

Status of sea cucumber resources and impact of fishing ban on the livelihood of fishers in Gulf of Mannar and Palk Bay

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Introduction

The sea cucumbers constitute an important part of non-fish income source for thousands of fishers along Gulf of Mannar and Palk Bay of south east coast of India. The fishery which is more than thousand years old was introduced by the Chinese stationed at Ramanathapuram, for preparing a dried sea cucumber product *Beche-de-mer*. The sea cucumber fishery in Gulf of Mannar and Palk Bay was artisanal in nature and consisted of fishermen who were good divers, the processors who acted as middlemen and the exporters. The sea cucumbers were chiefly collected by skin diving to a depth of 1.5 to 6.0 m in the shallow seas using non-mechanised country crafts. They were also caught as by-catch in trawlers locally known as *Thallu madi* (an indigenous modified trawler operating on wind power in shallow waters), besides the *Chanku madi* and *Attai madi* which were operated in deeper coastal waters.

Because of the increase in market demand, low cost of fishing and simple processing techniques for sea cucumbers, the industry developed as a lucrative business. Consequently, the resources were overexploited which was evident from the decline in catch and the size of the specimens fished/landed, poor catch per unit effort and decreased export volumes of processed sea cucumber from India. Since the sea cucumber fishery was not organized, management measures could not be implemented effectively. This was evidenced from the failure of the first legislation laid by the Ministry of Environment, Forests and Climate change,

Government of India in 1982 that imposed the ban on export of *Beche-de-mer* less than 75 mm. The fishery came to a stand still when the Ministry in the year 2003 included all the holothurians as protected animals along with 50 other marine species under the Indian Wild life (Protection) Act, 1972. The fishermen and traders strongly objected to this and representations were given several times to lift the ban, as it severely affected their livelihood. Several clandestine fishery and trade practices were reported for both raw and dried sea cucumbers trade from this region to neighbouring countries especially to Sri Lanka where sea cucumber fishery and trade is not banned. The fishermen who violated the law were also punished. The 14 years of ban might have helped in reviving the population, at the same time it also made a social and economic impact on scores of fishers dependent on the sea cucumber resources for their livelihood. To explore the possibilities of conservation and sustainable use of sea cucumber resource through community participation, ICAR-CMFRI had undertaken a short term project with funding support from BOBLME to study the present status of the sea cucumber stocks and the impact of current conservation measures on the stock and livelihood of fishers. Also, to suggest renewed management measures for the sustainable use of this resources. Some of the salient findings of the study are summarised below.

Status of sea cucumber resources

Of around 39 species of sea cucumbers reported from Gulf of Mannar and Palk Bay, only seven commercially valued species were being used for

Beche-de-mer preparation. Species like *Holothuria scabra* and *H. spinifera* along with *Bohadschia marmorata* and *H. atra* in small quantities were used for *Beche-de-mer* preparation during the initial period. Later, because of the poor prevailing market value, the processing of the latter two species were discontinued. Species like *Actinopyga echinites* and *A. miliaris* were also processed in huge quantities in the subsequent years. The intensive fishing paved the way for a sudden depletion of these two species that resulted in its total disappearance from fishery within a year. Similarly, *Stichopus chloronotus* that was once processed along Gulf of Mannar and Palk Bay also disappeared from the catches of sea cucumber. Occasional landings of *Stichopus hermanni* in large numbers was reported from Thoothukudi. Thus, the fishery of sea cucumbers along Gulf of Mannar and Palk Bay became centred around two species *H. scabra* and *H. spinifera* round the year and occasional landings of species like *Actinopyga echinites*, *A. miliaris*, *Stichopus hermanni* and *S. horrens*.

The status of sea cucumber population in Gulf of Mannar and Palk Bay was assessed by trawl and diving surveys by ICAR-CMFRI in 2015. The Swept Area Method was followed using a trawler (overall length 15m fitted with a 285 hp engine). Prawn trawl nets, modified with added sinkers or bobbins in the foot ropes locally called as '*Attai madi*' was used for the sea cucumber survey. Swept areas of 545,200 m² (13 trawl hauls) in Gulf of Mannar and 213,100

m² (12 trawl hauls) in Palk Bay were covered for the study. Seagrass was the major trawl catch component and sea cucumbers constituted the fifth major group that formed 3.4 and 3.04% of the catch in Gulf of Mannar and Palk Bay respectively.

Nine sea cucumber species with varying commercial values were collected from Gulf of Mannar. Medium valued *Stichopus horrens* (45%) was the major species followed by *Holothuria leucospilota* (27%), *H. atra* (16%), *Bohadschia marmorata* (8%), *H. scabra* (1.5%) and *H. spinifera* (1.5%). A few numbers of *Colochirus quadrangularis*, *H. edulis* and *Bohadschia* sp. were also observed (Fig. 1). In Palk Bay, six species were recorded. 85% of the catch was of the high value species *H. scabra* followed by *H. atra* (9%), *H. spinifera* (4%), *S. horrens* (1.5%), *B. marmorata* and *H. leucospilota* (Fig. 2). The diversity and density of sea cucumbers were higher in Gulf of Mannar than in Palk Bay which might be due to the greater depth and heterogeneous habitat of the region.

As a precursor to lift the ban, sea cucumber stock surveys were undertaken by Zoological Survey of India (ZSI) during 2006, 2011 and 2012 which reported the dominance of about 9 medium and low valued species in Gulf of Mannar with no improvement of stock. The survey conducted by CMFRI in 2015 for the BOBLME project also indicated the availability of around 9 number of species from Gulf of Mannar and Palk Bay with the numerical dominance of *S. horrens* from Gulf of Mannar and

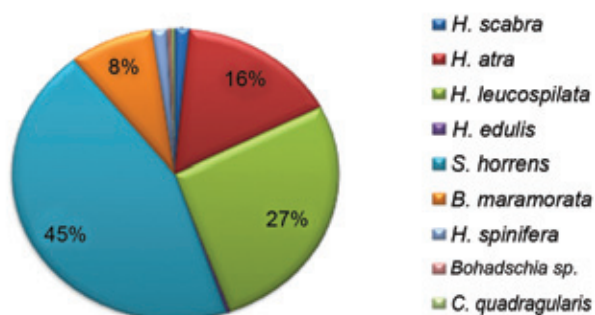


Fig. 1. Species composition of sea cucumbers recorded during surveys in Gulf of Mannar

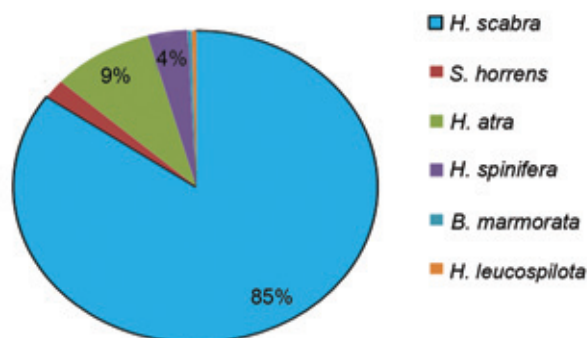


Fig. 2. Species composition of sea cucumbers recorded during surveys in Palk Bay

H. scabra from Palk Bay. All these post ban stock surveys confirmed the availability of high valued *H. scabra* and two medium valued species like *H. spinifera* and *Stichopus* spp. from this region. A few specimens of *Actinopyga miliaris* was reported during surveys in 2006 from Gulf of Mannar but was not reported in 2011 and 2012. Similarly none of the surveys indicated the occurrence of historically processed species *A. echinites* and *Stichopus chloronotus* from Gulf of Mannar and Palk Bay. This indicates the relatively high vulnerability of these species to fishing and the difficulty of depleted stocks to repopulate to its original level in Gulf of Mannar and Palk Bay because of its low reproduction or recruitment rate. All other species are relatively sturdy and less vulnerable to fishing pressure.

The individuals of *H. scabra* population in Gulf of Mannar was comparatively larger sized but in the Palk Bay most of them were medium sized. The length distribution pattern was unimodal for most of the species in Gulf of Mannar and Palk Bay. In Gulf of Mannar, the major species *Stichopus horrens* was collected from 59.7% of the survey sites and 13.6% each of the survey sites recorded high population abundance of $>1000 - >5000$ nos.ha⁻¹. Juveniles were abundantly distributed in seven sites. In Palk Bay, the major species *H. scabra* was reported from 96.2% of the survey sites and in 19.2% of the sites their density was >5000 nos.ha⁻¹ and 30.8% sites had density with >1000 nos.ha⁻¹ while in 34% sites juveniles were present. The studies on length weight relationship indicated allometric growth in sea cucumbers and it appears to be the general case of tropical holothurians. Study indicated that for a given length, the individuals collected from Gulf of Mannar were stouter than those collected from Palk Bay.

Influence of ban on livelihood of fishers

Sea cucumber landings were reported chiefly from 15 major centres in the Gulf of Mannar and from 25 centres in Palk Bay. It served as an important source of income for the livelihood of around 200000 fishermen in this area. The

interview survey was carried out in Gulf of Mannar (Ramanathapuram and Thoothukudi districts) and in Palk Bay (Ramanathapuram, Pudukottai and Thanjavur districts) to assess the impact of ban on livelihood of fishers in this area. A total of 21 villages in Gulf of Mannar and 20 villages in Palk Bay were selected for the survey. A total of 400 fishermen who have been specifically engaged in sea cucumber fishery, 80 middlemen and 20 traders were selected using proportionate random sampling technique from the selected villages. Data collection was done through interview method, key-informant interview and focused group discussions. Percentage analysis and Garrett ranking were done to process the data and arrive at meaningful conclusions.

All the respondents were involved in fishing/trade of sea cucumber, but 31% of the respondents had quit the sector after declaration of ban. They expressed the opinion that genuine fishermen and middlemen/traders have left the sea cucumber fishing as the ban affected their livelihood. They reported a loss in their regular income and they were also unable to take up other fishing activities due to lack of capacity for investment. Consequently, their debts increased and they were unable to give quality education to their children.

Before the ban, most of the fishermen (85%) sold sea cucumbers in the form of *Beche-de-mer* (processed) and remaining (15%) sold the sea cucumbers in fresh form. During ban only 5% of fishermen processed the sea cucumber, while the rest were selling it in fresh form. This was mainly due to the fear of being caught by the authorities during processing of sea cucumbers for violating the fishing ban. Fishers/middlemen/traders received a better price for processed sea cucumbers in comparison to fresh/unprocessed ones. When compared to exporters share, fishermen received ₹ 5,500 and ₹ 9,000 less per kg (20 counts) of processed sea cucumbers before and during ban respectively (Table 1). Thus it is clear that fishermen are receiving only half of the amount exporters receive in the sea cucumber marketing channel.



Bohadschia marmorata



Holothuria spinifera



Colochirus quadrangularis



Stichopus horrens



Holothuria atra



Holothuria edulis



Holothuria leucospilota



Holothuria scabra

*Bohadschia* sp.

Moreover, the price of sea cucumbers is high during ban enforced period in comparison to pre-ban period. The increase in price is due to the high demand in international markets and low supplies due to ban on sea cucumber fishing.

The results of interview survey based on the perception of fishermen reveals that the stock of sea cucumber population has increased significantly after the implementation of ban on sea cucumber fishing in the Gulf of Mannar and Palk Bay region. However, the clandestine collection of sea cucumbers and accidental catch in trawlers during the ban was also evident from the survey. The fishermen opined that the ban may be lifted at least for a few commercially important species with effective participatory co-management and conservation measures. The effective management measures suggested by them were: seasonal closure, size restriction, strict enforcement regarding banned gears and fishing methods, rotational harvest closures, stock enhancement through sea ranching, conducting periodical awareness

programme on conservation of sea cucumbers at village level, standardisation of commercial level seed production techniques of selected species of sea cucumbers and farming trials, demarcation of certain areas designated as No-Take Zone in consultation with the local communities and formation of fishermen co-operatives which can be given license for sea cucumber trade.

Total sea cucumber fishing ban versus regulated fisheries

The ICAR-Central Marine Fisheries Research Institute has played a significant role in the conservation of sea cucumbers in India. The institute implemented various projects since 1962 to study the systematics, biology, ecology, zoogeography, parasites and animal association, biotoxicity issues as well as captive breeding and farming of sea cucumbers. The institute has conducted several awareness creation programmes on importance of conservation of sea cucumbers for the fishermen of Gulf of Mannar and Palk Bay. The present ban on fishing and trade being implemented for more than 14 years has become ineffective because of the illegal removal of sea cucumbers and clandestine trade. However, if the ban is lifted, the following regulations are suggested to allow the conservation and sustainable utilization of the sea cucumber resources of the region. This can be achieved only through community participation which ensures their access to the resources along with shouldering the responsibility of conserving the resources. It is suggested that the moratorium may be lifted and fishing may be allowed with strict regulations. The

Table 1. Average market price (₹ per kg) for processed sea cucumbers

Supply chain	Before ban imposed		After ban imposed	
	20 counts	45 counts	20 counts	45 counts
Fishermen	5,000	2,000	9,000	3,000
1 st level middlemen	5,100	2,100	9,600	3,500
2 nd level middlemen	5,300	2,250	10,400	4,100
3 rd level middlemen	5,600	2,500	11,800	5,000
Traders	6,200	3,400	15,000	7,000
Exporters	10,500	5,000	18,000	11,400

(1US\$ = ₹ 64 approximately)

opinion gathered from interview surveys and consultations with stakeholders suggests that at least 4 or 5 regulatory measures may be needed to manage sea cucumber fisheries which are summarised below.

Seasonal closures

Seasonal closure is suggested to protect the reproductive stock for which peak spawning period of the commercially important species should be considered. Effective spawning of *Holothuria spinifera* and *H. scabra* occur due to changes in salinity, temperature and productivity of the environment, associated with the north east monsoon along south-east coast of India. Hence, seasonal closure of holothurian fishing is recommended from November to January which will ensure that the spawners breed and propagate their progeny.

Size regulation

The minimum individual length or weight of sea cucumber that can be legally fished or traded (Minimum Legal Size, MLS) is considered in this concept. It is based on the Size at First Maturity of sea cucumbers which generally varies with species. The size at first maturity estimated in the case of *H. scabra* is 230 mm. This can be implemented effectively through skin divers, who can visibly estimate the length and can perform selective harvesting, to avoid juvenile fishing. As sea cucumbers remain alive for some time even after capture, the juveniles collected by other modes of fishing like trawl nets can also be returned to sea.

Spatial closure and No Take Zone

The Marine National park located within the Gulf of Mannar Biosphere Reserve ensures the protection of sea cucumbers as fishing and other human activities are prohibited within the reserve. Such protected areas are absent in Palk Bay. The declaration of protected areas in Palk Bay would greatly ensure the protection of sea cucumber and seagrass population. As the sea cucumbers are density dependent breeders, the marine reserves

will help in maintaining the breeding population at adequate densities.

Gear regulations

This involves the prohibition or limit on the use of certain types, sizes or number of equipment for collecting sea cucumbers. Accordingly vigilance on the illegal operation of already banned destructive gears like *Thallu madi* and *Roller madi* operated in the inshore areas and seagrass habitats and the strict implementation of ban on operation of trawlers in inshore areas will reduce the damage to sea cucumber habitats and conserve sea cucumber populations in Gulf of Mannar and Palk Bay.

Catch quota

A catch limit or quota should be set for sea cucumber fishery, either for a year or for a fishing season. Quotas, also called "Total Allowable Catch" usually denote the weight in tonnes of live-weight or in terms of numbers also. This can be enforced for the holothurian fishery in Gulf of Mannar and Palk Bay also. This quota system allocated to each licensed fisher will provide a way to equitably distribute potential earnings from the resources. While it will be easier to implement catch quotas among small scale skin divers, it may be difficult for trawlers with high number of fishers participation.

Rotational harvest closure

This involves a periodic, temporal and spatial shifting of fishing effort, in a systematic way among demarcated fishing grounds. Rotational closure allows the size and abundance of sea cucumbers in the closed grounds to recover for a couple of years before being fished again.

Habitat protection

This measure ensures the protection of breeding habitats of sea cucumbers. Normally they occur in a variety of habitats like coral reefs, seagrass beds, salt marshes, mangroves, rocky, sandy and muddy shores etc. and there is a species specific habitat preference. Most of them prefer seagrass habitats

and as a result are profusely destroyed by trawl operations in these grounds. Similar to coral reefs, the protection of seagrass beds and their restoration helps in the conservation of sea cucumbers and other associated fauna. Interestingly, in neighbouring Sri Lanka which shares the Gulf of Mannar ecosystem with India, there is no trawl fishing. Here, the sea cucumber resources in the sea grass beds are reported to be abundant with high diversity.

Trade management

The illegal trade of sea cucumbers in Palk Bay and Gulf of Mannar at present involves a lengthy market chain of fishers, several middlemen, traders and exporters. If regulated fishery of sea cucumbers is permitted, it should be ensured that fishers receive a fair share of the export value by monitoring the income generated by the fishery. Monitoring the whole market chain from fisher to exporter allows government agencies to verify or set appropriate taxes and duties. It is necessary to have a process by which price data from the international market can be collected regularly.

Species requiring stricter management

The best way to manage the trade of sea cucumber fisheries is based on their population status. In Gulf of Mannar and Palk Bay, the fishery and trade of sea cucumbers were mostly restricted to two species namely, the high value *Holothuria scabra* and medium value *H. spinifera*. A few other medium value species namely, *Actinopyga miliaris*, *A. echinites* and *Stichopus hermanni* are fished and traded occasionally. The most widely traded species such as *H. scabra* and *H. spinifera* are more common whereas species like *Actinopyga echinites*, *A. miliaris* and *S. chloronotus* are rarely observed, indicating that the latter require more management.

Restocking and farming of sea cucumbers

One of the options for recovery of sea cucumber stocks is through restocking of juveniles and adults

through hatchery production and aquaculture. In India, the ICAR-CMFRI succeeded in the seed production of *H. scabra* in 1988 and *H. spinifera* in 2001. Further research has helped refining and standardising the mass production of seed of the two species. Programmes to grow hatchery-reared sea cucumbers in sea-pens (sea-farming) or in exclusively managed areas of natural habitat (sea-ranching) are growing in the Indo-Pacific region and Indian Ocean for the purpose of providing income for coastal communities. The community based management system ensures protection of released juveniles until harvest and these can result in small, but dense, breeding populations that improve egg production for rebuilding sea cucumber stocks in neighbouring fishing grounds. Community based sea ranching and farming enterprises can be initiated in Gulf of Mannar and Palk Bay, as we are bestowed with a vast coast line, island territories, bays and lagoons which favour such activities. Upgradation of the existing hatchery technique for cost effective, mass production of sea cucumber juveniles for sea ranching and farming activities can meet the growing market demand and in turn reduce the pressure on the wild stocks. This will aid conservation efforts and create a sustainable fishery that helps export of sea cucumbers from India.

Ecosystem approach to fisheries management

Effective management of sea cucumber fishery can be achieved by following an ecosystem approach, in which multiple regulatory measures are applied in a participatory manner in full consideration of the sea cucumber stocks, the ecosystems in which they live and the socio-economic systems. Considering the importance of multitude of critical habitats like coral reefs, seagrass beds, seaweeds, mangrove forests and rocky coast in this region, which also serves as the home for several endangered and vulnerable species habitats and species, it is worthwhile considering the management of entire area through an ecosystem approach jointly by India and Sri Lanka.