CIFT-Turtle Excluder Device (TED): Development and regulatory aspects

The following article is a part of FIFP webinars conducted on 5th December 2020 on the topic Certifications and regulations in seafood industry.

Note from the Chief Editor:

Certifications and regulations in seafood industry comprised the main theme of FIFP webinar conducted on 5th December 2020. In all, three presentations were made that covered Development and regulatory aspects of CIFT-Turtle Excluder Devices; Blue labelling Indian seafood: a sustainable seafood certification; and Food safety, QHSE and ethical certification schemes for seafood processing industry. Dr Leela Edwin traced the origins of trawling in India and contribution of CIFT in the development of improved fishing gear and craft technologies; and the role of CIFT in the conservation of sea turtles through design and fabrication of CIFT-TED was highlighted. She brought out the need for installation of turtle excluder devices in trawls to reduce the incidental catches and mortality of sea turtles of India. She elaborated on the design and fabrication of CIFT-TED in the context of turtle incidence in fishing gears. She provided details of conduct of experiments/field trials and demonstration with CIFT-TED on the west and east coast of India. She stressed the need for a sufficiently attractive system of incentives to promote the use of TEDs.

Abstract

CIFT Turtle excluder device (TED) installation in shrimp trawl nets intent to reduce the incidental catches and mortality of sea turtles of India. Sea turtles play a significant role in maintaining the balance of the food web in marine ecosystem. Among the five species of marine turtles, Olive ridley is the widespread species in Gahirmatha, Orissa, along north-east coast of India. Incidental mortality of sea turtles is due to the fishing practices such as trawling and gill netting operated in India. CIFT-TED, a single-grid with a top opening consists of a 1000x800 mm stainless steel oval frame with inside five 8 mm vertical grid bars is welded and fixed at a 45°angle. CIFT- TED experiments were successfully conducted in Cochin, Gahirmatha, Paradip, Debi and Visakhapatnam coast of India. CIFT-TED saves sea turtles with minimal catch loss as per the experiments conducted in west and east coast of India.

Introduction

Marine fisheries of India

Marine fisheries played a pivotal role in ensuring food and nutritional security of the growing population, enhanced income and foreign exchange earnings. Fishing is one of the largest industries in the country, providing almost 14 million people with employment (Boopendranath et al, 2010). The estimate of marine fish landings in

India for the year 2019 is 3.56 million tonnes compared to 3.49 million tonnes in 2018, showing a marginal increase of about 73,770 tonnes (2.1%). The mechanized sector contributed 2.98 million tonnes (83%) towards the total landings in 2019 which is 0.13 million tonnes more than that in 2018. (CMFRI, 2019). There are over 3432 marine fishing villages in India with a total marine fishermen population of 4 million, of which nearly one million are active fishers. The milestone of fisheries development in India was the introduction of mechanized boats during 1970s, mainly trawlers. Fishing fleet of India has been tremendously increasing after the introduction of mechanized boats. According to CMFRI Marine Fisheries Census, India has 199,141 fishing vessels comprising 72749 mechanized boats, 73410 motorized boats and 52982 non-motorised vessels operating along the 8118 km coastline of India (CMFRI, 2010).

Trawling in terms of investment and yield is known to be a very successful way of fishing for demersal populations. Over the years, trawling that targets primarily shrimps have gained attention and contributed to the growth of an organized fishing industry (Prakash, 2019). Trawlers make up almost 80 % of India's small-scale mechanized fleet. A top offender in bycatch capture, commercial shrimp trawling in tropical waters accounts for around 27 % of all global discards. In general, shrimp trawling is considered one of the least selective methods of fishing because bycatch may consist of more than several hundred teleost species (Eayrs, 2007). Rajagopalan et al. (1996) reported that 17.8% of the incidental catch along the Indian coasts was caused by trawls.

Origins of the trawling

During the exploratory surveys carried out by S.T. Premier, off the Bombay coast in 1902, trawling was first attempted in Indian waters and during 1906-07 by the Ceylon Company for Pearl Fishing Survey. Pair trawling operations were undertaken between 1947-1953 by the Japanese trawler Taiyo Maru 17. Shrimp trawling was launched off the coast of Malabar in 1955, using a 9.6 m head rope Gulf of Mexico style flat trawl. The rapid growth of otter trawling in Indian waters was triggered by the increased demand for shrimp for the processing industry.

Several prototypes of mechanized trawlers made of wood and fuel-efficient combination steel vessels designed for stern trawling have been launched by the Central Institute of Fisheries Technology. Different bottom trawling gear designs such as two seam and four seam trawls, long wing trawl, bulged belly trawl and six seam trawls were also implemented by CIFT, as well as energy-saving concepts such as rope trawl and broad mesh trawl and ancillary devices such as trawling otter boards. Bottom trawling is an important way of fishing for demersal, a less selective technique of fishing. A variety of non-target items, which may include protected and endangered species such as sea turtles, are also captured during trawling, along with the target resources.

Sea turtle fauna of India

Sea turtles were considered an important exploitable fishery resource due to their high commercial value. Turtle meat and eggs have been used as a fundamental source of protein for coastal communities. (Rajagopalan, 2008). In marine ecosystem, sea turtles play a significant role in maintaining the balance of the food web. The most significant factor contributing to the mortality of sea turtles is reported to be the accidental capturing of turtles in shrimp trawls. (Jeyabaskaran & Kripa, 2018). Five species of marine turtles viz., Olive Ridley turtle (*Lepidochelys olivacea*), Loggerhead turtle (*Caretta caretta*), Leather back turtle (*Dermochelys coriacea*), Hawksbill turtle (*Eretmochelys imbricata*) and Green turtle (*Chelonia mydas*) are known to inhabit the Indian coastal waters (Rao, 2011). Except for the loggerhead turtle, all four other species are known to nest along the coast of the mainland and the Bay Islands of India (Tripathy, 2009). All the species are capable of taking long distance migration.

Olive Ridley turtle in Orissa

The olive ridley, which is also believed to be the most abundant sea turtle in the world, is the most widespread common species in Indian waters. It is known as arribada (means "arrival by sea" in Spanish) for mass reproductive aggregations. (Tripathy, 2009). The world's largest known olive ridley nesting aggregations are in Gahirmatha, Orissa, along India's north-east coast. (Rao, 2011). Turtle nesting figures at Gahirmatha have ranged from 100,000 to 800,000 in different years. The mass nesting of olive ridley turtles at Gahirmatha takes place between December and March, and a second one of much lower severity is often followed by the first arribada at Gahirmatha after a period of 35- 60 days (Tripathy, 2009).

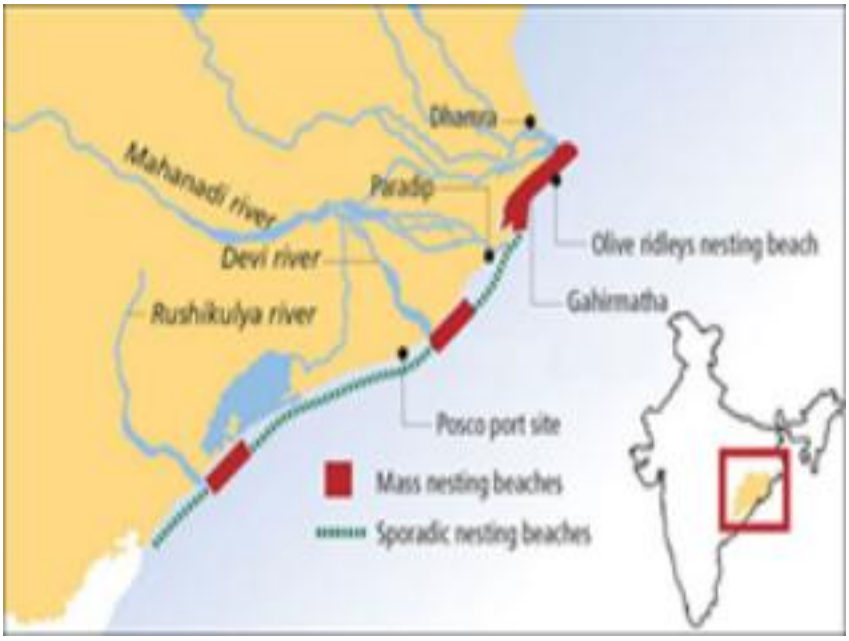

Fig. 1. Olive Ridley turtle nesting area in Orissa state

Exploitation and predation

Along the coastal waters of Tamil Nadu, Orissa and West Bengal, traditional fisheries for turtles exist. The poorest parts of the fisher population all over the world ingest the eggs and meat of sea turtles. A 1974 FAO analysis found that the legal trade in olive ridley eggs rose in the 1970s to half a million eggs (Rao, 2011). In the 1960s and 1970s, the type of exploitation in India could be classified as guided turtle fisheries for meat and shell, exploitation of adult female for nesting at the beach, exploitation of eggs for human consumption, predation of eggs by dogs and jackals and predation of hatchlings by birds and dogs (Rajagopalan et al, 1996). It is estimated that during every nesting season of sea turtles up to 1981-82, 50,000-80,000 adult olive ridleys consisting of both sexes were caught off Gahirmatha.

Conservation of sea turtles

The Government of India has given high priority to the conservation of sea turtles as an endangered species and all five species are covered as they are included in Schedule I of the Indian Wildlife (Protection) Act, as amended in September 1977 by the Schedule (Jeyabaskaran & Kripa, 2018). They are also protected under international agreements such as the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES 1973) and, where India is a signatory, the Bonn Convention on Migratory Species (CMS 1979). Sea turtles are listed on the World Conservation Union (IUCN) Red List as "critically endangered," "endangered," or "threatened". The United Nations Convention on the Law of the Sea (UNCLOS 1982) lays out coastal states commitments with respect to the scientific protection and control of marine migratory species. The Code of Conduct for

Responsible Fisheries (FAO, 1995), which includes advice on the sustainable conservation of fisheries, lays down the need to protect endangered species such as sea turtles ((Boopendranath et al, 2010).

Table.1.Marine Turtles & International Union for Conservation of Nature (IUCN) Status

Turtles	Scientific name	Length (cm)	Weight (kg)	IUCN status
Olive ridley	*Lepidochelus olivaceae*	70	50	Vulnerable
Hawksbill	*Eretmochelys imbricata*	90	100	Critically Endangered
Leatherback	*Dermochelys coriacea*	170	500	Vulnerable
Green turtle	*Chelonia mydas*	100	250	Endangered
Loggerhead	*Caretta caretta*	90	135	Vulnerable

Turtles are protected species under Schedule I of Indian Wildlife Protection Act (1972).

Turtle incidence in fishing gears

The accidental mortality of turtles due to fishing practices such as trawling and gill netting is substantial. On the east coast, particularly in Orissa, Andhra Pradesh and Tamil Nadu, where 75,000 mortality were recorded during 1990-2002, the incidental deaths of turtles during trawling operations are high. Off the Indian coast, 15,000 to 20,000 incidental turtle deaths are recorded annually (Rao, 2011). According to a CMFRI study, during 1997-98 trawls accounted for 13.1 % of turtle incidental catch in fishing gears along the coast, barring Gahirmatha coast, gill nets operated 60% from mechanized and conventional fishing vessels, seines 4.2 % and other gears such as bag net, stake net, hook and line accounted for 22.6 % (Rajagopalan et al., 2001). The incidental catch was comparatively high along the east coast due to congregation and high nesting activity, with maximum intensity occurring during January-March.

During the 'arribada' and fishing of green turtles in the Gulf of Mannar (GOM) and Palk Bay in Tamil Nadu, olive ridely fishing led to India occurred ridiculously in Orissa and West Bengal. However, the fishing and trade of turtles in Tamil Nadu was absolutely stopped in early 1980 and in Orissa in 1983 and turtles were declared endangered species in 1983 (Rajagopalan et al., 1996)

Expert Scientific Panel on TEDs

In the context of the US ban on imports of shrimp from countries which do not agree with the use of TEDs in shrimp trawlers, the Marine Products Export Development Authority (MPEDA) of Cochin has set up a Committee of Experts to determine the

economic benefits or losses arising from the installation of TEDs in shrimp trawl nets. The Committee suggested that in order to undertake a thorough analysis, an Independent Scientific Panel (ESP) be set up and the ESP was appointed on 10 July 1998 by the Government of India. The Fisheries Development Commissioner functioned as the Member-Convener of the Panel and other Members included the Heads of Central Marine Fisheries Research Institute (CMFRI), Cochin; the Fisheries Survey of India (FSI), Mumbai; the Central Institute of Fisheries Technology (CIFT), Cochin; the Central Institute of Fisheries Nautical and Engineering Training (CIFNET), Cochin; and a representative of the Wildlife Institute of India (WII), Dehra Dun. The terms of reference of the panel covered are the distribution in Indian waters of sea turtle species, by-catch of sea turtles by trawl nets, gillnets, etc., studies on the mortality of sea turtles due to non-fishing causes, studies/demonstrations on the efficacy of established TED models, loss of catch by the use of TEDs in trawl nets (cost-benefit analysis) and management measures for conservation of marine turtle species along the coastline of India. In this study, the Central Institute of Fisheries Technology (CIFT) worked closely together to pursue concurrent investigations into two ICAR-funded projects entitled Performance Evaluation of Suitable Selective Bycatch Reduction Devices (BRD) and Turtles (TED) in Shrimp Trawling, and responsible Trawl Systems development studies focusing on design, manufacture, field testing of Turtle Excluder Devices, and training of trawler fishermen and other stake holders in their fabrication and use.

The mandatory implementation of turtle excluder devices (TEDs) in all mechanized trawlers operating in mass nesting areas where incidental mortality has been reported to reduce incidental catches and death of sea turtles has been a very important recommendation of the ESP. The areas proposed to be brought under control included are entire Orissa coast during the period from November to April, coast of Midnapore District in West Bengal during December-March, coast of Srikakulam, Vizianagaram, Viskhapatnam and East Godavari Districts in Andhra Pradesh during November-April, coast of Nagapattinam, Turticorin, Ramanathapuram and Tirunelveli Districts in Tamil Nadu during December-April, coast of Pondicherry, excluding areas off the coast of Mahe, Karaikal and Yanam, during December-April, and coast of Quilon and Trivandrum Districts in Kerala, during December-March.

Design & Fabrication of CIFT-TED

An indigenous TED design was developed by the Central Institute of Fisheries Technology with a focus on reducing trawl net catch losses. CIFT-TED is a simple hard TED single-grid with a top opening (Prakash, 2019). It consists of a 1000x800 mm oval frame and is constructed of 10 mm stainless steel rods. Five 8 mm stainless steel rod vertical grid bars are welded to the inside of the oval frame. The distance between the deflector bars is 142 mm and there is a maximum distance of 90 mm between the frame and the adjacent deflector bar. In the TED extension, the frame was fixed at an angle of 45°. The device could be manufactured and installed at a cost of about

Rs.4000 with minimum training using locally available workshops and net making skills (equivalent to about USD 90) (Boopendranath et al, 2010).

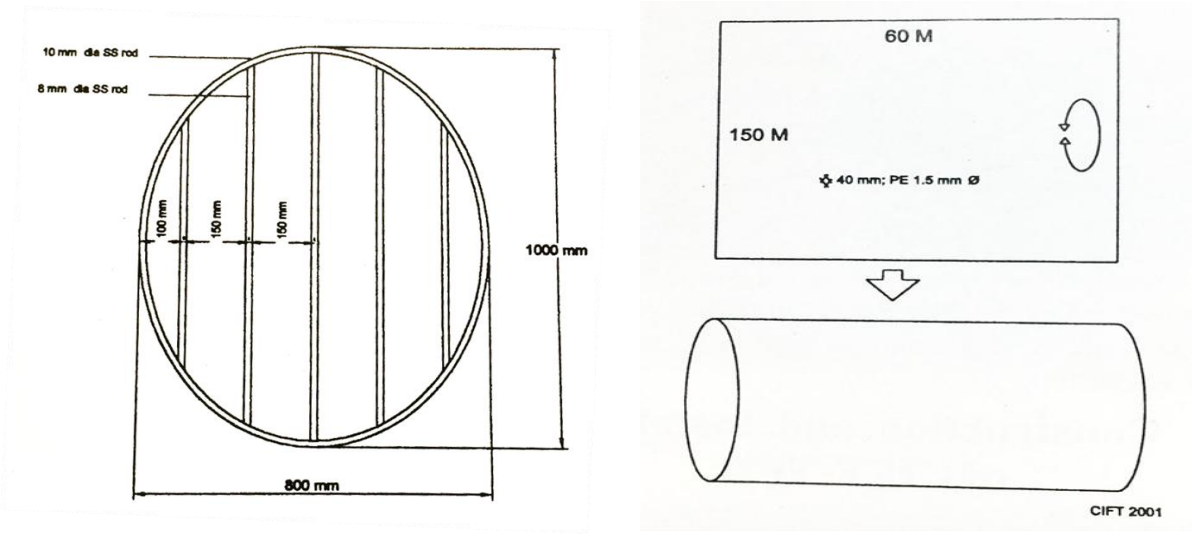

Fig. 2. Stainless Steel grid & Construction of extension piece 2.4 x 6m

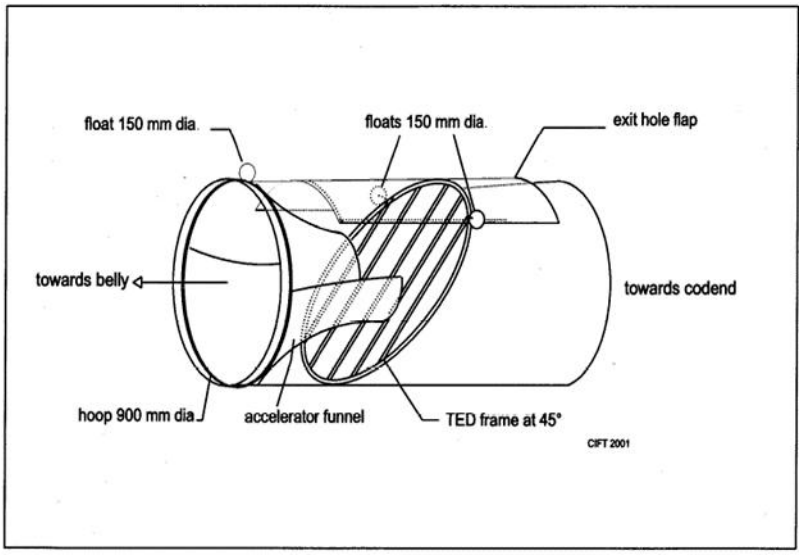

Fig. 3. Perspective view of CIFT TED

Experiments with CIFT-TED off Cochin, west coast of India

CIFT-TED experiment was first conducted off Kochi using a 32 m headline demersal trawl from the research vessel MFB Matsyakumari (17.5 m). For these operations, TED designs with dimensions of 1000 x 800 mm and 900 x 800 mm and a deflector with bar spacing of 144 mm were used. In 39 operations, the overall escape was observed at 2.4 %. In the retained catch (693.6 kg) at the main cod end, prawns formed about 15.4 % while they formed about 6.1 % in the excluder cod end catch (17.3 kg). The

recorded catch, however, was very low (19.2 kg per haul), suggesting an overall disadvantage of fitting a TED into the trawl net (Rao, 2011).

Field trials and demonstration of CIFT-TED off east coast of India

Studies conducted between November 2001 and March 2002 off Gahirmatha, Paradip and Debi (Orissa) at a depth of 11 to 24 m further demonstrated the effectiveness of CIFT-TED in saving sea turtles with minimal catch loss (Gopi et al., 2002). Results of 51 hauls showed a 100 % escape of 21 sea turtles entering the trawl and a 2.3 to 10.3 % catch loss. Demonstrations conducted by SIFT, Kakinada, at 25-40 m depth by commercial trawlers have shown that the decrease in catch due to TED installation is minimal. During the 15 demonstrations outside Andhra Pradesh, the percentage loss of catches of finfish and shellfish ranged from 0.5 to 3.6 % (Sankar and Raju, 2003)

Fig. 4. CIFT-TED installed trawl operation during 2001-2003 at Paradip, Orissa

In Visakhapatnam, CIFT-TED was tested and 90% of the turtles were able to escape. The results of 19 field trials carried out in 2001 along the east coast resulted in a total catch of 544.3 kg. The mean catch rate was estimated to be 27.3 kg per haul in operation without TED, while the mean catch rate in operation with a trawl installed by CIFT-TED was 26.4 kg, indicating a 3.3 percent catch loss. Only 0.5 % of the total 26.8 kg of shrimp landed was observed to have been excluded after TED installation. All four turtles were excluded from the net via TED.

No	Name of State/District	Season
1	Entire coast of Odisha	November- May

2	Srikakulam, Vizianagaram, Visakhapatnam & East Godavari districts in Andhra Pradesh	November –April
3	Midnapore coast (W. Bengal)	December-March
4	Nagapattinam, Tuticorin, Ramanathapuram & Tirunelveli districts in Tamil Nadu	December-April
5	Pondicherry	December –April
6	Kollam & Thiruvanathapuram districts in Kerala	December-March
7	Andaman and Nicobar Island	Mandatory, but season not specified

Table 2. Area and time of TED implementation in India

Challenges and prospects

The absence of an incentive-disincentive scheme to facilitate its adoption has constrained the use of TED among trawler fishermen. While many maritime states have TED legislation under the Marine Fisheries Management Acts, such as West Bengal, Orissa, Andhra Pradesh and Kerala, their enforcement has not been adequately successful to date. This points to the need for a sufficiently attractive system of incentives to promote the use of TEDs. This can take the form of increased pricing for goods resulting from TED-installed operations or TED-use related fuel subsidy schemes, as well as successful enforcement improvements, preferably under a co-management system, including all stakeholders involved.

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Dr. Leela Edwin has more than 35 years' experience in Fisheries research and is the Head, Fishing Technology Division, ICAR- Central Institute of Fisheries Technology (CIFT), Cochin since 2010. After completing M.Sc with first rank in Industrial Fisheries, she joined as Scientist through Agricultural Research Service at CIFT, Cochin and since then was involved in the research and development of improved fishing gear and craft technologies. She is recipient of several awards including the Jawaharlal Nehru Award 2000 for outstanding Post Graduate Research (best PhD Thesis in Fisheries Science in India) in Agriculture from the Indian Council of Agricultural Research; and the National Award for Technology Innovation (Runner Up) in the field of Polymer Science & Technology from Department of Chemicals & Petrochemicals, Ministry of Chemicals & Fertilizers, Govt. of India in 2013. She has more than 150 scientific publications to her credit in national and international journals. She has undergone advanced training in Fishing gear designing at the Fisheries and Marine Institute (MI) of Memorial University, New Foundland, Canada.

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