



Performance Evaluation of Turtle Excluder Device off Dhamra in Bay of Bengal

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Abstract

Turtles are endangered and protected species under the Indian Wildlife Protection Act 1972. A number of non-target resources, such as sea turtles, are caught during trawling. This study reports the field trials conducted using TED-installed fish trawls in Odisha waters to evaluate the efficacy of TED. The incidence of sea turtles was one for every 15 hauls and the turtle excluder device (CIFT-TED) showed 100% exclusion for the sea turtle entering the trawl system. The exclusion rates were 2.5% for the total catch and 2.7% for the shrimp. Twenty eight species of finfish were encountered during the trials of which 17 were represented in the excluded portion of the catch.

Keywords: Turtle conservation, Turtle Excluder Device, trawling, Bay of Bengal

Introduction

Incidence of sea turtles in the trawling grounds off Dhamra, in Odisha is a matter of concern among environmentalists and others in the country. Sea turtles are endangered species, which are protected under Schedule 1 of the Indian Wildlife Protection Act 1972 and its Amendment in 1991. They are also protected under international conventions such as Convention on International Trade in Endangered

Species of Wild Flora and Fauna (CITES, 1973) and the Bonn Convention on Migratory Species (CMS, 1979) to which India is a signatory. Sea turtles are listed as "critically endangered," "endangered" or "threatened" on the World Conservation Union (IUCN) Red List. FAO (2009) has developed guidelines to reduce sea turtle mortality in fishing operations.

Bay of Bengal coast has occurrence of turtles due to their annual nesting activity and the maximum occurrence is reported during January to March. Survey conducted by CMFRI along the Odisha coast during 1997-98 revealed that gillnets accounted for 60.0% of the incidental catch of turtles, trawls accounted for 13.1%, seines 4.2% and bag net, stake nets and hook and line contributed 22.6% (Rajagopalan et al., 2001).

About 1 305 trawlers (CMFRI, 2012) with a L_{OA} of 9.5 to 22 m (Edwin, et al. 2014) operate along Odisha coast. Mortality due to near shore trawling and gillnetting has been increasing each year (WWF, 2011). Odisha state has introduced a number of measures to protect turtles from incidental mortalities including closed areas, seasonal fishing closures and rules mandating the use of Turtle Excluder Devices (TED) in trawl nets. Odisha Marine Regulation Act (1982) prescribes the use of TEDs mandatory for all mechanised trawl fishing in coastal waters of Odisha and prohibits fishing off Gahirmatha nesting beach. Although the use of TED is mandatory in Odisha despite many attempts by authorities, the adoption of TEDs remains low and turtle mortality due to incidental catch remains high (WWF, 2011).

Initial experiments to evaluate a TED (Super Shooter TED) of 1030 x 850 mm size and deflector bar gap

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of 90 mm, imported from U.S., were conducted onboard the vessel *Matsya Shikari* (39.8 m L_{OA} ; 1740 hp stern trawler) of Fishery Survey of India, Visakhapatnam, August 1995. Fishing operations were conducted off Andhra Pradesh, north of Kalingapatnam, at a depth of 45-55 m. Experiments with the imported Super Shooter TED were continued using the same trawl gear from the fishing vessel *Matsya Shikari* off Andhra Pradesh, between Bhimli and Chilika, in 1995. An indigenous design of TED was developed at ICAR-Central Institute of Fisheries Technology with focus on reducing catch losses, which is a cause of concern for trawler fishermen in adopting the device (Dawson & Boopendranath, 2001; 2003; Boopendranath et al., 2003; CIFT, 2003; Rao, 2011).

In this study, results of field trials conducted using CIFT-TED installed in trawls along Odisha waters, to evaluate the efficacy of TED to release sea turtles and quantify the catch losses are reported.

Materials and Methods

Experiments were conducted on-board 13.7 m L_{OA} commercial wooden trawler, with an installed engine power of 106 hp. The trawler was equipped with GPS, echo sounder and VHF. Fish trawls with headline length of 33 and 40 m made of polyethylene netting of mesh size 160 mm in the wing-end tapering to 80 mm in the hind belly and 25 mm in

the codend were used for the experiments. Details of vessel and trawl used for experiments are given in Table 1.

Sixty fishing trials were conducted to observe the effectiveness of CIFT-TED in releasing sea turtles and the extent of catch loss due to TED installation, during December 2009-March 2010, in the depth range of 30-50 m, off Dhamra, Odisha (20°50' - 21°00' N lat; 86°56' - 87°10' E long) (Fig. 1) with the participation of ICAR-CIFT, WWF-India and Maa Dhamarai Fishermen Association.

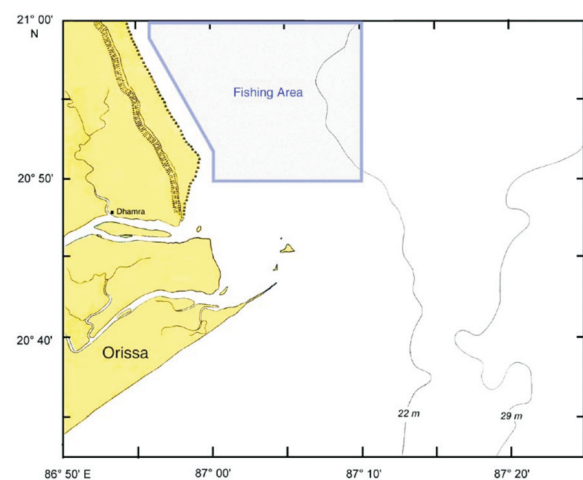


Fig. 1. Fishing area, off Dhamra, Odisha

Table 1: Details of vessel and fishing gear

Vessel	
Type	Wooden trawler
Length overall	: 13.7 m
Engine	: Ashok Leyland Marine Diesel (ALM 402)
Horsepower	106 hp @ 2000 rpm
Navigation, fish finding and communication equipment onboard	Global Positioning System (GPS); Echo Sounder; VHF
Crew complement	8-11
Gear	
Type	Fish trawl
Size (head rope length)	33-40 m
Mesh size: wing-end and belly sections	160-80 mm diamond mesh
Main codend mesh size	25 mm diamond mesh
Exit-hole cover codend mesh size	25 mm diamond mesh
Otter boards	1600 x 760 mm; 85 kg each (rectangular)

The device, christened as CIFT-TED, is single grid, hard TED design with top opening. It consists of an oval frame measuring 1000x800 mm and is constructed with 10 mm Ø stainless steel (SS) rod. Five vertical grid bars of 8 mm Ø SS rod are welded to the inside of the oval frame. The spacing between the deflector bars is 142 mm and the maximum spacing between the frame and the adjacent deflector bar is 90 mm. The frame was fixed in the TED extension at 45° angle.

CIFT-TED was installed in the commercial trawl, between the hind belly and codend, as described by CIFT (2003) (Fig. 2 and 3). An exit cover codend (25 mm diamond mesh) was additionally provided in order to retain the catch excluded due to the installation of TED (CIFT, 2003; Boopendranath et al., 2003). After each haul, the catches were sorted up to species or groups and weighed, separately for the retained catch in the main codend and excluded catch in the exit cover codend and percentage exclusion rates were worked out.

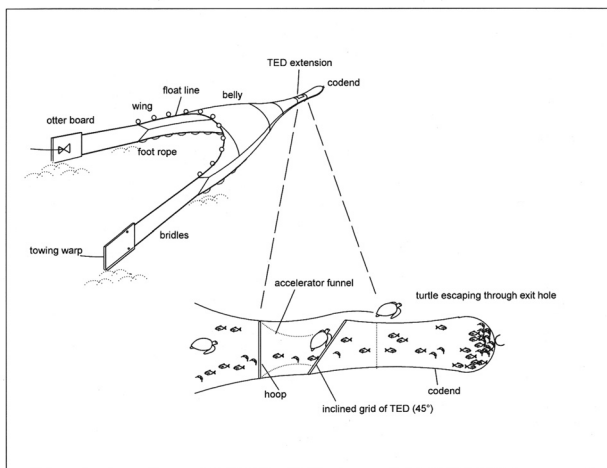


Fig. 2. TED installation in trawl (source: CIFT, 2003)

Results and Discussion

A total 1 920 kg of fish catch was obtained during 60 fishing operations conducted (Table 2). In addition to fish catch, four olive ridley sea turtles (*Lepidochelys olivacea*) consisting of 3 females (average weight: 39 kg and average carapace length: 67 cm) and one male (45 kg; carapace length: 69 cm) were caught in the trawl during the operations and all were safely excluded through the TED. Of the total fish catch, 97.5% (1873 kg) was retained in the trawl codend and 2.5% (47 kg) was excluded (Table 2). The composi-

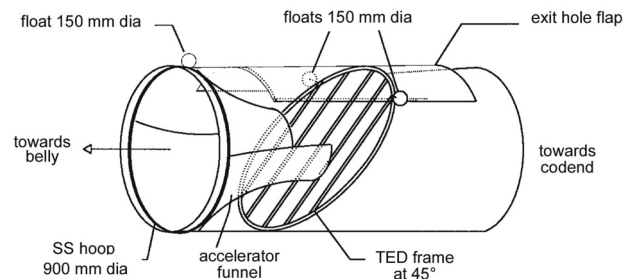


Fig. 3. Perspective diagram of CIFT-TED (source: CIFT, 2003)

tion of the catch retained and excluded are given in Fig. 4 and Fig. 5. Species or group-wise retention and exclusion rates during the period of observations are represented in Table 2.

Of the 28 fish species groups monitored during the observations, 17 groups exhibited varying degrees of exclusion ranging from 8.25% (eel) to 0.44% (crabs) (Table 2). Overall catch loss due to installation of the TED, during the period of observations was 2.5% (excluding sea turtles). Total shrimp catch obtained during the operations was 98.76 kg of which 2.7% (2.67 kg) was seen excluded. Non-shrimp catch during the period of operations was 1 821 kg, of which 2.5% (44.6 kg) was seen excluded due to installation of TED.

Studies conducted with Super Shooter TED off Andhra Pradesh, indicated an overall escapement of 31% of fin fishes (Ramaraao, 1995). Observations with Super Shooter TED of size 1040 x 840 mm with a 89 mm deflector bar gap indicated a total catch loss of 43%, off Andhra Pradesh (Kirubakaran et al., 2002). The catch loss from CIFT-TED ranged from 2.3 to 10.3% from 51 hauls off Gahirmatha, Paradip and Debi (Odisha) between 11 to 24 m depth with 100% escapement of 21 sea turtles (Gopi et al., 2002). The percentage loss of catch of finfish and shellfish during the 15 operations off Andhra Pradesh from commercial trawlers ranged from 0.5 to 3.6% (Sankar & Raju, 2003). The catch losses of both shrimp and non-shrimp resources are comparable in these two studies and is relatively less when compared to the results of Super Shooter TED operations. Studies with CIFT-TED along the east and west coast of India have shown a mean catch loss in the range of 0.52% for shrimp and 2.44-3.27% for non-shrimp resources, which is considerably less

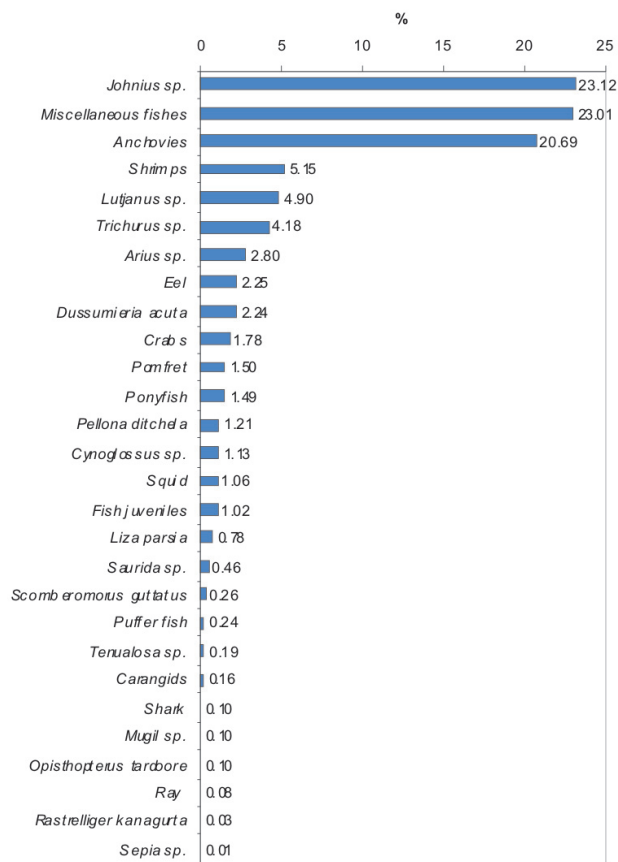


Fig. 4. Percentage composition of total catch (excluding sea turtles)

than the loss incurred during the operations with Super Shooter TED (CIFT, 2003). The loss of finfish catch is expected to vary from zone to zone and from season to season, depending on the percentage representation of large finfishes and elasmobranchs in the trawl catch. As turtle exclusion in TED is dependent on a physical separation process based primarily on size differences, finfishes larger than that could be let in through deflector bar spacing can't be retained. It is to be noted, however, that large species that are excluded due to installation of TED are not lost to the fishery as a whole, as they can be caught by other fishing techniques in vogue in the fishing area (Boopendranath et al., 2010).

Experiments with 3 designs of NMFS (National Marine Fisheries Service) TEDs off Mississippi coast showed a 51-53% reduction of bycatch and 3% increase in the shrimp catch. Results of the investigations conducted off Georgia-Florida coast with NMFS TED, Louisiana TED, Georgia TED and

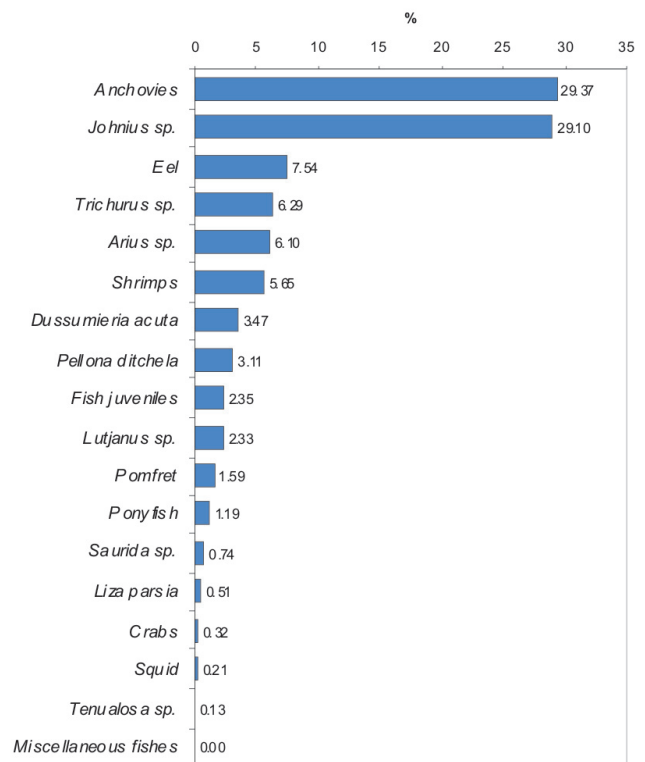


Fig. 5. Percentage composition of excluded catch

Texas TED indicated a 97% escapement of turtles with 22-44% reduction in the bycatch while shrimp catch varied from a decrease of 22% to about 4% increase (Christian & Harrington, 1987). Experiments with Morrison Soft TED showed an 8% reduction in the shrimp catch and 24% reduction in bycatch (Kendall, 1990). Studies conducted with TEDs along the south-eastern USA showed reduction in bycatch by 59% and shrimp catch varied from 12% decrease to 8% increase (Harrington & Vendetti, 1995). Experiments conducted in New South Wales and Queensland, Australia with different TEDs gave varying results. Application of Morrison soft TED in Queensland showed 32% reduction in bycatch and 29% reduction in prawn catch (Robins-Troeger, 1994). Experiments with Aus TED along the Queensland coast showed 11-59% bycatch reduction while shrimp catch varied from 9% decrease to about 2% increase (Robins-Troeger et al., 1995). It is evident from all these studies that there is considerable variation in escapement of shrimp and bycatch from trawl nets attached with TEDs.

Indian fishermen target both shrimp and non-shrimp resources, for economic trawling operations.

Table 2: Species/group-wise catch and exclusion rates

Species/groups	Retained catch, kg	Excluded catch, kg	Total catch, kg	% exclusion
Finfishes				
Anchovies	383.23	13.87	397.10	3.49
<i>Arius</i> sp.	50.89	2.88	53.77	5.36
Carangids	3.00	0.00	3.00	0.00
<i>Cynoglossus</i> sp.	21.60	0.00	21.60	0.00
<i>Dussumieria acuta</i>	41.40	1.64	43.04	3.81
Eel	39.60	3.56	43.16	8.25
<i>Johnius</i> sp.	429.98	13.74	443.72	3.10
<i>Liza parsia</i>	14.65	0.24	14.89	1.61
<i>Lutjanus</i> sp.	93.03	1.10	94.13	1.17
<i>Mugil</i> sp.	1.97	0.00	1.97	0.00
<i>Opisthopterus tardoore</i>	1.97	0.00	1.97	0.00
<i>Pellona ditchela</i>	21.70	1.47	23.17	6.32
Pomfret	28.00	0.75	28.75	2.61
Ponyfish	28.10	0.56	28.66	1.95
Puffer fish	4.60	0.00	4.60	0.00
<i>Rastrelliger kanagurta</i>	0.55	0.00	0.55	0.00
<i>Saurida</i> sp.	8.50	0.35	8.85	3.95
<i>Scomberomorus guttatus</i>	5.00	0.00	5.00	0.00
<i>Tenualosa</i> sp.	3.55	0.06	3.61	1.66
<i>Trichiurus</i> sp.	77.25	2.97	80.22	3.70
Fish juveniles	18.50	1.11	19.61	5.66
Miscellaneous fishes	441.57	0.00	441.57	0.00
Elasmobranchs				
Rays	1.50	0.00	1.50	0.00
Sharks	2.00	0.00	2.00	0.00
Crustaceans				
Shrimps	96.09	2.67	98.76	2.70
Crabs	33.93	0.15	34.08	0.44
Cephalopods				
Squid	20.27	0.10	20.37	0.49
<i>Sepia</i> sp.	0.25	0.00	0.25	0.00
Total catch excluding sea turtles	1872.68	47.22	1919.89	2.46
Sea turtles				
<i>Lepidochelys olivacea</i>	0.00	160.00	160.00	100.00
Total	1872.68	207.22	2079.89	9.96

If the target were shrimp alone, fishermen could benefit from installation of a TED in the trawl net due to (i) higher catch values due to reduction of large bycatch species which could damage the shrimp, (ii) shorter sorting times (iii) lower fuel costs due to reduced net drag as the codend would

fill more slowly and (v) higher catches of shrimps. For these reasons, TEDs are sometimes designated as Trawling Efficiency Devices. Experiments with TED designs, which have deflector gap of less than 90 mm in Indian waters, though successful in excluding turtles, showed poor performance in the

retention of targeted non-shrimp catch components (Boopendranath et al. 2010).

During the period of operations, the incidence of sea turtles was one for every 15 hauls. The turtle excluder device (CIFT-TED) has given 100% exclusion for the sea turtle which has entered the trawl system, confirming that it is effective in preventing sea turtle mortality during trawling. The exclusion rates were 2.5% each for the total catch and non-shrimp catch and 2.7% for the shrimp catch.

Though several maritime states such as West Bengal, Odisha, Andhra Pradesh and Kerala have TED regulations under the Marine Fisheries Regulation Acts, its implementation has not been sufficiently effective so far. This points to the need for a sufficiently attractive incentive scheme for encouraging the use of TEDs. This may take the form of better price realisation for the produce derived from TED-installed operations or TED-use linked subsidy scheme for fuel, as well as effective changes in the enforcement, preferably under a co-management regime, involving all concerned stakeholders.

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References

- Boopendranath, M.R., Percy Dawson, Pravin, P., Remesan, M.P., Raghu Prakash, R., Vijayan, V., Mathai, P.G., Pillai, N.S., Varghese, M.D. and Ramarao, S.V.S. (2003) Design and Development of Turtle Excluder Devices for Indian Fisheries, Book chapter in: *Marine Turtles of the Indian Subcontinent* (Shanker, K. and Choudhury, B.C. Eds), Universities Press (India) Pvt. Ltd., Hyderabad, pp 244-261
- Boopendranath, M.R., Raghu Prakash, R. and Pravin, P. (2010) A review of the development of the TED for Indian fisheries, *Indian Ocean – South-East Asian (IOSEA) Marine Turtle MoU Website*, www.ioseaturtles.org/pom_detail.php?id=96
- CIFT (2003) CIFT-TED for Turtle-safe Trawl Fisheries – A Success Story in Responsible Fishing (English), CIFT Special Bulletin No. 12a (English) in print and CD versions, CIFT, Cochin
- CMFRI (2012) Marine Fisheries census 2010 - Part I Ministry of Agriculture Krishi Bhavan New Delhi and CMFRI Kochi
- Christian, P. and Harrington, D. (1987) Loggerhead turtle, finfish and shrimp retention studies on four excluder devices (TEDs). In: *Proceedings of the non-game and endangered wildlife symposium*, 8-10 September 1987, Georgia DNR, pp 114-127
- Dawson, P. and Boopendranath, M.R. (2001) CIFT-TED – Construction, Installation and Operation, CIFT Technology Advisory Series -5, ICER-Central Institute of Fisheries Technology, Cochin. 16 p
- Dawson, P. and Boopendranath, M. R. (2003) CIFT-TED– Construction, Installation and Operation, Kachhapa 8: 5-7
- Edwin, L., Pravin, p., Madhu, V.R., Thomas, S.N., Remesan, M.P., Baiju, M.V., Ravi, R., Das D.P.H., Boopendranath, M.R and Meenakumari, B. (2014) *Mechanised Marine Fishing Systems: India*, Central Institute of Fisheries Technology, Kochi: 277p
- FAO (2009) Guidelines to reduce sea turtle mortality in fishing operations, FAO Fisheries Department, FAO, Rome: 128p
- Gopi, G.V., Pandav, B., Choudhury, B.C. (2002) A quantitative analysis of incidental turtle mortalities during commercial shrimp trawling in the coastal waters off Odisha, Wildlife Institute of India, Dehradun: 40p
- Harrington, D. and Vendetti, R. A. (1995) Shrimp trawl bycatch reduction in the Southeastern United States. In: *Solving bycatch: considerations for today and tomorrow*. Fairbanks, Alaska. Alaska Sea Grant College Program Report No.96-03, University of Alaska, Fairbanks, pp 129-136
- Kendall, D. (1990) Shrimp retention characteristics of the Morrison soft TED: a selective webbing exclusion panel inserted in a shrimp trawl net. *Fish. Res.* 9: 13-21
- Kirubakaran, P., Neelakandan, M., Shaji, S., Rao, D.V., Venkateswarlu, N. and Verghese, C. P. (2002) Preliminary observations on the operation of TED in bottom trawl, *Fish. Chimes*. 21(12): 31-33
- Rajagopalan, M., Vivekanandan, E., Balan, K. and Kurup, K.N. (2001) Threats to Sea turtles in India thorough incidental catch, *Proc. National Workshop for the Development of a National Sea Turtle Conservation Action Plan*, Bhubaneswar, Odisha, Wildlife Institute of India, Dehradun, India (Shanker, K. and Choudhury, B.C., Eds), pp 12-14
- Rao, G.S. (2011) Turtle excluder device (TED) in trawl nets: applicability in Indian trawl fishery. *Indian J. Fish.* 58(4): 115-124
- Robins-Troeger, J. B. (1994) Evaluation of Morrison soft turtle excluder device: and bycatch variation in Moreton Bay, Queensland. *Fish. Res.* 19: 205-217

- Robins-Troeger, J. B., Buckworth, R. C. and Dredge, M. C. L. (1995) Development of a trawl efficiency device (TED) for Australian trawl fisheries II, Field evaluation of the AusTED. *Fish. Res.* 22: 107-117
- Ramarao, S.V.S. (1995) Tour report on operation of Turtle Excluder Device from FSI vessel, 20-30 September 1995. CIFT, Cochin
- Sankar, O.B. and Raju, M.A. (2003) Implementation of the Turtle Excluder Device in Andhra Pradesh, Kachhapa. 8: 2-5
- WWF (2011) Turtles and TEDs. Outcome of trials conducted off Dhamra Orrisa WWF-India New Delhi