



Research Note

Depredation and Catch Loss due to the Interaction of Aquatic Organisms with Ring Seines off Cochin Region

Leena Raphael, Rithin Joseph and Leela Edwin*

ICAR- Central Institute of Fisheries Technology, P. O. Matsyapuri, Cochin - 682 029, India

Depredation is the removal of or damage to captured fish or bait (commercial or recreational), caused by predators. Dolphins depredate or steal the catch of fishers. Humpback dolphins are the most common cetaceans found in Indian waters and are known to cause damage and depredation of fish from certain fishing gears (Dipani et al., 2015). Depredation results in economic, social and ecological impacts and thus decreasing the fishery landings and threatening marine predator population through increased risk of entanglement (Rafferty et al., 2012). The significant socio-economic impact of puffer fish on the local fisheries of the Eastern Mediterranean countries was reported by Kaligirou, 2010. Sherief et al. (2015) had reported the depredation and food loss in gillnets along Lakshadweep waters. Fishery Survey of India (2008) has analysed the area-wise depredation rate of the tuna long line vessels in the three regions of the EEZ and the depredation rate is found to be higher in Andaman and Nicobar waters for the depredated cruises (2.99%), followed by Arabian Sea (2.57%) and Bay of Bengal (2.08%). Tett & Mills (1991) report that a shift from diatom to flagellate dominance in phytoplankton communities could lead to the replacement of crustacean zooplankton and fish by cnidarians such as jelly fish as primary predators.

The catch of pelagic fishes formed 61% of total marine fish production (4.82 lakh t) of Kerala during 2015. Ring seines contributed 25% of the total landings of the state (CMFRI, 2016). Ring seines, otherwise known as mini purse seines are a group

of lightly constructed purse seines which are one of the most efficient gears for catching pelagic resources (Edwin et al., 2014; Edwin & Das, 2015). According to estimates by CMFRI, there are 495 mechanised ring seiners in operation in Kerala of which 18.2% are from Ernakulam district (CMFRI, 2012; Edwin et al., 2014). Large meshed ring seines known as '*thanguvala*' have a mesh size of 16-22 mm, length ranging from 600 to 1500 m and hung depth between 83 to 100 m. They are operated at a depth of 30-50 m, having 40 to 60 fishers on-board. There are two smaller versions of small meshed ring seine known as '*choodavala*' with a mesh size of 8-14 mm, length of 250 to 500 m, depth of 45-75 m and operated at a depth of 10-20 m for anchovies. This gear is operated by 10-15 fishers. The second modified form of small meshed ring seines have recently emerged in central Kerala with dimension of 140-250 m in length, depth of 23-45 m and mesh size of 8-10 mm. This gear is operated at a depth of 12-18 m from small canoes with an L_{OA} of 12 m and propelled by outboard motors (OBM). These small meshed ring seines are entirely constructed using nylon multifilament with selvages made of HDPE webbing.

The operational hazards faced by the ring seine fishers include the attack by cetaceans, puffer fish bites, entanglement of small fish like *Ambassis* spp. and jellyfish blooms which may enter ring seines. The damage caused by aquatic organisms results in economic loss due to damage of net, expenditure for repair and also loss of fishing days. The main objective of this study was to identify and quantify the menace caused by aquatic organisms in the ring seine fishery along Cochin in terms of economic loss.

Out of 61 units operating from Chellanam fishing village 20 units were selected randomly for data

Received 13 December 2016; Revised 27 February 2017; Accepted 02 March 2017

* E-mail: leelaedwin@gmail.com

collection. The small units landed their catch at Chellanam mini fishing harbour and the larger units landed their catch at Kalamukku landing centre. This study was conducted from November 2015 - October 2016. Information on 240 fishing trips was collected from the selected units. Details regarding the damage caused to ring seines were collected from fishers and boat owners from the landing centres through structured pre-tested questionnaire prepared for the purpose. Information was collected on the seasonal interaction of aquatic organisms, level of damage, catch loss, details of cetacean sightings and bites, major species involved in the attack and traditional methods employed for deterring damage to nets. The fishers were shown coloured photographs of cetaceans and asked to identify the species. Depredation and catch loss are expressed as percentage of total catch.

About 90% of the fishers interviewed reported of having faced cetacean attack during the pre monsoon and post monsoon period. The positive side of cetacean interaction is that when cetacean occurrence is noticed the fishers can ascertain the presence of pelagic fish shoals nearby. Dolphins and other cetaceans come within the vicinity of the ring seines during the time of aggregation and brailing of the catch. The cetacean attacks in small meshed ring seines are frequent during the month of August - May and least during monsoon months. Fishers believe that dolphins come near the shore from the deeper waters due to the scarcity of fish in the sea. During each month about 10 to 15 kg of webbing is replaced by the fishers due to dolphin attack.

The dolphins come in groups of about 2-10 and bite the bunt region of the ring seine where the catch is concentrated. The spinner dolphin (*Stenella longirostris*) is the dominant species observed in Cochin region. The humpback dolphin (*Sousa chinensis*) is another species causing damage to the gear. Other species like bottlenose dolphins (*Turisops aduncus*), long-beaked common dolphin (*Delphinus capensis*) and Rissos dolphin (*Grampus griseus*) are also seen associated with pelagic shoals but do not cause depredation. Fishers report that dolphins selectively attack sardines and mackerel catch, and not other species like *Ambassis*.

The conventional methods employed by the fishers to deter the cetaceans are fireworks, throwing stones, throwing bait fish to distract and fishers jumping into the water to scare them away. With the

dual intentions of conserving dolphins and reducing the operational hazard to ring seine fishers developed a special type of net that forms an outer protective wall to the ring seines known as "Pannivala"/Dolphin Wall Net (DWN) (Prajith et al, 2014). The DWN is used only in large ring seines. The danger posed by using DWN is that the feet of fishers gets entangled when fishers jump into the sea to keep away dolphins.

Rarely groups of 20-30 dolphins have also been reported by fishers operating off Cochin.

Puffer fish bite is another major problem faced by fishers during the monsoon and post monsoon seasons. In the present study 75% fishers reported puffer fish bite mainly in the bunt region of the ring seine. When more puffer fish gets caught inside the gear along with the targeted species they prey upon the catch and tear the webbing. The dominant species causing damage is the smooth blaasop (*Lagocephalus inermis*). *Arothron* spp. and *Diodon* spp. are also reported and cause damage to the gear. Fishers opined that the puffer fish menace started in Kerala coast after the 2004 tsunami. Mohamed et al. (2013) reported that one of the reasons for the increase in puffer fish is due to the decline of predatory fishes such as Cobia (*Rachycentron canadum*). Puffer fish attacks are often reported from different parts of the world (FAO, 2012).

During the study about 82% fishers reported jellyfish interaction. The fishermen had to sometimes intentionally give up the entire catch to prevent heavy damage of the net. They sometimes cut off portions of the net in order to release the jellyfish into water fearing random tearing of the net. *Marivagia stellata* is the dominant species and other species like *Lychmorhiza malayensis* and *Chrysaora caliparea* also caused menace. Fishers report maximum occurrence of jelly fish is during the post monsoon season. *Chrysaora caliparea* causes heavy sting when coming in contact with the body and when it enters the net this species is mixed up with the catch. Fishers do not operate the net when jelly fish occurrence is noticed along with fish shoal. *Marivagia stellata* is a cepheid scyphozoan which was initially described from the Mediterranean coast of Israel by Galil et al. (2010) and from Kerala coast by Galil et al. (2013). The increase in jellyfish population along the southwest coast of India in recent years correlate well with the increase in the occurrence of algal blooms in the coastal waters, a

consequence of the nutrient run off from land (Nandakumar, 2013). Panda & Madhu (2009) has investigated the ascendance pattern of jellyfish biomass in coastal waters off Veraval. Jelly fish tend to thrive in polluted waters due to lack of competition posed by other aquatic organisms. Over-fishing has also caused the reduction of natural jelly predators like the tuna and sea turtle and probable reduction of small pelagics has reduced competition for food leading to increase of jelly fish population.

Entanglement of fishes belonging to the family Ambassidae is another problem faced by fishermen operating large meshed ring seines (*thanguvala*) during the monsoon and post monsoon season. Twenty five percent fishers reported this problem during the study. The large mesh ring seines usually target sardines and mackerel. When *Ambassis* is gilled/entangled considerable time and labour is lost for removing each fish from the net. *Ambassis gymnocephalus* is the most common species found entangled in the ring seines. There are no reports of entanglement in small meshed ring seines (*Choodavala*) (Edwin, 1997).

About 200-350 kg of nylon webbing and 700 kg of nylon webbing is estimated to be discarded each year in small and large ring seines annually due to attack by cetaceans and other organisms. In large ring seines on an average about 1000 kg of webbing is used for mending and patching purposes annually. The economic loss caused by dolphin attacks ranges from Rs.10000-15000 month⁻¹ and in some cases when the attack is severe, upto Rupees three lakhs is spent for repair. Loss of fishing days for repair is another associated loss.

Puffer fish bite causes serious damage and the total repair costs upto Rs.1- 3 lakhs. In small ring seines, about 20-30 kg of net has to be replaced after every puffer fish attack. Fishers report that once the jelly fish enters the net, they sacrifice their catch worth Rs.2000-3000 in order to save the gear. Sometimes when large jellyfish bloom is noticed the fishers operating small ring seines return to the shore incurring a loss of Rs.1500 day⁻¹ spent on fuel. In large ring seines if *Ambassis* spp. entanglement takes place, besides forfeiting the fuel cost of around Rs.18000/trip, the fishers are unable to use the gear for fishing until the entangled fish are removed which involves a labour of a couple of days or sometimes more. The wages for dislodging the entangled fish is Rs.700/person/day and atleast 25 persons are engaged to make the 1500 m long net reusable.

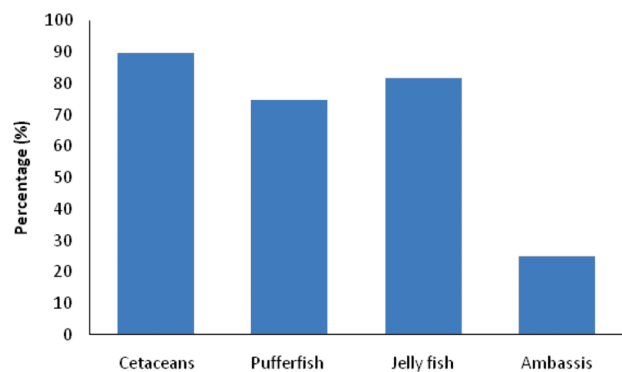


Fig. 1. Percentage attack reported by aquatic organisms during the study period

Table 1. Species causing menace in ring seines

| Aquatic organisms | Family | Scientific name | Common name |
|-------------------|----------------|-------------------------------|----------------------|
| Cetacean | Delphinidae | <i>Stenella longirostris</i> | Spinner dolphin |
| | Delphinidae | <i>Sousa chinensis</i> | Humpback dolphin |
| Pufferfish | Tetraodontidae | <i>Lagocephalus inermis</i> | Blaasop fish |
| | Tetraodontidae | <i>Arothron</i> spp | Fat puffers |
| | Diodontidae | <i>Diodon</i> spp | Porcupine fish |
| Jellyfish | Cepheidae | <i>Marivagia stellata</i> | - |
| | Lychnorhizidae | <i>Lychnorhiza malayensis</i> | - |
| | Pelagiidae | <i>Chrysaora caliparea</i> | - |
| Fish | Ambassidae | <i>Ambassis gymnocephalus</i> | Bald glassy perchlet |

One of the interventions to reduce the dolphin attack in ring seines is the use of acoustic deterrent devices such as pingers. Pingers are often referred to as acoustic alarms, as they are designed to alert marine mammals of the presence of nets without causing pain or damage to the animal's auditory system (Kraus, 1999). These acoustic pingers can be fitted in the bunt region of the net where heavy attack is noticed. Another measure to reduce the puffer fish attack is the use of stronger netting material such as UHMWPE (Ultra-high-molecular-weight polyethylene) for construction of bunt portion of ring seines. UHMWPE is three times stronger than nylon of equal dimension and its abrasion resistance is also high (Thomas & Edwin, 2012), which can prevent damage due to bites. Special escape panels (Madina panels) which are sections of fine mesh prevents dolphins from becoming entangled in the gear (Ben-Yami, 1994), can also be experimented in the Indian conditions.

In Kerala, non motorised/motorised traditional fishing vessels play a major role in ensuring livelihood of the fisher folk. The interaction of aquatic organisms and pelagic fishery has been a major issue in this small scale sector. Depredation by cetaceans and puffer fish is a growing problem in other fishing gears also, that has serious economic implications for fisheries. The loss incurred due to interactions can be mitigated by using some of the measures mentioned here. *In-situ* underwater studies on the behaviour of the cetaceans and other species that depredate the catch, can help in developing suitable interventions to reduce the menace caused by these species in the Indian waters.

Acknowledgments

The study was carried out as part of the project "Green Fishing Systems for Tropical Seas" funded by the "National Agricultural Science Fund (NASF)" ICAR. The authors are thankful to NASF and Director, Central Institute of Fisheries Technology, Cochin for providing the necessary facilities.

Reference

- Ben-Yami, M. (1994) FAO Purse Seining Manual, Fishing News Books LTD., Oxford: 406 p
- CMFRI (2012) Marine Fisheries Census 2010, Part – I Kerala, Published by Central Marine Fisheries Research Institute, Government of India, Ministry of Agriculture, Department of Animal Husbandry, Dairying and Fisheries, New Delhi, 96 p
- CMFRI Annual Report (2013-2014) Central Marine Fisheries Research Institute, Cochin
- Dipani, S., Divya, P., Ketki J., Mihir, S., Rahul, M. and Isha, B. (2015) Humpback dolphins (Genus *Sousa*) in India: an overview of status and conservation issues. *Advances in Marine biology* 72: 229-256
- Edwin, L. (1997) Studies on the ring seine fishery of south Kerala coast. Ph.D Thesis, Cochin University of Science and technology, Cochin: 138 p
- Edwin, L. and Dhiju, D.P.H. (2015) Technological changes in ring seine fisheries of Kerala and management implications. Central Institute of Fisheries Technology, Cochin: 104 p
- Edwin, L., Thomas, S.N., Pravin, P., Remesan, M.P., Madhu, V.R., Baiju, M.V., Sreejith, P.T., Ravi, R. and Das, D.P.H. (2014) Fishing system catalogue 1- Mechanised marine fishing systems: Kerala, Central Institute of Fisheries Technology, Kochi: 113p
- FAO (2012) EastMed TECHNICAL DOCUMENTS The Puffer Fish *Lagocephalus sceleratus* (Gmelin, 1789) in the Eastern Mediterranean
- Fishery Survey of India (2008) Depredation in the longline fishery of the Indian waters. Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture, government of India 29: 27 p
- Galil B.S., Gershwin, L.A., Douek, J., Rinkevich, B. (2010) *Marivagiastellata* gen. et sp. nov. (Scyphozoa: Rhizostomeae: Cepheidae), another alien jellyfish from the Mediterranean coast of Israel. *Aquatic Invasions*, 5: 331-340
- Galil, B.S., Kumar, B.A. and Riyas, A.J. (2013) *Marivagiastellata* Galil and Gershwin, 2010 Scyphozoa: (Rhizostomeae: Cepheidae), found off the coast of Kerala, India. *BioInvasions Records*, 2, 317-318
- Kalogirou, S., Corsini-Foka, M., Sioulas, A., Wennhage, H. and Pihl, L. (2010). Diversity, structure and function of fish assemblages associated with *Posidonia oceanica* beds in an area of the Eastern Mediterranean Sea and the role of non-indigenous species. *Journal of Fish Biol.* 77: 2338-2351
- Kraus, S. (1999) The once and future ping: Challenges for the use of acoustic deterrents in fisheries. *Mar Technol Soci J.* 33(2): 90-93
- Mohamed, K.S., Sathianandan, T.V., Kripa, V. and Zacharia, P.U. (2013) Puffer fish menace in Kerala: a case of decline in predatory control in the southeastern Arabian Sea. *Current Science*, 104 (4): 426-429
- Nandakumar, T. (2013) Jellyfish proliferating along Kerala coast. *The Hindu*. (www.thehindu.com)
- Panda, S.K. and Madhu, V.R. (2009) Studies on the preponderance of jellyfish in coastal waters of Veraval. *Fish. Technol.* 46(2): 99-106

- Prajith, K.K, Dhiju, D.P.H and Edwin, L. (2014) Dolphin Wall Net (DWN) – An innovative management measure devised by ring seine fishermen of Kerala-India to reducing or eliminating marine mammal fishery interactions. *Ocean & Coastal Management* 102: 1-6
- Rafferty, A.R., Brazer, Jr, E.O. and Reina, R.D (2012) Depredation by harbour seal and spiny dog fish in a Georges Bank gillnet fishery, *Fish Manag. Ecol.* 19: 264-272
- Sherief, M.P.S., Dhiju D.P.H., Thomas, S.N. and Edwin, L. (2015) Food loss from gillnets operated in Lakshadweep water, ICAR-Central Institute of Fisheries Technology, Cochin. *Fish Tech Rep. I* (2), July-December 2015
- Tett, P., and Mills, D. (1991) The plankton of the North Sea: Pelagic ecosystems under stress? *Ocean and Shoreline Management* 16: 233-257
- Thomas, S.N. and Edwin, L. (2012) ICAR- Fish Technology Newsletter Vol. XXIII / No. 4, October -December 2012: 3-7