Responsible Fishing Technologies for Conservation of Marine Biodiversity

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Major threats to marine fisheries and biodiversity include land-based pollution and eutrophication; overfishing, destructive fishing, and illegal, unreported and unregulated (IUU) fishing; alterations of physical habitats; invasions of exotic species and global climate change. Overfishing, destructive fishing and IUU fishing are widely recognised as the greatest threats to marine biodiversity and fisheries, causing depletion of targeted populations, changes in the structure and integrity of the impacted ecosystems, changes in the life history traits of organisms and modifications in the habitats. The Food and Agriculture Organization of the United Nations has reported that nearly 80% of the world's fish stocks are now fully fished, overfished or depleted and requires effective and precautionary management. The principles for sustainable fisheries and conservation of biodiversity have been enshrined in the international fishery instruments adopted for governance of the oceans, such as the 1982 UN Law of the Sea Convention (LOSC); the 1993 FAO Compliance Agreement; the 1995 UN Fish Stock Agreement; the 1995 FAO Code of Conduct for Responsible fisheries; the 1948 IUCN Red List of Endangered Species Assessment; the 1992 Convention on Biological Diversity (CBD); the 1975 Convention on International Trade in Endangered Species (CITES); the 1995 Global Plan of Action for the Protection of the Marine Environment from Land based Activities and the International Convention for the 1973/78 Prevention of Pollution from Ships (MARPOL 73/78).

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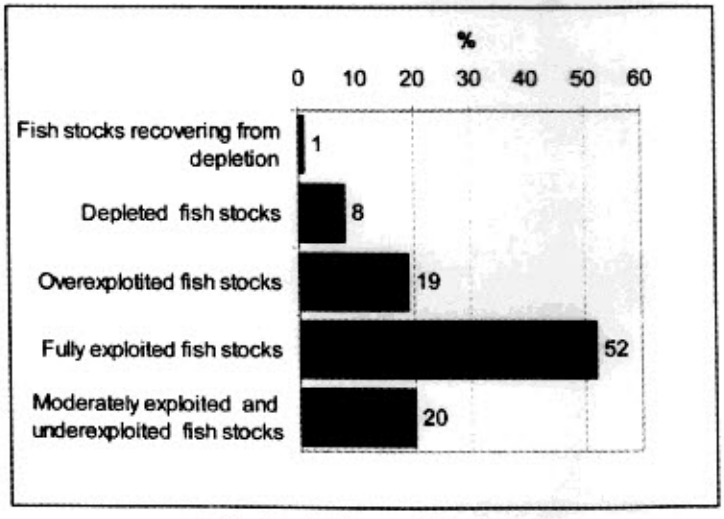
The 1992 Convention on Biological Diversity (CBD) is an important global agreement on the conservation and



Status of world fish stocks (source: FAO)

sustainable use of biological diversity which focuses on the conservation of biodiversity, sustainable use of the components of biodiversity, and sharing the benefits arising from the commercial and other utilisation of genetic resources in a fair and equitable way. The conservation measures outlined in CBD which are of particular relevance to marine biodiversity include protected areas, regulation and management of biological resources, protection, rehabilitation, and restoration of degraded ecosystems and habitats. The United Nations proclaimed May 22 as the International Day for Biological Diversity (IDB) to increase understanding and awareness of biodiversity issues.

Important national policies, legislation and action plans for conservation and sustainable use of marine biodiversity and fisheries conservation based on these principles include Ecosystem Approach to Fisheries (EAF) Management, matching capacity to ecosystem productivity, improving and optimising fishing systems in terms of selectivity and environmental impacts, establishment of marine protected areas (MPAs) with stakeholder participation, market driven conservation strategies such as ecolabelling of seafood and development of participatory fishery management systems. Technologies for responsible fishing in the context of conservation of biodiversity are generally oriented towards reducing bycatch of non-target species, protected species and juveniles and minimising the environmental impact of fishing gear and their operation.

Technologies for bycatch reduction

The importance of reducing bycatch and minimizing ecological impacts of fishing operations has been emphasized by scientists and fishery managers and recognized by fishermen. The shrimp trawl is a non-selective gear that commonly has an associated catch of non-targeted organisms such as finfish and miscellaneous invertebrates. Trawl fisheries in different parts of the world are now being required to use bycatch reduction devices as a result of pressure from conservation groups and legal regimes introduced by the governments. The FAO Code of Conduct for Responsible Fisheries, which gives guidelines for sustainable development of fisheries, stresses the need for developing selective fishing gears in order to conserve resources, protect non-targeted resources and endangered species like sea turtles.

Various types of bycatch reduction technologies have been developed in the fishing industry around the world. Devices developed to exclude the endangered species like sea turtles, and to reduce the non-targeted species in shrimp trawling are collectively known as Bycatch Reduction Devices (BRDs). These devices have been developed taking into consideration variation in the size, and differential behaviour pattern of shrimp and other animals inside the net. The salient features of some of the promising BRDs appropriate for tropical trawl fisheries are described below:

Approaches for bycatch reduction in fishing operations

Gear design related approaches

Trawls

- Trawl design improvements
- Mesh size optimisation
- Bycatch reduction devices and turtle excluder devices
- Juvenile and trash fish excluder devices

Purse seines

- Seine design and seine depth appropriate for schools of target species

- Mesh size optimisation
- Use of aprons in the seine design

Gill nets

- Optimisation of gillnet dimensions
- Optimisation mesh size
- Choice of netting material
- Choice of colour of netting
- Optimisation of hanging ratio
- Use of biodegradable materials in rigging and construction to prevent ghost fishing

Hooks and lines

- Hook design optimisation
- Hook shape and size
- Hook spacing
- Use of circle hook to minimise sea turtle bycatch
- Use of rare earth magnets in the proximity of hooks to deter sharks
- Use of dyed baits, side sets, subsurface line setting chutes and bird scaring steamers to deter birds
- Use of deep setting of line to minimize sea turtle bycatch

Traps

- Trap design optimisation
- Optimised trap mouth
- Escape windows
- Use of biodegradable materials in rigging and construction to prevent ghost fishing

Operation related approaches

- Choice of bait type and bait size appropriate for the target species in hook and line operations; use of dyed baits, side sets, subsurface line setting chutes and bird scaring steamers to deter birds; and use of deep setting of line to minimize sea turtle bycatch.
- Use of scaring devices and acoustic deterrents to prevent cetacean bycatch in gillnets.
- Choice of fishing area
- Choice of fishing depth
- Choice of fishing time and season

Escape windows

Escape windows made of square meshes, simple slits kept open by means of floats and sinkers (bigeye BRD) or opening with a rigid frame (fisheye BRD) are provided on the upper side of the codend or belly and they function based on the differential behaviour of fishes and shrimps. Fishes that have entered the codend tend to swim back and escape through the openings, at the top in the front section of the codend. Square mesh has the advantage that the mesh opening is not distorted while under operation, unlike diamond meshes. Bycatch exclusion rates of 35-51% with a shrimp loss of 0.8-2% have been reported during trawl operations in Indian waters, using semi-circular fisheye BRD.

Sieve net

Sieve nets (also known as veil nets) are cone shaped nets inserted into standard trawls which direct unwanted bycatch to an escape hole cut into the body of the trawl leading to a second codend. The large mesh funnel inside the net guides the fish to a second codend with large diamond mesh netting, while shrimps pass through large meshes and accumulate in the main codend. Bycatch exclusion rates of 15-50% with shrimp loss of 5-15% have been reported in sieve net installed trawl operations in different fishing grounds.

Rigid grid sorting devices

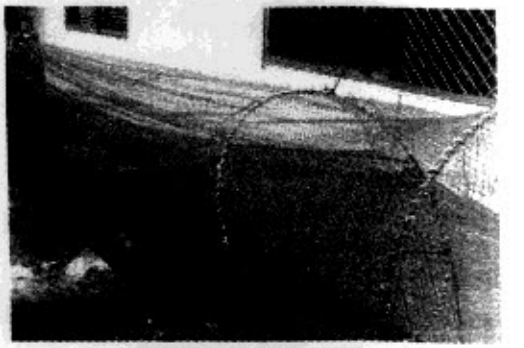
Several designs of rigid grid sorting devices have been developed for separation of shrimp from non-shrimp resources such as Nordmore grid, Juvenile and Trash Excluder Device (JTED) and rectangular and oval grid BRDs. Bycatch

Oval grid BRD operation

of 10-13% have been reported during trawl operations in Indian waters, using rigid sorting devices.

Juvenile Fish Excluder cum Shrimp Sorting Device (JFE-SSD)

Trawler fishermen in India and other tropical fishing nations depend on both finfish and shrimp catches to keep the commercial operations economically viable. Trawl bycatch in the tropical waters has a significant percentage of juveniles. The Juvenile Fish Excluder cum Shrimp Sorting Device (JFE-SSD) is a Smart Gear (WWF) award winning design developed by Central Institute of Fisheries Technology (CIFT), Cochin 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. JFE-SSD operations

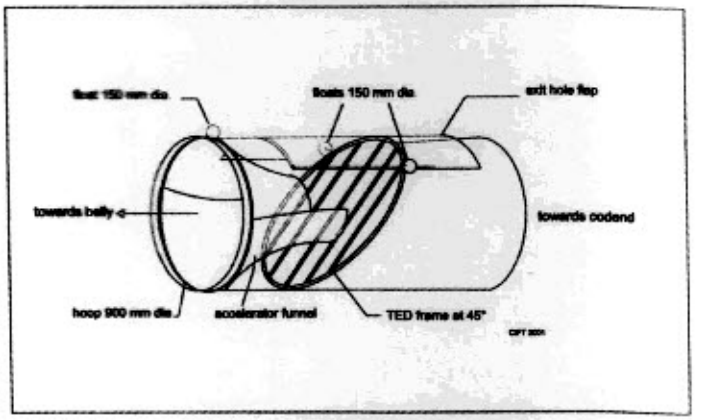


JFE-SSD ready for installation in trawl

off Cochin have realised bycatch reduction up to 43% with a shrimp retention of 96-97%.

Turtle Excluder Devices

Turtle Excluder Devices (TEDs) are recognized internationally as a convenient and effective measure for protecting sea turtles from trawling-related mortality and also for reducing bycatch in shrimp landings. Many trawl fisheries throughout the world are now required to use TEDs for their shrimp trawl fisheries. There are a variety of TED designs available today, which vary with regard to construction details, principle of operation, materials for construction and depending on the target resource groups and conditions of fishing. CIFT-TED is an efficient turtle excluder device developed at CIFT with focus on reducing catch losses, which is a cause of concern for trawler fishermen in adopting the



Perspective view of CIFT-TED

device. Catch losses during the operations due to installation of CIFT-TED were in the range of 0.52-0.97% for shrimp and 2.44-3.27% for non-shrimp catch components.

Semipelagic Trawl System

Demersal trawls are generally non-selective and a large number of non-targeted species and juveniles are landed during trawling, in addition to its impact on benthic communities. Resource specific trawls for Semi-Pelagic resources have comparatively low impact on the benthic communities. CIFT Semi-Pelagic Trawl System (CIFT SPTS-I) has been developed as an alternative to shrimp trawling in the small-scale mechanized trawlers operating in the tropical waters. The system consists of an 18 m four panel semi-pelagic trawl with double bridles, front weights and vertically cambered high aspect ratio otter boards of 85 kg each. It is capable of attaining catch rates beyond 200 kg per hour in moderately productive grounds and selectively harvest fast swimming demersal and semi-pelagic finfishes and cephalopods, which are mostly beyond the reach of conventional bottom trawls, currently used in commercial trawl fisheries in India.

Conclusion

Bycatch reduction technologies and approaches most appropriate for the regional fishery conditions need be adopted and enforced legally, after careful scientific evaluation and commercial trials. Enforcement of BRDs and TEDs and promotion of low impact semi-pelagic trawl system for demersal finfish resources in small-scale mechanised fisheries in the tropics as alternative to shrimp trawling, along with regulation on total fishing effort at sustainable levels will facilitate protection and restoration of biodiversity and enhance the resilience of the fish stocks to fishing pressure and climate change impacts through enhanced stock and breeding stock biomass.

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