Biodiversity assessment of sea cage farming sites in Gulf of Mannar, Tamil Nadu, India

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Introduction

Marine fin and shellfish farming is an age old practice across the globe to augment the seafood production and to supplement the protein rich food. The open sea cages are particularly advantageous for maintaining the brood stock of potential species like cobia (*Rachycentron canadum*) and silver pompano (*Trachinotus blochii*) for captive breeding. A large congregation of various bioresources are also found to be associated with cage farming (Imelda *et al.*, 2010). In the present study, an attempt was made to understand the biodiversity of the cage farming area at Mandapam in Gulf of Mannar, India.

Material and methods

Qualitative and quantitative estimations of phytoplankton, zooplankton and macrobenthos were made based on samples collected regularly from the cage farm site as well as from the reference site at Mandapam (09°27.70'N, 79°12.52'E) during Nov. 2009 – Jan. 2012. The cage site had cages for *Rachycentron canadum*, *Trachinotus blochii* and *Lates calcarifer* (Fig.1).

Fig. 1. A view of the cage farm site at Mandapam

The fouling communities in the cage nets were enumerated by placing quadrant of 1 square metre size on the cage nets that were beached at the time of net exchange. The fish diversity in the cage farm site was studied. The Shannon diversity index, H' (log e); Margalef's richness index, d; Pielous evenness index, J' and Simpson index, 1-Lambda' were assessed to understand the diversity of plankters and benthos. In the cluster analysis, Bray-Curtis similarity was used to construct the dendrogram. All the analyses for the diversity profile were done using the *PRIMER* (v.6) software (Clarke & Warwick, 2001).

Results

Phytoplankton, Zooplankton and Macrobenthos

A. Monthwise distribution :- 39 genera of phytoplankton, 20 groups of zooplankton and 4 groups of macrobenthos were observed and their monthwise distribution is given in Figs. 2-4. Phytoplankters belonged to the genera *Navicula, Rhizosolenia, Thalassiothrix, Pleurosigma, Coscinodiscus, Nitzschia, Melosira, Chaetoceros, Fragilaria, Biddulphia, Dinophysis, Ceratium* etc. were recorded. The zooplankters were Copepods, Prawn larvae, Crab larvae, Appendicularians, Medusae, Bivalves, *Balanus* nauplii, Cladocerans, *Lucifer* sp. etc. Bivalves, Gastropods, Foraminiferans and Polychaetes were the macrobenthos recorded.

It can be seen that in the case of phytoplankters, zooplankters and macrobenthos, no particular changing pattern is observed and the numbers showed fluctuations between cage and reference sites in different months.

B. Biodiversity :- The diversity indices of community structure of plankters and benthos are given in Table 1.

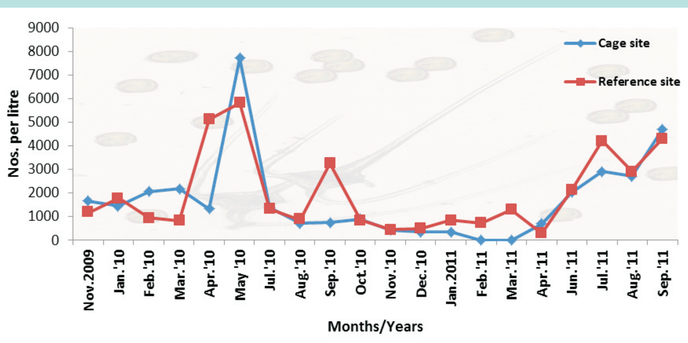

Fig. 2. Distribution of Phytoplankters at Cage and Reference sites

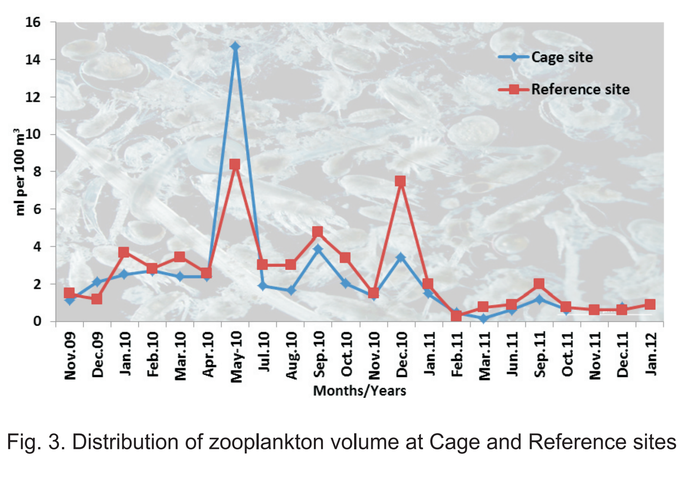

Fig. 3. Distribution of zooplankton volume at Cage and Reference sites

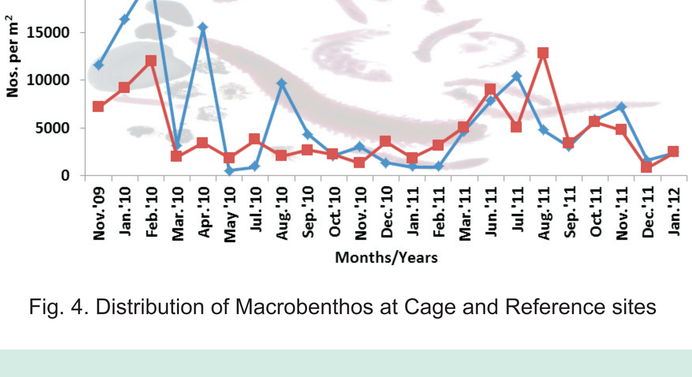

Fig. 4. Distribution of Macrobenthos at Cage and Reference sites

Table 1. Diversity indices of phytoplankton, zooplankton and benthos - Cage & Control sites

Diversity indices / Groups	Margalef's Richness index, d		Evenness index, J'		Shannon - Wiener diversity index, H'		Simpson index, 1-Lambda'	
	Cage site	Control site	Cage site	Control site	Cage site	Control site	Cage site	Control site
Phytoplankton	3.08	3.16	0.97	0.97	2.32	2.34	0.90	0.90
Zooplankton	2.61	2.48	0.93	0.93	2.32	2.28	0.89	0.89
Benthos	1.02	1.05	0.99	0.99	1.36	1.40	0.76	0.78

The richness index which incorporates the number of individuals and genus/groups was the maximum for phytoplankton followed by zooplankton and it was the minimum for benthos. The evenness index of phytoplankton and zooplankton/benthos did not show much variation. The Shannon-Wiener's index did not show much variation in the case of phytoplankton and zooplankton but it was slightly less for benthos. This was true for Simpson index also, which provide information on dominance of genus/group.

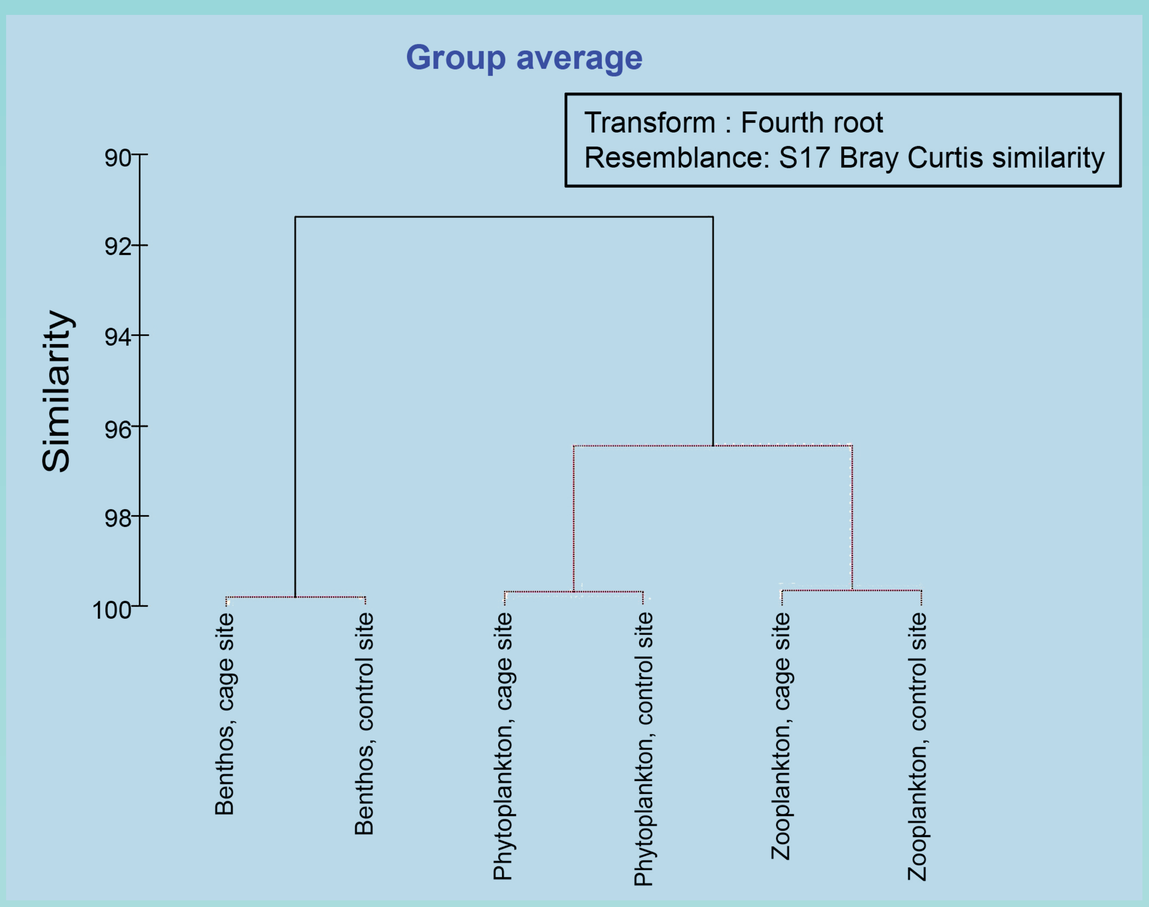

Fig. 5. Dendrogram of plankters and benthos during the study period

Dendrogram depicted in Fig. 5 indicates three clusters of phytoplankton, zooplankton and benthos. Again, Phytoplankton and zooplankton formed a single cluster and benthos joined to this at 96.5% similarity. All the four diversity indices and dendrogram indicate that the variations between cage and reference sites with respect to phytoplankton, zooplankton and benthos were negligible.

Fouling in cage nets

The fouling was found to be extremely high in the cage site at Mandapam and the dominant fouling community was the barnacles (915 nos./sq.m) which was followed by pearl oysters, rock oysters, sponges, seaweeds, Ascidians and *Modiolus* sp. (Fig. 6). The barnacles often form a very thick mat on the cage nets and smaller the size of mesh, the barnacle infestation was more, adding tremendous weight to the cage nets and minimizing water exchange to the cages (Badhul *et al.*, 2011). The composition of different fouling organisms on Pompano cage net during October, 2009 is depicted in Fig. 7.

Fig. 6. Heavily fouled cage net by barnacles at Mandapam

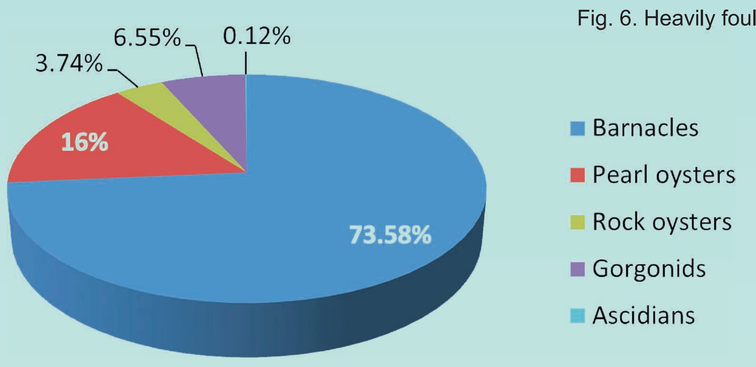

Fig. 7. Composition of fouling communities attached to the pompano cage net at Mandapam

Fish aggregation in the cage site

The fishes found in the cage farm site include *Scarus ghobban, Sardinella albella, Psammoperca waigiensis, Rastrelliger kanagurta, Leiognathus dussumieri, Siganus javus, S. canaliculatus, Lethrinus nebulosus* etc. indicating the rich aggregation of fishes in the cage farm site (Fig. 8-17).

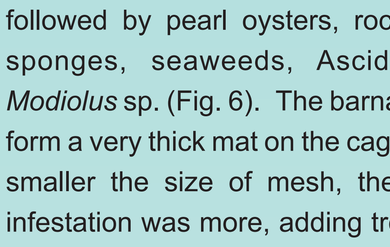

Fig. 8. *Scarus ghobban*

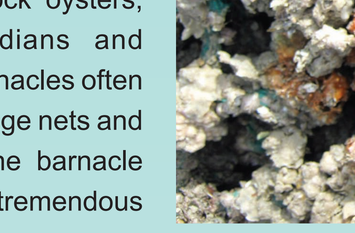

Fig. 9. *Siganus canaliculatus*

Fig. 10. *Parupeneus indicus*

Fig. 11. *Pellona ditchela*

Fig. 12. *Sardinella albella*

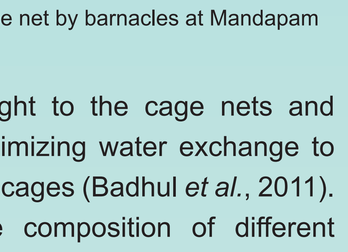

Fig. 13. *Trachinotus blochii*

Fig. 14. *Psammoperca waigiensis*

Fig. 15. *Lutjanus fulviflamma*

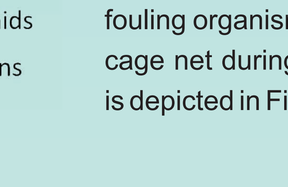

Fig. 16. *Lethrinus nebulosus*

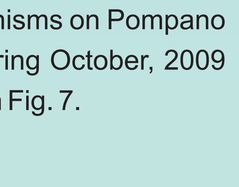

Fig. 17. *Chaetodon collare*

Conclusion

The cage farm had rich assemblages of phytoplankton, zooplankton and macrobenthos; besides rich aggregation of commercially important fishes. However, the rate of fouling was high compelling periodic cleaning and net exchange to facilitate good water exchange. Thus, the present investigation indicated that the cage culture activity had no adverse impact on the ecosystem using the present cage culture methodology and this can be popularised to enhance fish production.

References

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