Indian J. Plant Genet. Resour. 29(3): 326-329 (2016)
DOI 10.5958/0976-1926.2016.00058.9

Responsible Fisheries for Resource Conservation

CN Ravishankar
Director, ICAR-Central Institute of Fisheries Technology, Matsyapuri P.O., Cochin – 682029, Kerala, India

The 20th century had seen an increase in the fishing capacity, in terms of the number of vessels, the increase in size of the vessels and advances in the electronic and navigational equipment coupled with easily manufactured and durable fishing nets. The effect of these innovations sequentially, was initially the increase in fish landings, then the plateauing of catches and, the myth of inexhaustibility of fishery resources in the sea was proven wrong. A large number of stocks world over have declined and the status of many of the stocks now are alarming. Overfishing, irresponsible and destructive fishing practices, and illegal, unreported and unregulated (IUU) fishing have long been recognized as leading causes that have reduced biodiversity and modified aquatic ecosystem functioning (Boehlert, 1996; Jackson *et al.*, 2001; Lotze *et al.*, 2006; Worm *et al.*, 2006).

In India about 1,94,490 fishing crafts of various sizes and classes are under operation in marine fisheries, consisting of 72,559 mechanised, 71,313 motorised and 50,618 non-mechanised fishing vessels (CMFRI, 2012). The existing numbers now is in excess by a factor of 3.8 for mechanized vessels and motorized vessels by 4.8 as per optimum fleet size estimates by Kurup and Devaraj (2000).

The term bycatch refers to the non-targeted species retained, sold or discarded for any reason. Global bycatch by the world's marine fishing fleets was estimated at 28.7 million t in 1994, of which 27.0 million t (range: 17.9-39.5 million t) were discarded annually and shrimp trawling alone accounted for 9.5 million t (35%) of discards annually (Alverson *et al.*, 1994). Average annual global discards, has been re-estimated to be 7.3 million t, during 1992-2001 period (Kelleher, 2004). Davies *et al.* (2009) redefined bycatch as the catch that is either unused or unmanaged and estimated it at 38.5 million tonnes, forming 40.4% of global marine catches.

In India, Pillai (1998) reported that among the bycatch, about 40% is consisted of juveniles. Kelleher (2004) has estimated total bycatch discards in Indian fisheries at 57 917t, which formed 2.03% of the total landings. Juveniles contributed 36% of the discards (15.9% of total catch) in single day fishing and 78% (23.5% of total catch) in multi-day fishing conducted during 2001-02 in Karnataka (Zacharia *et al.*, 2005). Najmudeen & Sathiadhas (2008) have estimated the annual economic loss due to juvenile fishing by trawlers, purse seiners, ring seiners and mini-trawlers together, along the Indian coast at US$19 445 million yr^{-1}. Pramod (2010) has estimated the bycatch discards of Indian trawlers as 1.2 million t. Dinesh babu *et al.*, 2013, studied the Low value bycatch (LVB) composition of catches along the east and west coasts of India report that the all India contribution of LVB increased from 14% in 2008 to 25% in 2011.

Globally, shrimp trawling contributes to the highest level of discard/catch ratios of any fisheries, ranging from about 3:1 to 15:1. Trawl fisheries for shrimp and demersal finfish alone, account for over 50% of the total estimated global discards. Shrimp trawling contributes the most to the bycatch among the different fishing systems in India (Boopendranth *et al*., 2008).

Overfishing as a result of increased capacity both in terms of number of fishing vessels and the installed engine power and bigger fishing nets which often do not conform to the legal sizes and designs stipulated, is one of the most important reasons for overfishing.

There is a considerable reduction in percentage of discards by trawlers operated along Indian EEZ and the discards in Indian trawl fisheries in 2011 was less than 10% (Dineshbabu *et al.*, 2013). This reduction in bycatch discards both locally and globally, in recent years could be attributed to (i) increased use of bycatch reduction technologies, (ii) anti-discard regulations and improved enforcement of regulatory measures, and (iii) increased bycatch utilisation for human consumption or as animal feed, due to improved processing technologies and expanding market opportunities, which encourage the fishermen to land the catch which consists predominantly of the juveniles of commercially important species, which is a very serious issue in fisheries.

**Author for Correspondence: Email- directorcift@gmail.com*

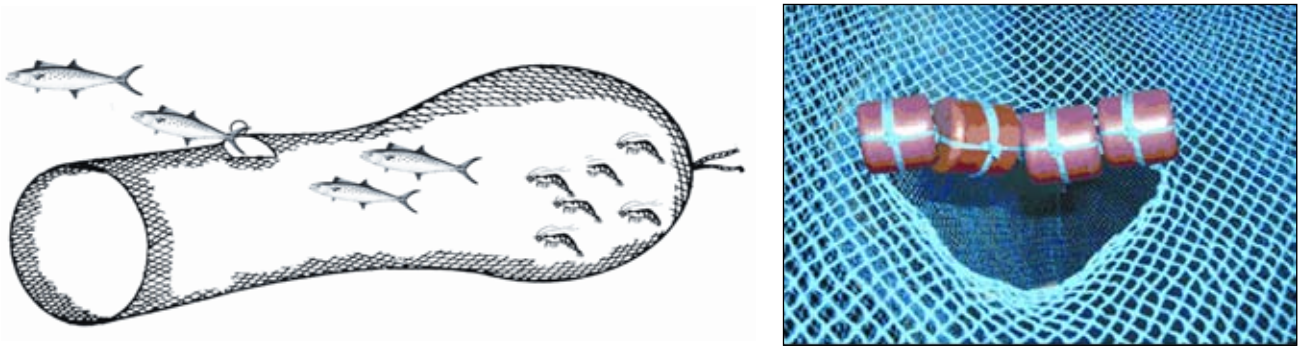

Fig. 1. View of Bigeye BRD in the trawl codend showing escaping finfishes (left) and Bigeye BRD attached to the codend (right)

Though the use of legal gears is mandatory, the adoption has been very poor. Recent studies indicate that investing to achieve sustainable levels of fishing by strengthening fisheries management, financing a reduction of excess capacity on the conventional resources and adoption of responsible fishing regime are required to rebuild the overfished and depleted conventional fish stocks (Worm *et al.*, 2006, 2009). Development, field testing and adoption of responsible fishing technologies for different gears assume great significance in this context.

Devices developed to exclude endangered species like turtle, and to reduce non-targeted species are collectively known as Bycatch Reduction Devices (BRDs). A large number of technologies have been developed and field tested to reduce the incidence of bycatch in trawlers, which generates largest quantity of bycatch in India (Boopendranth *et al*., 2008, Boopendranath and Pravin, 2009). A number of BRDs such as Rectangular Grid BRD, Oval Grid BRD, Bigeye BRD, Fisheye BRD, Juvenile Fish Excluder cum Shrimp Sorting Device (JFE-SSD), Radial Escapement Device (RED), Sieve net BRD and Separator Panel BRD have been developed and field tested in Indian waters (Boopendranath *et al.*, 2008, 2012) (Fig. 1).

The Juvenile Fish Excluder cum Shrimp Sorting Device (JFE-SSD), an International Smart Gear-2005 price winning design (WWF, 2012) developed at Central Institute of Fisheries Technology (CIFT) (Cochin, India) which brings down the bycatch of juveniles and small sized non-targeted species in commercial shrimp trawl and at the same time enables fishermen to harvest and retain large commercially valuable finfishes and shrimp species (CIFT, 2007) was also successfully demonstrated (Fig. 2). CIFT Semi-pelagic Trawl System (CIFT SPTS) has been developed as an alternative to shrimp trawling in the small-scale mechanized trawl sector (CIFT, 2011).

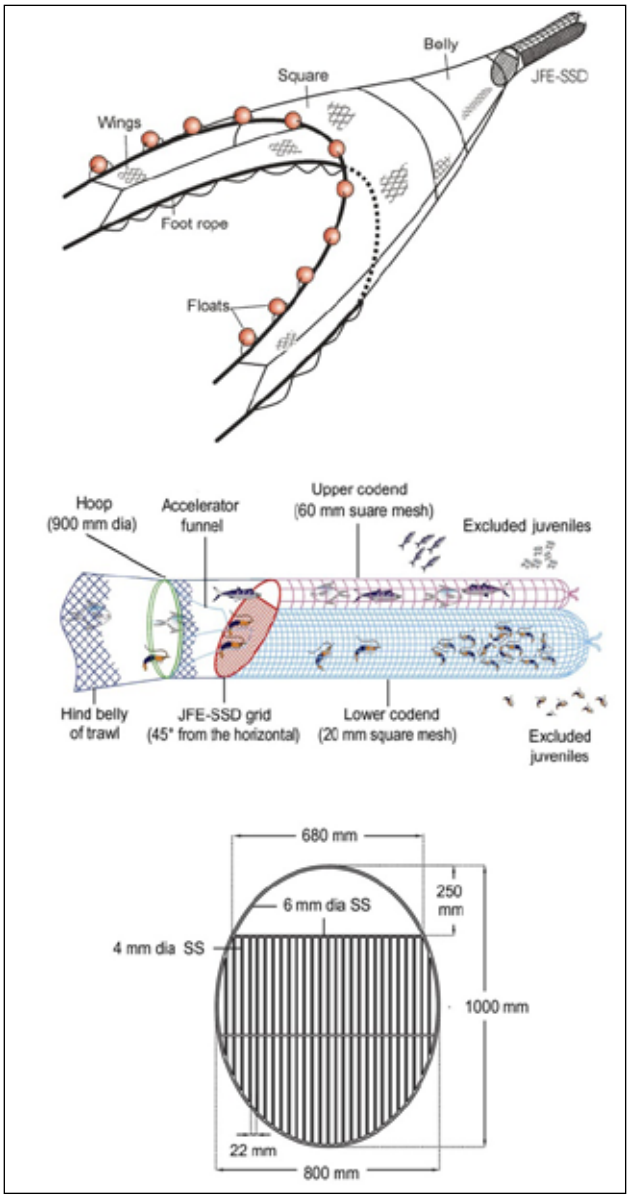

Fig. 2. The Juvenile Fish Excluder cum Shrimp Sorting Device (JFE-SSD)

Use of square mesh codends and square mesh windows that help in the release of juveniles is another promising technology developed and popularized by CIFT (Madhu *et al.*, 2015; Madhu *et al*., 2010). Large mesh purse-seines for capture of large pelagic species, BRDs for release of Hilsa juveniles, circle hooks for longlining (Kumar *et al*., 2013), optimized trap designs for lobster and fish are other technologies developed by CIFT for targeted fishing in the Indian waters.

Use of responsible fishing gears which reduce the incidence of juveniles and utilisation of the bycatch, by grading it into different categories like, for conversion to supplements, fish meal and as a source of pharmaceuticals and nutraceuticals, need to be explored. Changes will have to be made in the treatment of bycatch onboard, like sorting and preservation of the bycatch component if sourced for pharmaceuticals, need to be attempted.

Conclusions

Fishing industry is facing major environmental, economic and social issues. The volume of landings has been declining and has plateaued for several years due to depletion of fish stocks. To address the overexploitation of fisheries resources, management tools have been developed and additional measures, including incentives to improve the selectivity of fishing gear, the obligation to change fishing location, the reduction of by-catch and the gradual reduction of discards have been worked out but have shown lower adoption in the Indian scenario.

Improvements that can be made for processing the incidental catches for by-product up gradation in an environmental and economic perspective to reduce the impacts also need to be addressed.

Adoption of ecosystem based fisheries management which incorporates responsible fishing practices along with strict implementation measures would help in protecting and restoration of biodiversity and enhance the resilience of the fish stocks and ecosystem services.

References

Alverson DL, MH Freeberg, JG Pope and SA Murawski (1994) A global assessment of fisheries bycatch and discard. FAO Fish. Tech. Pap. 339, 233 pp.

Aneeshkumar KV, PS Khanolkar, P Pravin, VR Madhu and B Meenakumari (2013) Effect of hook design on longline catches in Lakshadweep Sea. *Ind. J. Fish.* **60(1):** 21-27.

Bhathal B and D Pauly (2008) Fishing down the marine food webs and spatial expansion of coastal fisheries in India 1950-2000. *Fisheries Research* **91:** 26-34.

Boehlert GW (1996) Biodiversity and the sustainability of marine fisheries. *Oceanography* **9(1):** 28-35.

Boopendranath MR (2012) Waste minimization in Fishing Operations, *Fishery Technology* **49:** 109-112.

Boopendranath MR and P Pravin (2009) Technologies for responsible fishing–Bycatch Reduction Devices and Turtle Excluder Devices. Paper presented in the International Symposium on Marine Ecosystems- Challenges and Strategies (MECOS 2009), 9-12 February 2009, Marine Biological Association of India, Cochin.

Boopendranath MR, P Pravin, TR Gibinkumar and S Sabu (2008) Bycatch Reduction Devices for Selective Shrimp Trawling, Final Report on ICAR Ad-hoc Project, Central Institute of Fisheries Technology, Cochin.

CIFT (2007) Responsible Fishing–Contributions of CIFT. CIFT Golden Jubilee Series. Central Institute of Fisheries Technology, Cochin, 46 pp.

CIFT (2011) CIFT Semi-Pelagic Trawl System: An Ecofriendly Alternative to Bottom Trawling for Smallscale Mechanised Sector, MR Boopendranath, MP Remesan, MP Pravin and VR Madhu, (eds.). CIFT Technology Advisory Series. Central Institute of Fisheries Technology, Cochin, 16 pp.

Davies RWD, SJ Cripps, A Nicksona and G Porter (2009) Defining and estimating global marine fisheries bycatch, *Marine Policy* **33(4):** 661-672.

Kurup KN and M Devaraj (2000) Estimates of optimum fleet size for the exploited Indian shelf fisheries, Central Marine Fisheries Research Institute, Cochin. *Mar. Fish. Infor. Serv. T and E Ser.* **165:** 2-11.

Dineshbabu AP, EV Radhakrishnan, S Thomas, G Maheswarudu, PP Manojkumar, SJ Kizhakudan, SL Pillai, R Chakraborty, J Jose, PT Sarada, PB Sawant, KK Philipose, VD Deshmukh, J Jayasankar, S Ghosh, M Koya, GB Purushottama and G Dash (2013) An appraisal of trawl fisheries of India with special reference on the changing trends in bycatch utilisation. *Journal of the Marine Biological Association of India* **55(2):** 69-78, July-December, 2013.

FAO (1995) Code of Conduct for Responsible Fisheries, FAO, Rome. Available online at ftp://ftp.fao.org/ docrep/fao/005/ v9878e/v9878e00.pdf.

George M J, C Suseelan and K Balan (1981) Bycatch of shrimp fisheries in India, *Mar. Fish. Inf. Ser. T&E. Ser.,* **28:** pp 3-13.

Gordon A (1991) The bycatch from Indian shrimp trawlers in the Bay of Bengal- Programme for its improved utilisation. Working paper No. 68, Bay of Bengal Programme, Chennai, 29 p.

Kelleher K (2004) Discards in the World's Marine Fisheries – An Update. FAO Fisheries Technical Paper 470, Food and Agriculture Organization of the United Nations, Rome.

Lotze HK, HS Lenihan, BJ Bourque, RH Bradbury, RG Cooke, MC Kay, SM Kidwell, MX Kirby, CH Peterson and JBC Jackson (2006) Depletion, degradation, and recovery potential of estuaries and coastal seas. *Science* **312:** 1806-1809.

Luther G and YA Sastry (1993) Occurrence of spawners, juveniles and young fish in relation to the fishery seasons of some major fishery resources of India – a preliminary study, Marine Fisheries Information Service, T & E. Series. 122, pp 1-8.

Madhu VR, B Meenakumari, Satyen Kumar Panda (2010) Trawl Codend Selectivity Estimates for Goldband Goatfish In: B Meenakumari, MR Boopendranath, L Edwin, TV Sankar, N Gopal and G Ninan (Eds) *Coastal Fishery Resources of India: Conservation and Sustainable Utilisation*, p. 260-369, Society of Fisheries Technologists (India), Cochin

Menon NG (1996) Impact of bottom trawling on exploited resources, In: Marine Biodiversity, Conservation and Management (NG Menon and CSS Pillai (Eds), pp 97–102, Central Marine Fisheries Research Institute, Cochin.

Najmudeen TM and R Sathiadhas (2008) Economic impact of juvenile fishing in a tropical multi- gear multi-species fishery, *Fisheries Research* **92:** 322-332.

Pillai NS (1998) Bycatch Reduction Devices in shrimp trawling, *Fishing Chimes* **18(7):** pp 45-47.

Pramod G (2010) Illegal, Unreported and Unregulated Marine Fish Catches in the Indian Exclusive Economic Zone, Field Report (Pitcher, T.J., Ed.), Policy and Ecosystem Restoration in Fisheries. 29 p, Fisheries Centre, University of British Columbia, BC, Vancouver, Canada.

Rao GS (1998) Bycatch discards of trawlers of Visakhapatnam *In:* Advances and priorities in fisheries Technology, Society of Fisheries Technologists, India Cochin, 501-505.

Worm B, EB Barbier, N Beaumont, JE Duffy, C Folke, BS Halpern, JBC Jackson, HK Lotze, F Micheli, SR Palumbi, E Sala, KA Selkoe, JJ Stachowicz and R Watson (2006) Impacts of biodiversity loss on ocean ecosystem services. *Science* **314:** 787-760.

Worm B, R Hilborn, JK Baum, TA Branch, JS Collie, C Costello, MJ Fogarty, EA Fulton, JA Hutchings, S Jennings, OP Jensen, HK Lotze, PA Mace, TR McClanahan, C Minto, SR Palumbi, AM Parma, D Ricard, AA Rosenberg, R Watson and D Zeller (2009) Rebuilding global fisheries. *Science* **325:** 578-585.

Zacharia PU, PK Krishnakumar, C Muthiah, AA Krishnan and RN Durgekar (2005) Quantitative and qualitative assessment of bycatch and discards associated with bottom trawling along Karnataka during 2001-2002, Paper presented at the International Symposium on Improved Sustainability of Fish Production Systems and Appropriate Technologies for Utilisation, CUSAT, Cochin.