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DESIGN CONSIDERATIONS FOR FABRICATION OF BYCATCH REDUCTION DEVICES

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With the development and broader availability of synthetic gear materials, recent advances in vessel technology, navigational electronics, gear handling machinery, fish detection methods and fish behaviour studies, large-scale changes have taken place in the design, fabrication, operation and catching capacity of modern fishing gears such as trawls, purse seines and long lines. Widely used traditional fishing gears such as entangling nets, hooks and lines and traps have also benefited by way of design upgradation and efficiency improvement in the recent years. New innovative fishing systems such as electrical fishing, light-assisted fishing, FAD-assisted fishing and fish pumps have also been developed and accepted in different parts of the world. Design process for fishing gear has been greatly influenced in recent years by resource management and conservation, environmental safety and energy efficiency imperatives.

Mechanisms of fish capture

There are different systems of fish harvesting used in the world, ranging from primitive to highly sophisticated systems. Fishing gear varies with structure, materials used, principle of capture process and method of operation. The selection of fishing gear mostly dependent on fish species, environmental factors and fishing ground conditions. Fishing gear use five mechanisms to capture fishes

1. Gilling and Tangling
2. Trapping
3. Filtering
4. Hooking and spearing
5. Pumping

The most commercially used fishing gears are – Purse seine and Trawl net followed by gillnet, entangling nets and traps. Based on the usage of material of construction the fishing gears are grouped into – 1. Net fishing gear – Fishing with netting which is constructed with webbing – Gillnets, Trawl nets, Purse seines etc. 2. Tackles – fishing gear in which hooks are an

important part and catch fish individually – Hooks and lines 3. Miscellaneous gears – Traps, Grappling and wounding, stupefying methods and 3electrical fishing.

Factors affecting fishing gear design

Important factors which influence the design of fishing gears are (i) biology, behaviour and distribution of target species; (ii) fishing depth, current and visibility; (iii) sea bottom conditions; and (iv)other factors such as the scale of operations, size and engine power of fishing vessel, energy conservation objectives, selectivity and resource conservation objectives.

Design of fishing gear is greatly influenced by biological characteristics such as body size and shape, feeding habits and swimming speed; behavior in the vicinity of fishing gear and during capture process; spatial distribution and aggregation behavior of the target species. Body size and shape determine the mesh size required to enmesh and hold the fish in gill in nets and the mesh size to retain the target size groups of the species without gilling in the trawls, seines and traps. Body size is also related to the tensile strength requirements for the netting twine in gill nets and hook size and lines in hook and lines. Feeding habit of the target species is more important in passive fishing methods like hook and line and traps where the fish is attracted by the bait, and in the active fishing methods like troll line used for catching predatory fishes Consideration of the swimming speed of the target species is more important particularly in the active fishing methods like trawling, seining and trolling. Fishes are known to sustain a cruising speed of 3-4 body lengths per second for short duration. Catching efficiency is maximized when the vertical opening of the trawl mouth, vertical dimension in gill nets, and the catenary of the main line of the long line with branch of lines and hooks, coincide with the vertical range of the layer of maximum fish abundance. Hence knowledge of the vertical distribution of the target species could be used to optimize the horizontal and vertical dimensions of the netting panels in gill nets, main line catenary in long line and mouth configuration in trawls

Hydro-acoustic pressure increases approximately at the rate of one-unit atmospheric pressure (I bar) for every 10m depth. Buoyancy elements used in the deep sea fishing gear such as deep sea trawls, gill nets and bottom vertical lines have to be strong enough to withstand the high pressure at the fishing depth. Prevailing strong currents in the fishing grounds may restrict the choice of fishing gears to longlines and gillnets which are less affected by currents. Light levels at the fishing depth could influence the fishing success, as vision of fish is affected by light levels. In passive fishing gears such as gillnets, visibility of netting panel adversely affects fishing efficiency, visibility is again negatively indicated in hook and line operation while in light-assisted jigging-controlled light plays an important part.

Rough sea bottom conditions limit the operation of most of the fishing gears close to the ground except handlines, vertical longlines, bottom vertical longlines and traps. Trawling on

rough bottom requires special rigging such as bobbin rig on rock hopper rig, improvements in trawl design to minimize gear damage or loss and selection of appropriate otter boards. Design features of fishing gears will also be influenced by the scale of operations, size and engine power of fishing vessel, energy conservation objectives, selectivity and resource conservation objectives, catch volume requirements, operational and handling requirements of the gear, prevailing weather conditions, skill required for fabrication, maintenance and operation, material availability, local traditions and economic considerations.

Gear Based Technical Interventions – considerations

The appropriate match between MMS (Minimum Mesh Size) and MLS (Minimum Legal Size) is a particular problem in multispecies fisheries. The link between MLS, gear selectivity, and discarding rate is often poorly understood. Stress-induced behavioral deficits increase the risk of predation in the hours or days after the encounter (Behavioral impairment of fish escaping trawls). Behavioral impairment not measured in the field and survival studies, which traditionally use enclosures to measure mortality, do not have predation risk. Reflex action mortality predictors are often employed, but may not mimic the actual field conditions. There is a need to go beyond well-known areas of research and to define possible behavioral ecology frameworks. The crucial questions that need to be answered before implementation of any gear based technical measure:

How large a change in gear/mesh size is possible?

How long will it take to realize economic benefits and who will get them?

How easily can the fishers manipulate selective properties of gear, legally and illegally?

How to compensate for potential catch losses?

How much does it cost to improve gear selectivity and who will pay?

Are other unrelated measures, more efficient to improving stock status and future conditions?

Conclusion

Gear based technical devices can address juvenile bycatch to a great extent. The most practical method in juvenile exclusion in a multi species multi gear system like ours, is gear based modifications. Considering the devices and operation, we can see that the structure and size made them effective and easy to incorporate in the existing fishing gear. Most of the devices like fish eye and hooks have considerably less installation procedure. Since most of these devices, are based on interactions and escapement, mortality could be an issue. Devices that avoid direct contact such as aberration and funnelling are safe to operate whereas filtering type of excluding devices are harmful and increase mortality. The best option would be to avoid the interaction by spatial / temporal closures based on prior knowledge. Which is in fact leads to socio economic adversity as the lean periods coincides with restricted fishing season. Alternative livelihood is yet a hurdle in the under developed and developing countries. Economic status of fisherfolk should be considered while implementing such restrictions.

Studies to be taking up for accessing behavioural responses of fish, to avoid interaction of non-targets are novel approach yet taking pace gradually, could serve a better alternative option. Close association with fishermen community will help significantly in the outcome of the studies carried out by research institutions. Monitoring the practices at sea is the bigger task hardly affordable by legislative bodies. Development of MCS systems in the sector will play a better role.

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