Bycatch issues in longline operations and mitigation strategies

Renjith R. K.
ICAR-Central Institute of Fisheries Technology, kochi
renjith.rk@icar.gov.in

Introduction

Long line fishing is employed by both artisanal and mechanized sectors (Kurien and Willmann, 1982). It is considered as one of the best methods of fishing that ensures sustainability due to the least impact exerted on the surrounding environment and the catch can be selective (Rouxel, 2017). For example, any fish too small, or not the right species can be placed back into the water, without harm. These gears make it possible to operate in places with rocky or uneven bottom where it is impossible to deploy gears like ring seine or trawls (Mathai, 2009). Long lining can be used to target both pelagic and demersal fish with the lines being rigged and set at a position in the water column to suit the particular species. A basic long line consists of a long length of line, light rope or more common now is heavy nylon monofilament, the 'main line', this can be many miles in length depending on the fishery. To this main line, multiple branch lines with baited hooks on (snoods) are attached at regular intervals. This rig is set either on the seabed (demersal) or in midwater (pelagic) with a 'dhan' bouy at either end, and allowed to fish for a period.

Longlines can be further classified as 1. Set longlines: These are stationary lines that are anchored to the vessel, the seafloor or to an anchored buoy. Setting can be practised either horizontally or vertically. 2. Drift longlines: these are attached to floats that drift freely with the ocean currents.

Species Targeted in Long line fishing

In the Indian seas, longline fishery is mainly targeting yellowfin and bigeye tunas. As reported elsewhere (Shivasubramaniam, 1963; Pillai and Honma, 1978) the bycatches, especially sharks constitute a major portion of the longline catch in the Indian waters also. Mechanized sectors of Kerala, Tamil Nadu, and Andhra Pradesh rely on longlining for high value fishes like tuna, marlin, sail fish and sharks. In Kerala, landings from hooks and lines fishery contribute about 3.3% of the total fishery. Seerfish landings registered an upward trend with 83.3% increase from 2010 to 2011, out of which 54.7% was contributed by longline in Kerala (CMFRI, 2012). During 2011, 50.8% of elasmobranch catch was contributed by line fishing and grouper contributed about 15% by longline. In Tamil Nadu, 10.6% of seerfish, 1.2% of tuna and 4.2% of elasmobranchs were contributed by hook and line (CMFRI, 2012). In Visakhapatnam, annual catch of tuna recorded by hooks and lines was 2714 t during 2011 constituting dominant species, *Thunnus albacares* (53%), *Katsuwonus pelamis* (31%) and *Euthynnus affinis* (16%) (CMFRI, 2012). According to CMFRI (2012), a total of 29 longliners are operating in Kerala coast, 380 in Tamil Nadu and 21 in Andhra Pradesh during 2010 (Vipin et al., 2014).

Bycatch scenario in longline fishing

Since the numbers of species caught are less in a single operation, average mortality rate is assumed to be less than other fishing methods considering population parameters. Line fishing catches desired fishes during operation and unlike trawls, it avoids contact with the sea bottom

hence it is assumed that very few species are affected other than targeted species. In a multispecies fishery like India, bycatch reduction has always been challenging (Lobo, 2012). Since the selectivity of line fishing is prominent, concern for bycatch is considerably less alarming.

Surface long lines for dolphinfish practised in the Atlantic had a high bycatch of seabirds (0.147 birds/1000 hooks). However, the traditional pelagic longline captures seabirds during winter months (Neves et al., 2006), while the surface longline for Dolphinfish takes place during summer in the Atlantic (Swimmer et al., 2005). A range of characteristics including low depth, deployment during daylight hours, and use of small hooks make it particularly dangerous for seabirds by being available throughout fishing and not only during deployment as in the longline for Swordfish and tuna. Catch rate of sea turtles was also high in the surface longline for Dolphinfish (1.08 turtles/1000 hooks) comparable to rates reported in the pelagic longline fishery for Swordfish in the SW Atlantic of 0.68–2.85 turtles/1000 hooks (Domingo et al., 2006).

Sharks and cetaceans cause significant damage worldwide in pelagic longline fishery operations. Damages are in the form of bite-offs, loss of gear, catch displacement, reduced gear efficiency, and depredation of the catch (Yano & Dahlheim, 1994; Secchi and Vaske, 1998; Garrison, 2007). The experimental longlines operated in Indian waters showed a very high shark catch during the post-monsoon season in the Bay of Bengal (John and Neelakandan, 2004).

Advantage of longline fishing

Long line is more selective than other types of fishing in terms of species and size, and provides high quality fish (Erzini et al., 1996). The method can be used in spawning fish as they normally only bite after completion of spawning (Farmer et al., 2017). Lines are set for a relatively short time so that any unwanted species can often be returned live to the sea. Advantages of longline fishing is listed below

a. **Quality of end product:** while comparing meat quality from long line fishing and trawl caught fishes, line caught fishes exhibit firmer as well as whiter meat. The better quality may be due to better bleeding and less compression damage. Both the compression damage and the poor bleeding out are caused because trawling brings up from five to twenty tons of fish onto the deck each time, while with long-lining the fish are brought on board one by one.

b. **Lower fuel consumption:** A significant advantage that longliners have over trawlers is the relatively low fuel consumption per unit of catch. For example, it was established that a trawler expends 0.6-1.5 tonnes of fuel per tonne of raw fish caught, while a longliner expends 0.1-0.3 tonnes (Karpenko, 1997; Makeev and Shentyakov, 1981; Pavlov and Makeev, 1987; Glukhov, 1994; Chumakov and Glukhov, 1994a, 1994b; Sorokin and Chumakov, 1995). With regards the amount of fuel used over time, the longliner spends 2.7 times less fuel every hour than a trawler (Zherebenkova and Makarova, 1990). The results of modern-day research in the Barents Sea show that a longliner spends 0.3-0.6

tonnes of fuel per tonne of raw fish caught (Grekov, 2007a). This is approximately 20-40 % of the fuel consumption of a similar type trawler (Bjordal and Lokkeborg, 1996).

c. **Species selectivity:** In general, neither the trawl nor the longline can be considered as fishing gears that have a high selectivity towards some species of fish. Trawl can hardly be called a selective fishing gear as it takes almost everything that comes into a forenet (Bjordal and Løkkeborg, 1996). As for the longline, it is more selective because of its passivity. The catch depends mostly on the behaviour, biology and physiology of the fish. In particular, most fish cannot be caught by a longline as they are simply unable to swallow a hook (Lokkeborg, 2000). According to the work carried out at Barrent Sea, twenty-nine species of fish are harvested by longline. When carrying out trawler-acoustic counting of ground fish stocks, up to 70 types of fish were recorded in trawls (Grekov, 2007).

d. **Size selectivity:** As the number of hooks on a longline is limited, the hooking of a large fish reduces the number of free hooks and so lowers the chances of catching juveniles. Furthermore, the hook itself is selective regarding fish size as small-sized fish can swallow a baited hook of no larger than a certain size. By changing the size of the hook and bait, therefore, one can satisfactorily control the volume of by-catch of small-sized fish (Grekov, 2007).

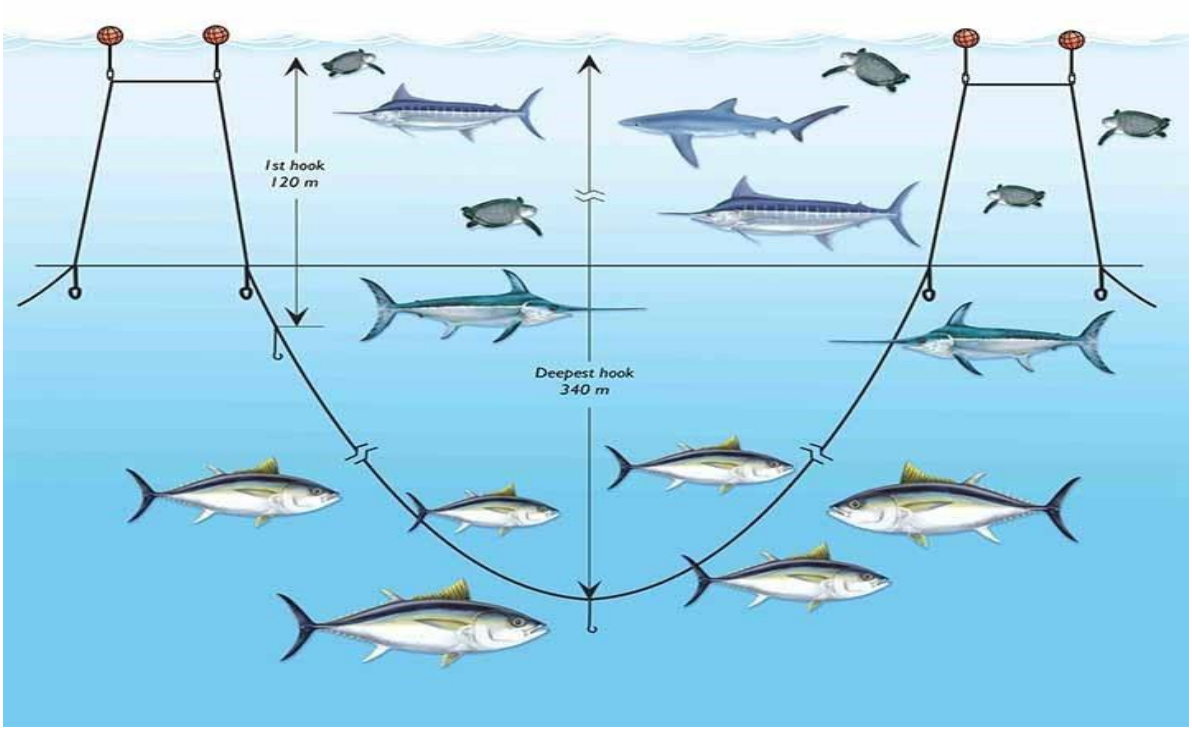
e. **Value of fish products:** In general, the larger the fish, the higher its value. There are more large fish in logline catches and longliners tend to catch more products of large size. Consequently, more income is generated. According to verbal information provided by ship owners, the market value of fish produced by longliners is 15-20 % higher than for trawlers, largely because of the higher quality of product harvested by longliners

Conservation of non-targeted resources

Major bycatch in line fishing are turtles, seabirds, sharks and non-targeted fishes. The most discussed case is the incident of turtles in tuna long line. There are many methods adopted by sector all around the world for the conservation of these resources. Methodologies developed specifically for each organism. These methodologies are listed below:

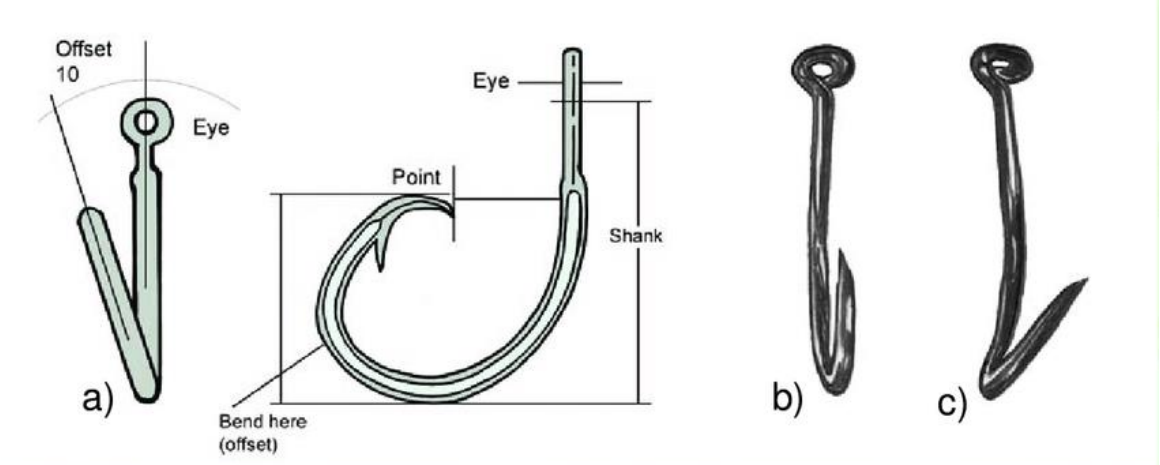
a. **Avoid hotspots:** Hotspots are the location where the unwanted species are caught in large quantities. There is currently no quantification of what constitutes a hotspot. This would be left to the fishermen to determine if they are fishing in an area that is resulting in the incidental capture of sharks, sea turtles, sea birds, marine mammals or unwanted fishes.

b. **Set operational depth to deeper or shallow waters**: This may work in case of shark species which swim to the surface waters. Setting line deeper than 100m will avoid most of the species and only yellow fin tuna may come in contact.



Deep and shallow water setting of long lines. Courtesy: Swot,2006

c. **Use circle hook with offset:** Circle hooks have a rounded shape with a point oriented toward the shank, which is different than the J hook that has a point oriented parallel to the shaft. Circle hooks are wider and therefore more difficult for sea turtles to become hooked on. The offset creates a larger gap between the point and the shank hence the turtles can escape from accidental hooking. Similar to other species, circle hooks are wider and more difficult for some marine mammals to bite and become hooked on. Bill fishes are also known to escape from circle hooks without incidents of hooking. Use of wider circle hooks in place of narrower J and tuna hooks to reduce turtle bycatch rates and mortality in longline fisheries has also been found to reduce seabird bycatch rates by about 80% (Gilman, 2011)



Courtesy: FAO, 2009

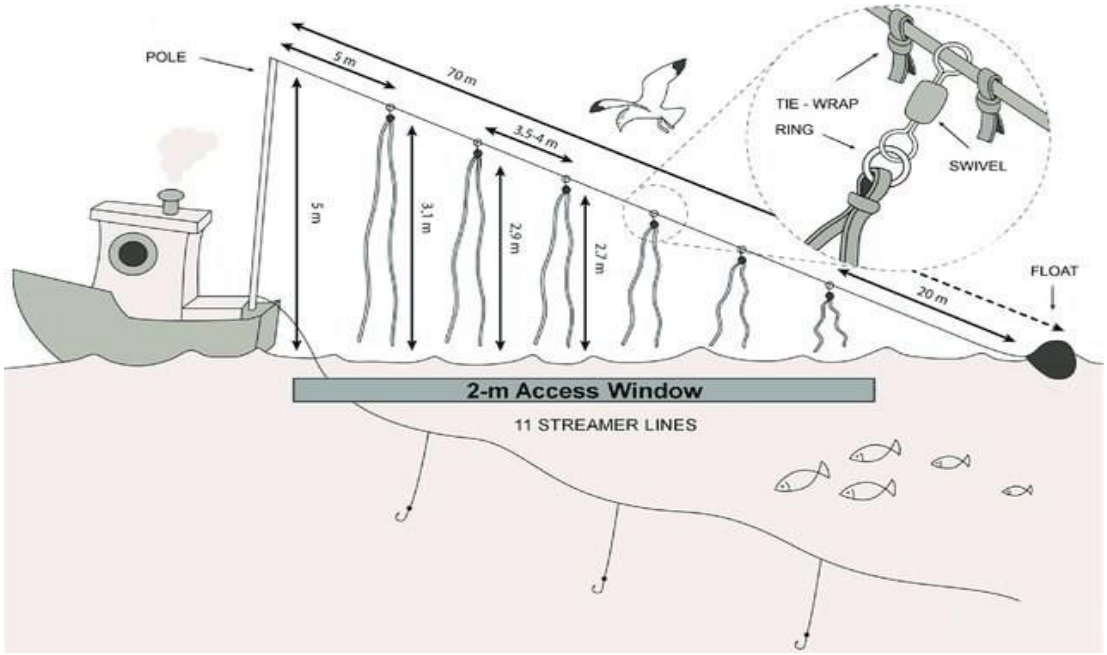
d. **Line weighting:** Weights are added to the branch line so hooks are quickly deployed to the target fishing depths. This reduces bycatch of seabirds by moving the baited hooks out of the diving range of seabirds. The effectiveness of line weighting depends on the distance between the weight and the hook (a short distance accelerates the initial sink rate) and the amount of weight added (greater weight accelerates the subsequent sink rate). This mitigation measure must be used in conjunction with properly deployed streamer lines or night setting in case of seabird interaction. Using weight or lead swivels of minimum weight 45g within 1m of the hook may reduce sea turtle interaction also.

e. **Use of finfish bait:** Using finfish instead of squid for bait has been shown to reduce sea turtle interactions. This may be more effective for leatherback sea turtles compared to other species. Using finfish instead of squid for bait has been shown to reduce interactions with some but not all shark species

f. **Night setting**: Night setting is the practice of setting and hauling fishing gear between dusk and dawn. No modifications to fishing gear are needed and this has been proved to avoid sea bird interaction to logline.

g. **Shorter soak time:** This reduces the amount of time the gear is in the water, reducing potential interactions. It also may reduce mortality in incidentally captured turtles because they remain hooked for a shorter period of time Adequate soak time reductions would be species/fishery specific. The challenging part is to determine soaking time for specific species with experimental fishing.

h. **Streamer line (tori or bird scaring line):** An extra line will be dropped behind the boat with streamers that is towed from a high point as the baited hooks are deployed (usually near the stern). An aerial segment with streamers suspended at regular intervals is formed as the vessel moves forward, creating drag on the streamer line. The mitigation measure works by maintaining the streamer line over the sinking baited hooks, therefore preventing seabirds from attacking the bait and becoming hooked.



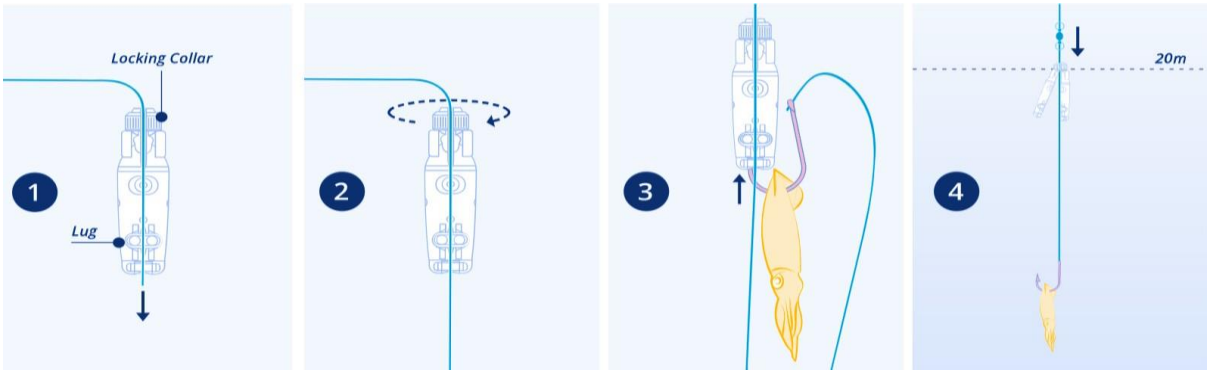
Courtesy:Vero & Jacob, 2018

i. **Conduct fleet communications:** This will allow fishermen and policy makers to determine where marine mammal sightings may have occurred and move fishing locations when interactions occur

j. **Prohibit the use of wire leaders and shark lines:** Shark lines are attached to the floats and stay above mainline of longline. Wire leaders prevent sharks from being able to bite through and escape after accidental capture. Shark lines may attract more sharks to the fishing gear.

k. **Removing the first and/or second hooks closest to the float in each basket:** The hooks closest to the float fish in shallower water and therefore have a higher likelihood of incidentally capturing sea turtles.

l. **Hook-shielding devices:** These are devices that encase the point and barb of baited hooks. This prevents seabird attacks during the setting process. Hooks are released after the hook has reached a minimum of 10m depth or has been in the water for a minimum of 10 minutes. The Hook Pod and Smart Tuna Hook are two devices assessed as having met ACAP (Agreement on the Conservation of Albatrosses and Petrels) performance requirements.



Hook pod being detached after deployment. *Courtesy: Hookpod Limited, Devon, UK*

The shield gets fitted to a baited Smart Tuna Hook. *Courtesy: ACAP, 2015*

m. Use 'weak' hooks: These are specially designed hooks that break or bend when certain amount of pressure is applied, allowing incidentally captured species the ability to escape. Mostly used in case of marine mammal incidents as they are stronger than fishes.

n. Restrict the use of light sticks: This may reduce billfish interactions by lessening the ability to see baited hooks. Turtles are also found attracted to light sticks.

o. Use of monofilament for the mainline and branch line: Monofilament line reduces the risk of entanglement compared to multifilament lines. Monofilament is less flexible, making it easier to release entangled sea turtles (i.e. reduces knotting of the line).

p. **Time/area closures:** Time-area closures and restrictions on the timing of setting could further reduce seabird bycatch as these factors have been observed to have significant effects on seabird catch rates

q. **Cover the point of the hook:** This will reduce the ability of sea turtles to bite and become hooked.

r. **Avoid using light sources:** This may reduce sea turtle interactions by lessening the ability of turtle to see baited hooks.

s. **Fisheries certification:** It is important to recognise and reward good fishing practices in the market place. Among the most popular seafood certification organisations is the Marine Stewardship Council. The Council certifies fisheries based on the sustainability of fish stocks, the level of environmental impact (one of the parameters is that the fisheries should have negligible/low levels of bycatch), and whether the fishery is being effectively managed. A fishery that comes close to meeting these criteria of sustainability is the pole and line skipjack tuna fishery in the Lakshadweep. However, it is important to recognize the dynamic nature of what constitutes bycatch and evolve incentive systems which recognise the moral, social, and economic implications of bycatch along with its ecological impacts. It is equally important to understand that certification alone is not likely to bring about major improvements in the conservation of bycatch species. So far certification has primarily been effective in raising awareness among consumers (Ward, 2008). Its shortcomings are that it is seen primarily to market opportunities, and has rarely, if ever, helped the recovery of depleted species (Jacquet et al. 2009; Jacquet et al. 2010).

Conclusion

Line fishing methods especially longline and pole and line widely used in Indian waters has advantages in biological and economical aspects as discussed earlier. Considering the current production from line fishing where tuna is targeted, production level has to fill in the huge gap with estimated potential of tuna from coastal fishing and island fishing. However, it is also to be noted that line fishing has the clear drawback of needing to use additional biological resources in the form of bait especially live bait for. The large scale development of the line fishery is one of the means of optimizing exploitation of resources from Indian waters. At the same time, it is necessary to understand that development of the fleet must not only be aimed at increasing size but also at increasing efficiency.

Reference

ACAP, 2015. Retrieved at *https://www.acap.aq/*

FAO. 2009. Guidelines to reduce sea turtle mortality in fishing operations.

SWOT (2006) New Deep-Set Longline Is Smart Gear. Report, vol. 1

Vero Cortés and Jacob González-Solís (2018). Seabird bycatch mitigation trials in artisanal demersal longliners of the Western Mediterranean. PLOS ONE. 13. e0196731. 10.1371/journal.pone.0196731.