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Benefits of jellyfish blooms: perceptions of trawl fishers of the southeast coast of India

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Original Article

Abstract

Jellyfish have been considered a nuisance to fisheries since they are known to have adverse effects on the fishing operations of both mechanised and motorised crafts in many parts of the world. However, trawl fishers in the Gulf of Mannar are optimistic about better pelagic fish shoals during the peak season of *Cyanea* spp. in June to August. Therefore, personal enquiries were conducted to gather perceptions of trawl fishers in the Pamban Therkuvadi Fish Landing Centre. They observed jellyfish accumulations during the first few hauls, followed by a heavy catch of pelagics at 26-40 m depth off Mandapam. They also cited the occurrence of foraging fish shoals in jellyfish accumulations. The landings from mechanised fish trawls were dominated by bigeye scad (34%), barracudas (16%), round scads (12%) and Indian mackerel (3%) during the bloom period. The catch composition of finfishes was entirely different during the non-bloom period, as silverbellies, goatfishes, other carangids, especially trevallies, and pompanos, snappers, groupers, and lethrinids occurred more in the trawl landings.

Keywords: *Bigeye scad, Cyanea spp., Mandapam, pelagics, trawl fishers*

Introduction

Gelatinous zooplankton include pelagic Cnidaria (true jellyfish), Ctenophora (comb jellies) and Tunicata (salps). They are often perceived as a nuisance in marine ecosystems because they feed on the eggs and larvae of commercially important finfish, as well as shellfish, due to competition between jellyfish and fish for planktonic crustaceans, and by hindering the growth and movement of aquatic plants (Boero, 2013). Adverse impacts on fisheries due to jellyfish aggregations in fishing grounds include relocation to avoid blooms, loss of fishing time, extra hauls and sorting time, painful stings and gear damage (Kim *et al.*, 2012; Baliarsingh *et al.,* 2020; Chinnadurai *et al.*, 2023). The frequency and severity of this phenomenon have increased in some species and some regions cyclically several times over the past 50 years. Potential causes of jellyfish blooms include overfishing, global warming, eutrophication, transport of exotic species in ballast water in general, and the monsoon effects in particular in the Gulf of Mannar (Baliarsingh *et al.*, 2020). The positive impact of jellyfish blooms is seldom reported from India. The current paper aims to analyse the beneficial sides of jellyfish bloom along the Gulf of Mannar from the perceptions of trawl fishers.

Material and methods

Description of the fishery

Monthly samplings and personal enquiries with fishers using a pre-tested questionnaire were conducted at Pamban Fish Landing Centres (FLC), Gulf of Mannar (GoM) in Tamil Nadu during 2021-23. The survey was not conducted during May due to the trawl ban. Fishermen typically commence their journey at 06:00 and return by 08:00 the following day. During a single trip, each vessel makes 4–6 hauls, and the total operating time ranges between 12 and 18 hours. Single-day fish trawls that operate within the Ramanathapuram district of Tamil Nadu (GoM) are active on Mondays, Wednesdays and Fridays each week, a participatory management implemented by fishers and line departments. These vessels were fishing up to a depth of 25-60 m at a distance of 23-32 km from the shore in the GoM, which covers the fishing ground off Danushkodi in the north to off Kilakarai in the south. The fish trawl nets have a 5m to 6m mouth size and 25 to 30 mm code end mesh size. Based on the cyclic phenomena of meteorological events

experienced in the GoM, four seasons are broadly indicated as month-wise, and they are (1) Post–Monsoon (January to March), (2) Summer (April to June), (3) Pre-Monsoon (July to September), and (4) Monsoon (October to December). A legal ban on trawling was imposed in Tamil Nadu from mid-April to mid-June, and hence, there was no data during May.

Data on fish production were gathered from the National Marine Fisheries Data Centre (NMFDC), CMFRI, Kochi, which in turn collected and estimated the data based on a multi-stage random sampling technique stratified over space and time. Fish species were identified following FAO (FAO, 1983), and species composition was obtained from commercial catches. The locations of fishing grounds in the GoM are given in Fig. 1.

Description of the questionnaire

The questionnaire had queries related to the fish catch, species composition, fishing ground, and seasons. As the effect of jellyfish bloom was mostly confirmed to be associated with the mechanised single-day fish trawls of the FLC, 56 fishers (n=56) on 52 boats (out of 80) were surveyed fortnightly in every fishing month from the Pamban Therkuvadi fish landing centre. Open and closed-ended questions were included in the questionnaire. The second section of the questionnaire collected information regarding the whether they fished year-round, dominant species of fish they were catching most often and those species during the jellyfish bloom period particularly. The third section of the questionnaire asked the respondents to provide their opinion regarding the state of fishing, included best and worst periods of the year for fishing, how they get rid of the jelly mass. The fishers were provided the opportunity to explain their responses regarding the occurrence of jellyfish blooms in fish catch and adverse or beneficial outcomes.

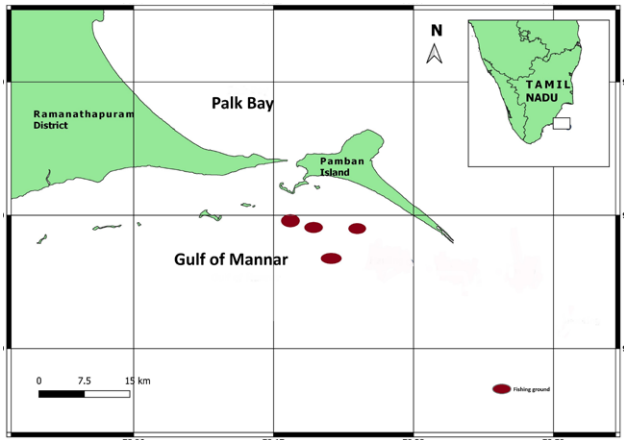

Fig. 1. Fishing grounds off Mandapam, Gulf of Mannar

Results and discussion

Single-day fish trawling consists of boats of 12.2-14.2 m overall length (OAL) and 148-193HP engine power, making six hauls per trip, each haul extends up to 3 hours. These vessels were fishing up to a depth of 25 - 60 m at a distance of 23-32 km from the shore in the GoM. The fishers observed jellyfish accumulations during the first 2 hauls, followed by a heavy catch of pelagics (400-780kg/boat) at 26-40m depth off Mandapam during June to August (pre-monsoon). The total fish landings in the GoM during 2021 to 2023 are presented in Fig. 2. The highest fish catch was observed during the pre-monsoon period, which would coincide with the jellyfish aggregations in the area. The average fish landing during the peak season was 70904.7 tonnes, at a 95% confidence interval (45658.6, 96150.8) tonnes, while the catches in other seasons were lower, at 34163.7 tonnes in summer, 38938.4

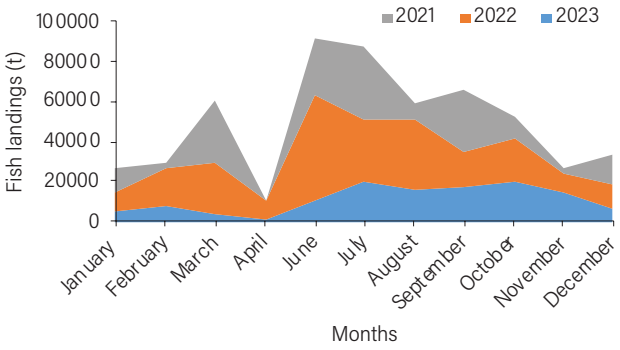

Fig. 2. Total fish landings by single-day trawlers in the study area during 2021-2023

tonnes in the post-monsoon season, and 37811.8 tonnes during the monsoon.

They also cited the occurrence of foraging fish shoals in jellyfish accumulations. The landings from mechanised fish trawls were dominated by bigeye scad (34%), barracudas (16%), round scads (12%) and Indian mackerel (3%) during the bloom period (Fig. 3). Fishers emphasised more catch of barracudas and pomfrets like high-value species during the jellyfish bloom period. The catch composition of finfishes was slightly different during the non-bloom period, as evidenced by more landings of silverbellies, goatfishes, other carangids, especially trevallies, and pompanos, snappers, groupers, and lethrinids during non-bloom periods.

The perceptions of fishers in the context of fish landings, the best season and ways for avoiding jellyfish masses are presented in Table 1. Most expressed a beneficial side of the bloom in Question 1. The most favoured season was pre-monsoon, when more catch coincided with the bloom period

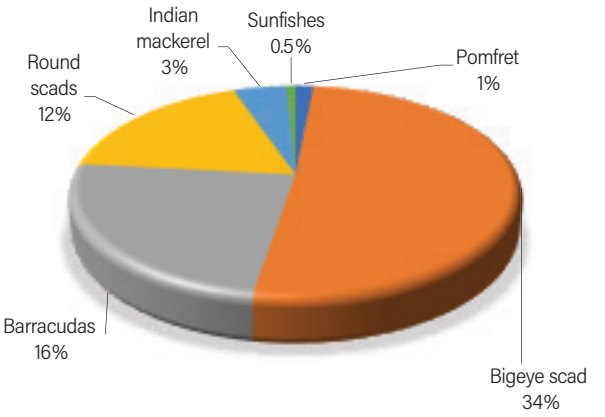

Fig. 3. Composition of major fish resources in Pamban FLC during the jellyfish bloom period

Table 1. Perceptions of fishers on jellyfish bloom

No.	Questions	Answers	Rspondents (%)
1	State of fishing during jellyfish bloom	Excellent	38
		Good	45
		Poor	7
		No opinion	10
2	Best periods of the year for fishing	Post-monsoon	10
		Summer	20
		Pre-monsoon	61
		Monsoon	9
3	How to get rid of the jelly mass?	Relocation	33
		Navigating through a jelly mass	18
		Discard	37
		Communication from fellow fishers	12

in the area. More or less equal proportion of the fishers avoid jellyfish masses by relocating the ground and discarding the jellyfish from the vessel. Many fishers' experience of the bloom period is that it favours more catch and the presence of high-value fish than in the non-bloom season. While some fishers made mixed observations as 'more or less', again depicting a positive hope over the bloom (Fig. 4).

The fishers categorised the adverse effects of the bloom as sorting and discarding of jellyfish from the remaining fish catch, which is the major negative side, followed by machine damage while dragging through the mass and/or hauling the net (Fig. 5).

Trawl fishers in the GoM observed jellyfish blooms during the pre-monsoon period, particularly in the 25 to 40-meter depth zone. Although jellyfish blooms are known to be a nuisance

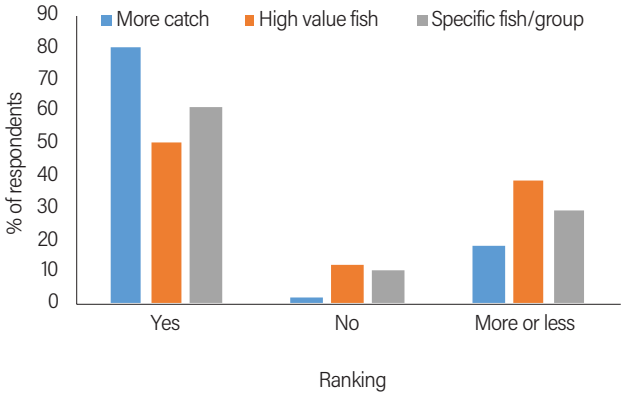

Fig. 4 Response from the fishing community on the beneficial side of jellyfish in fish landings

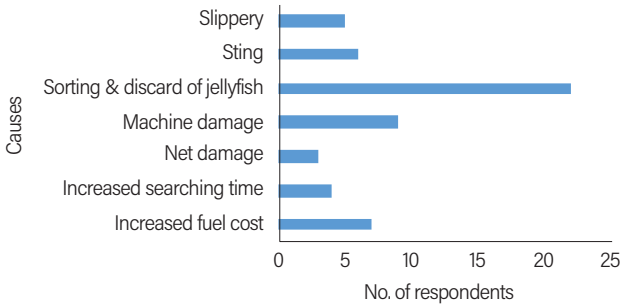

Fig. 5. Categorising the adverse effects of jellyfish bloom in the fishing ground of the GoM

to fishing vessels, gear, and the fishers themselves, their presence often signals an increase in catches of high-value fish in the region. Fishers believe that the bloom provides food for species like bigeye scad, round scad, mackerel, barracudas, and pomfrets. As a result, trawl fishers in the Pamban and Mandapam areas of the GoM are generally optimistic about the presence of *Cyanea* spp. blooms.

The reasons for jellyfish accumulations have been extensively studied across India and elsewhere. Surface currents and advection favour jellyfish aggregations (Johnson *et al*., 2005). Beach stranding of *Porpita porpita* along the Rameswaram coastline, GoM, might be due to cyclone Nivar, which swept members of the species towards the shoreline (Tharik *et al*., 2021). The aggregation of *Pelagia noctiluca* in the southern part of Hare Island and Manoli Island, GoM, during October 2018 has been studied (Ramesh *et al*., 2021). Scyphozoan medusae typically have a short generation time of two to seventeen months (Pitt and Lucas, 2014), and some scyphozoans like *Cyanea nozakii* prefer high temperature (23–26.8 °C) and high salinity (Lu *et al*., 2003). Higher incidence of *Cyanea* spp. aggregations/ blooms have been reportedly more frequent from 2011 to 2020. Thus, the rise in sea water temperature, accompanied by an increase in salinity in recent years, has

facilitated an increase in the incidence of aggregating jellyfish in Indian waters (Siddique *et al.*, 2022).

Seasonal oceanographic conditions prevailing during the summer monsoon, fall, and early winter may promote jellyfish aggregations and other mass occurrences. Only two jellyfish species were known to form aggregations during 1981-1990, but the diversity of jellyfish species increased to nine by 2011-2020 (Siddique *et al.*, 2022) in India. Jellyfish may play a keystone role in avoiding the monopoly of a few species resulting from abnormal reproductive success through active predation on them (Boero, 2013). Therefore, amidst numerous harmful effects, jellyfish bloom does have a few beneficial aspects, as shown in the present study. Continuous field monitoring, as well as gut content analysis coupled with DNA sequencing, would help to shed more light on the impacts of jellyfish bloom on the commercial fishery.

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Author contributions

Conceptualisation: RL, SR, TS, SJK; Methodology: RL, SR, TS; Data Collection: RL, MM; Data Analysis: RL, SR; Writing Original Draft: RL; Writing Review and Editing: RL, SR, SJK; Supervision: RL

Data availability

The data are available and can be requested from the corresponding author

Conflict of interest

The authors declare that they have no conflict of financial or non-financial interests that could have influenced the outcome or interpretation of the results.

Ethical statement

No ethical approval is required as the study does not include activities that require ethical approval or involve protected organisms/ human subjects/ the collection of samples/ protected environments.

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