modiolus, polychaete worms, sea urchin and bryozoans were recorded. Monthly panel study showed barnacles as the most dominant group on the panel (50.48%) (Fig.4.). In the middle panel, Barnacles were present throughout the period of study with a complete dominance during the month of May.

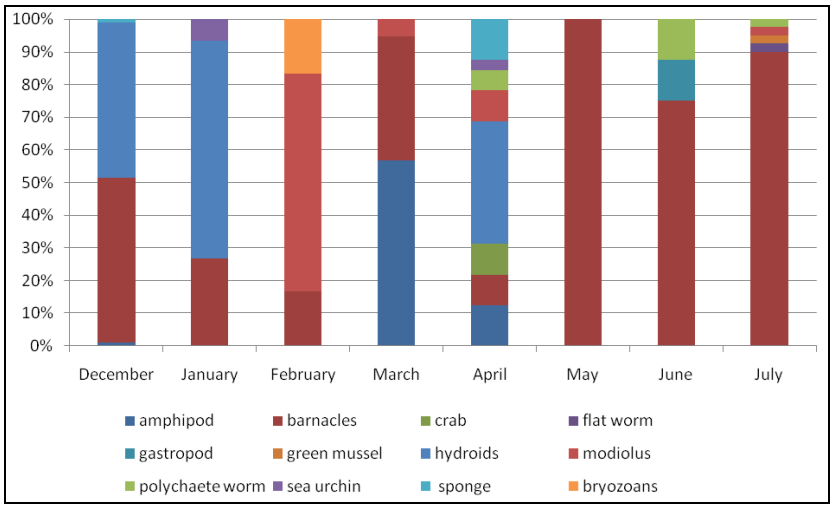

Fig 4: Percentage of Macrofouling organisms on the middle panel.

3.3. Bottom Panel (6mt)

In the bottom panel, a total of 9 macrofouling organisms were recorded viz., amphipods, barnacles, gastropods, crabs, hydroids, modiolus, polychaete worms, isopods and sea urchin. Month wise percentage of dominant species was recorded and (Fig.5.) found barnacles throughout the culture period except in the month of February with a peak of 93.75% during March. Lowest percentage was of sea urchin that is (3.13%) which was only found during April. Overall barnacles were abundant (49.63%) followed by hydroids (25.41%). The sea urchin was recorded as the least dominant with 0.39% occurrence.

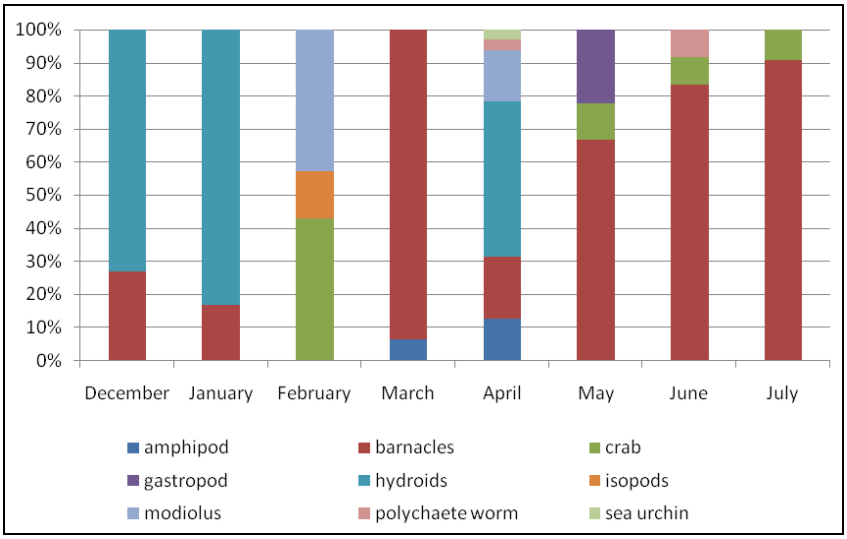

Fig 5: Showing the percentage of Macrofouling organisms on the bottom panel.

The present investigation showed that the overall percentage of fouling with barnacles and hydroids was 29.74%, 51.25%, 49.63% and 31.56%, 18.58%, 25.41% on top, middle and bottom panels respectively. The density of bio-foulers varied between 2-260/cm^2. It was reported that regular cleaning of nets can prevent the early stages of bio-fouling succession, mainly the first bio-fouling colonisers like Hydroid [7, 8, 9] in marine cage farms. It was found that there is a significant variation in the occurrence of species between three depths (p<0.05). Earlier reports also showed a significant variation in the assemblage of fouling organisms on the net panels with the depth [10, 11, 6]. This variation can be because of many factors such as temperature, salinity, light intensity, nutrient availability, dissolved oxygen conditions and current of the water [5]. Jennifer [12] studied succession development of fouling communities on open ocean aquaculture fish cages in the western Gulf of Maine, USA. It was observed that the hydroids were dominated in the early months of culture during the present investigation. Blocher, [14, 13] and Jemimah EK [5] also recorded that Hydroids dominated in early months which was latter replaced by barnacles.

Barnacles are reported to breed round the year [15, 16] and

among the macro-fouling communities barnacle are most dominating macro-foulers along the Indian coasts [18, 16]. Present studies revealed that overall; the barnacles are the most dominating fouling organisms on the net panel at 3mt and 6mt depths in the marine cage farm at Karwar. In east coast, Kaplakkam waters, panel studies have shown similar results [17].

4. Conclusions

The study revealed that the occurrence of biofouling communities on cage panels varied significantly among the three depths and between the months. The barnacles and hydroids formed a major contribution of the fouling organisms throughout the study period. The barnacles are the most dominating fouling organisms present on the net panels at 3and 6mt depth. Regular net exchange at monthly intervals and washing and drying of the nets will reduce the fouling effect in marine farm.

5. Acknowledgement

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