Trawl Net – Ecological Consequences and Abatement Measures

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SUMMARY

In the mechanized sector 46.5% of the catch was contributed by the mechanized multi day trawlers, 12.5% by single day trawlers.Due to over fishing and destructive fishing gear the coral reefs have been reduced to about 60% in southeast Asian region.During trawling, 281 sp. of juvenile finfish and shellfish is harvested as by-catch.During bottom trawling the top-level predators are removed or threatened by bottom trawling, which has a direct effect in the tropic level in the marine ecosystem. Bycatch Reduction Devices paved significant way to minimize environmental impacts caused by trawl net.

INTRODUCTION

Trawling is a method of fishing that involves towing a fishing net through the water behind one or two boats. The boats that are used for trawling are called trawlers or draggers. Trawl net is an advanced mechanically operated net used in industrial fisheries categorised under the bag nets. The trawl is cone-shaped net towed along the sea bed to capture demersal fishes or in mid water for pelagic species. In 2019, the marine fish landings are about 3.56 mt. In which, Tamil Nadu stands 1st position in India replacing Gujarat which contributes about 7.75lakh tones (21.8%) with an increase in marine capture fisheries. In that the mechanized sector contributing about 83%,in which 46.5% of the catch was by the mechanized multi day trawler, 12.5% by single day trawler, a total of 788 marine fish species were landed along the Indian coast(CMFRI,2018).Trawling is the major gear used to exploit marine resources along Indian coast. Penaeid shrimp are the main target of bottom trawl fishery. Out of 35,228 trawlers in the fishery, Tamil Nadu accounted for about 16.4%.
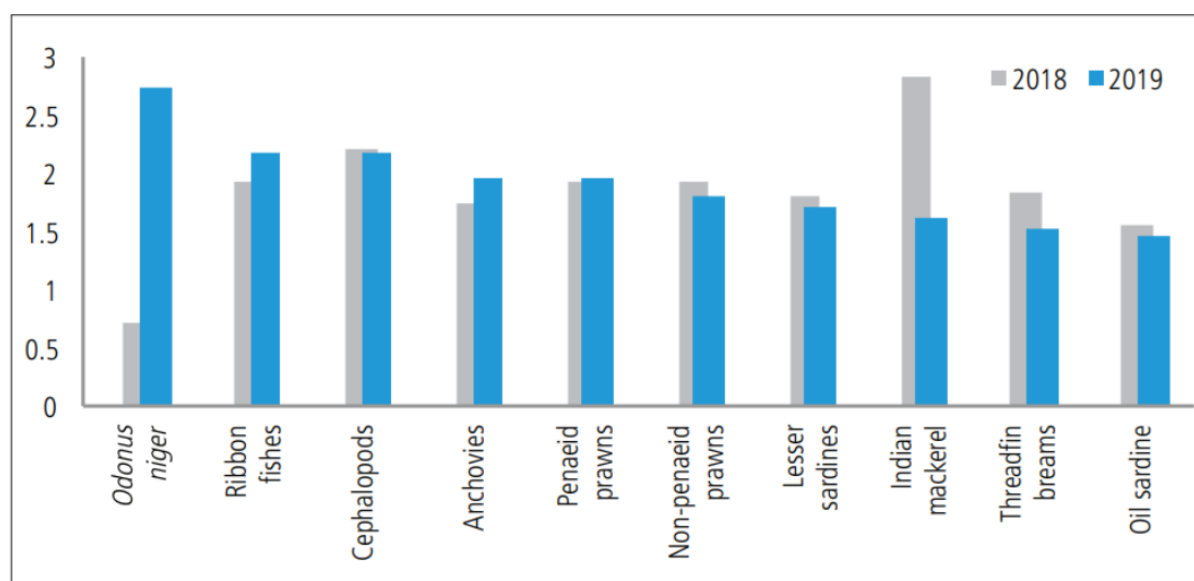

Fig1. All India landings of major resources

Impacts of trawling on Coral reef

Coral reefs are large underwater reef-building structures composed of the skeletons of colonial marine invertebrates called coral. The corals are classified into hermatypic or "hard" corals (*Acropora sp*) and non-hermatypic or"soft" corals (*Alcyonacea*) based on the reef building structures. They protect coastlines from the wave action and tropical storms, provide habitats and shelter for many marine organisms.They are the source of nitrogen and other essential nutrients for marine food chains, assist in carbon and nitrogen fixing.Because of the unknown commercial value of thecold-watercoral reef at the depth of 800-1300m are harvestedby operation of trawl net in west Ireland.Due to over fishing and destructive fishing gear the coral reefs have been reduced to about 60% in southeast Asian region. Deep-water coral *Lopheliapertusa* in Norwegian waters has been crushed due to trawl gear, wire, otter board although the region is richness in long line and gill netting.Octocoral

encountered in dredge operated at a depth of15-20m before trawling. Adult Coral in subtidal water of Veraval that is after the close of ban period not found.

Impacts of trawling on Seabed

The seabed is the bottom of the ocean is much important in terms of Biodiversityirrespective of depthTheimportant features of the ocean floor include the continental shelf, the continental slope, the continental rise, the abyssal plain, and ocean trenches.Before trawling the presence of organic carbon surface in the seabed is about 3500-4000µg/g,surface sediment chlorophyll ranges from 0.1-0.2µg/g but at 2-4cm sediment strata very low values of chlorophyll ranges from 0.07-0.25µg/g after trawling and the surface sediment phaeopigment ranges from 2-4µg/g has been reported. The significant difference occurs in organic carbon source on the ground affected by trawling. Thespecieshabited in seabed are less adaptive to change in marine sediment strata. The decade time required to rejuvenation of this damage.The efficiency trawling over the seabed depends on the design and method of rigging and the towing speed.The intense trawling lead to changes in primary sediment bedforms and textural rearrangement. In other word the portion of the catch from the trawl which is not targeted.

Impacts of trawling on By-catch

By-catch is defined as the the catch of marine species and other organisms harvested or caught into the net accidently. By-catch landings of trawlers in Karnataka, Kerala and Tamil Nadu during 1985–90 was recorded 20 genera of fishes, 26 genera of crustaceans, 23 genera of gastropods, 15 genera of bivalves, 10 genera of echinoderms, polychaetes, anemones, sponges, gorgonids, ascidians and echiuroids, besides a large number of juvenile young fishes and cephalopods.The by-catch encountered in shrimp trawling is ranged about 12.85 ± 1.97kgh^{-1}. By-catch ratio in accordance with shrimp is 1:0.6 to 1:6908. The high level of discard is during late pre-monsoon(Sept) ranges about 0.57lakh tonesdue to lack of sustainable method of harvesting the resources. The low level of discard is recorded during post-monsoon(Nov&Dec) ranges about 0.72lt. The highest catch per unit effort is about 83.4 kg/hr reported during monsoon and pre-monsoon, due to intensive trawling after the ban period. The lowest catch per unit effort is about 26.6kg/hr during post-monsoon period. Average catch per unit effort of discard is about 55kg/hr in which the maximum contribution of 90% (48kg/hr) is contributed by finfish.The highest range of discard shrimp per ratio is about 3:1 to 15:1 documented in shrimp trawl.

Impacts of trawling on benthic community

Benthic communities are largely composed of macroinvertebrates, such as annelids, molluscs, and crustaceans.The main reason for the regression of *Posidonia oceanica*resource is bottom trawling. This leads to loss of natural habitation for fishes and the recovery rates are also very slow. The impact of trawling is long lasting and there is a reduction in bioturbation zone and this will lead to of eutrophication. The large organisms are more affected compared to small organisms to trawling. Trawling creates a furrow on the seabed mainly due to otter trawling and dredges. The operation of beam trawl and scallop dredging leads to flattening of irregular bottom topography which leads to change in natural benthic community. The trawl penetrates to depth of 30mm in the seabed. The subtidal seagrass beds are lost due to large scale engineering activities leads rise to turbidity fluctuation.
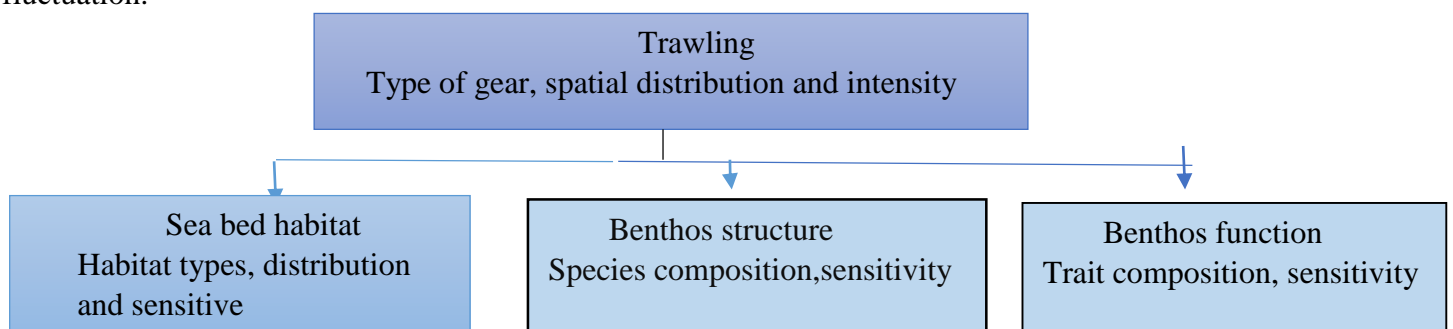

Fig 2. Impacts of trawl net on benthic ecosystem

Impacts of trawling on Food Chain

During bottom trawling the top-level predators (sharks) are removed or threatened by bottom trawling, which has a direct effect in the tropic level in the marine ecosystem. The total biomass food for the top-level predators are increased leads to a depletion in the next tropic level. The marine environment has the same level of impact due to the removal of low-level species. In this the effects in each trophic level are inversely proportional to thetop-level predators. Trawling reduces the total biomass of the macro infauna invertebrate communities, which leads to drop in the total food consumption rate because of the food(carbon) reaching the bottom are utilized by the mid pelagic species which caused scarcity among the benthic organisms. During trawling the species richness is about 50% and the magnitude change in biomass of the species is about 65%, which lead to gradual decrease in upcoming years. Change in the food web leads to change in the feeding behaviour, taxonomical changes, production changes and the species acquire a new habitat leads to difficulties in data collection, survey andmonitoring.In annual trawling, the small benthic fauna indicates the maximum fold range of about 17.5cm.

Impacts of trawling on Marine Mammals

Marine mammals are aquatic animals (seals, whales, manatees, sea otters and polar bears) that rely on the ocean and other marine ecosystems for their existence. During trawlingthree marine mammals of *Lagenorhynchusacutus(*white-sided dolphin), *Delphinus delphis* (common dolphin) and *Halichoerus grypus*(grey seal) have been identified.*The highest catch ratio is about* 0.0606 to 0.1000 per tow and 0.0107 to 0.0137 per hour is recorded in French sea bass fishery. Grey seal caught at a rate of 0.0513 per tow or 0.0396 per hour of towing.The food trophic level plays a major role in mammals. As there is a high destruction in the low trophic level competition between the mammals are greatly increased. This clearly evident that alteration in the marine ecosystem leads to distinct relationship between the marine mammal's predation and the potential catch by fisheries.

Mitigation measures

- Attaching the acoustic alarms in trawl to prevent mammals getting closure to the gear
- Restriction duration of trawling and regulated fishing grounds.
- By catch reduction has to be employed in trawl.
- Semi-pelagic trawls have comparatively low impact on the benthic biota, as it operates a little distance above the sea bottom. The area of seabed affected by high aspect ratio otter boards is typically 40% of the area affected by low aspect ratio otter boards with similar board area.
- By usingTurtle Excluder Device (TED) before the cod end of the trawl net at angle leading to upward and downward for escapement of turtle.
- Increase in cod end mesh size
- Conversion of trawler into tuna long liner cum gill netter.

Table1. By-catch exclusion and shrimp loss in different BRD's, during shrimp trawling operations off southwest coast on India

BRDs	By catch exclusion %	Shrimp loss %
Bigeye BRD	11.4-37-3	2.3-4.2
Fisheye BRD	46.6-62.7	0.8-3.8
Oval grid BRD	57.8-58.7	6.1-8.0
Sieve net BRD	14.7	4.5
JFE- BRD	42.9	5.2

Table2. Marine fish and shellfish landings in Kerala during pre-trawl ban (before 1988)   and post-trawl ban (after 1988) periods

Fishery items	Pre-trawl ban	Post-trawl ban	Impact
Marine fish & shell fish	3.5 lakh tonnes	5.7 lakh tonnes	70%
Prawn	33,000 tonnes	54,000 tonnes	60%

Squid & cuttle fish	10,000 tones	40,000 tonnes	400%
Perches	20,000 tonnes	54,000 tonnes	150%
Sciaenid's	30,000 tonnes	90,000 tonnes	300%
Demersal fishes	1,36,000 tonnes	2,62,000 tonnes	70%
Catch in trawl net/unit(kg)	492	702	210

CONCLUSION

Adoption of ecosystem-based fisheries management which incorporates responsible fishing practices strict regulation of fishing capacity and establishment of marine protected areas (MPAs) would facilitate protection and restoration of biodiversity and enhance the resilience of the fish stocks and ecosystem services. A wide range of proven technologies and procedures are readily available for minimizing the direct andindirect impacts of fishing activities on biodiversity. BRDs and TEDs need to be adopted and enforced legally in trawl net, under a participatory management regime to prevent marine mammal's mortality. Semi-pelagic trawling can be promoted as an alternative to shrimp trawling in small mechanised trawl sector in India, to minimize environmental impacts. Since trawling sector cause changes in ecosystem and the resources are over exploited. The trawl fishing can be legally prohibited in the country to make sure the sustainable harvest of resources. However, promotion of deep sea fishing, multi days gill netting and long line will help in resource conservation.

REFERENCES

B. MadhusoodanaKurup, P. Premlal, Joice.V.Thomas, and Vijay Anand, (2003), 'Bottom trawl discards along Kerala coast : A case Study' *School of Industrial Fisheries, Cochin University of Science and Technology, Fine Arts avenue. Cochin 682 01 6, India,1.* mar. biol. Ass. India, 45 (1): 99 – 107

J.K.Jethva, V.R.Madhu, B. meenakumari,Satyankumarpanda, P.J. Vaghela &Usha bhagiratham, (2014).'Impact of bottom trawling on the epifauna off veraval coast, India' *Indian Journal of Geo-Marine Science*, vol 43(2), pp, 297-312

K. N., and Diliberto, Smith, C. J., Papadopoulou, S.(2000). 'Impact of otter trawling on an eastern Mediterranean commercial trawl fishing ground.' – *ICES Journal of Marine Science,* 57: 1340–1351.

K. V. Jayalakshmy· B. Meenakumari · V. R. Madhu, S. K. Panda · D. T. Vaghela,Usha Bhagirathan(2008), 'Impact of bottom trawling on sedimentcharacteristics—a study along inshore waters off Veraval coast, *India' Springer Science + Business Media B.V.*DOI 10.1007/s10661-008-0700-0.

S. Behera b, T.S. Bhoumik b, , S.K. Chakraborty a, R. Samanta a, L. Shenoy a, T.S. Nagesh b, (2016),'Bycatch characterization and relationship between trawl catch and lunar cycle in single day Shrimp Trawls from Mumbai Coast of India' *Regional Studies in Marine Science,* Elsevier.