

Subsurface gillnetting: What motivated fishermen to Change

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ABSTRACT

Gillnet is a popular fishing method used for catching tuna and tuna like fishes especially by small scale fisheries of coastal states of the Indian Ocean. However, gillnets are known for extremely high bycatch which includes not only commercially important fish species but also a large number of non-target endangered, threatened and protected (ETP) species. Information about gillnet bycatch is not well known from major coastal states, however, studies initiated by WWF-Pakistan provide comprehensive information about bycatch of gillnet fisheries of Pakistan. It is estimated that more than 12,000 cetaceans and 29,000 sea turtles used to be annually entangled in the gillnet fisheries of Pakistan alone.

Considering high bycatch of ETP species, WWF-Pakistan introduced subsurface gillnetting in Pakistan as a mean for reducing entanglement and mortality of at least cetaceans and turtles. Placing gillnet below 2 m proved to a success, as catches of target species of gillnet fisheries including yellowfin and skipjack tunas increased substantially whereas catches of some important species such as billfish and dolphinfish substantially decreased. However, high catches of target species i.e. yellowfin, longtail and skipjack tunas compensates for the losses incurred due to decreased catches of these two species group.

There was a major reduction in entanglement and mortality of cetaceans and turtles in subsurface gillnet. Entanglement and resultant mortality of cetaceans was observed to decrease from 12,000 in 2013 to mere 186 in 2018 (reduction of 98.45 %). Increase in landings of commercially important species including yellowfin, longtail and skipjack tunas is the main incentives for the tuna fishermen to shift from surface gillnetting to subsurface operations; however, there are a number of other benefits which resulted in its immediate adoptability by the entire tuna gillnet fleet. The operation of subsurface gillnetting is comparatively hassle-free as compared to surface gillnetting because the chances of fouling during deployment and retrieval are reduced. Less entanglements of ETP species help in saving time which otherwise lost during disentanglement and process of discard. These merits of subsurface gillnet operation motivated the gillnet fishermen of Pakistan to shift from surface to subsurface gillnetting within a span of less than two years.

INTRODUCTION

Gillnetting is the main mode of fishing of tuna and tuna like species in Pakistan and other regional countries of the Arabian Sea. A very large fleet of gillnet vessels is based in Pakistan, Iran, Indian west coast, Oman and Yemen. Pakistan's tuna fleet is estimated to be about 700 vessels of various sizes. In Iran there are about 4,000 gillnet vessels which are engaged in fishing for tuna and tuna like fishes (Shahifar, 2018). Indian fleet based in the Arabian Sea is also large (Koya *et al.*, 2018)..

Gillnet deployed for catching tuna in the Arabian Sea is known to have high bycatch of a number of commercially important species as well a large number of non-target endangered, threatened and protected (ETP) species including sea turtles, whales, dolphins, whale sharks,

mobulids, requiem sharks, sea snakes and sunfish (Koya *et al.*, 2018; Moazzam, 2012d, 2013, 2017, 2019; Moazzam and Nawaz, 2014, Moazzam *et al.*, 2013, 2016; Nawaz and Moazzam, 2014, Nawaz *et al.*, (2012), Shahifar, 2018).

In order to reduce entanglement of megafauna, pilot scale alternate gears are being experimented but conversion of fleet to any such change will take many years before it is fully adopted by fishermen. WWF-Pakistan, therefore, has convinced the tuna gillnet fishermen to use subsurface gillnetting (placing gillnet about 1.5 to 1.8 m below surface) which requires only minor modification in the fishing operation.

Through WWF-Pakistan's crew based observer programme (Moazzam and Nawaz, 2019), this modification was demonstrated and was readily accepted by fishermen. Since the start of modification in August 2014, the entire gillnet fleet from Pakistan is converted to subsurface to gillnet operation by 2016. This major change in fleet operation has taken place because of additional benefit accrued by the tuna gillnet operators. Present paper encompasses these additional benefits of subsurface gillnetting which made it popular and resulted in reduction of major bycatches especially of ETP species.

MATERIALS AND METHODS

The information presented in the present study is based on the interaction with fishermen that are engaged in gillnet fishing for tuna and tuna like species in coastal and offshore waters of Pakistan. Almost all of the fishermen who provided the information for this study have adopted subsurface gillnetting as a result of the conversion programme initiated by WWF-Pakistan in 2014 (Moazzam and Nawaz, 2017). Data collected through WWF-Pakistan's Crew Based Observer Programme was used in the present study.

Results and Discussions

In Pakistan, gillnets consisting of monofilament and multifilament are used for catching tuna and tuna like species. Monofilament net is mainly used for catching frigate (*Auxis thazard thazard*) and bullet tunas (*Auxis rochei*) in coastal waters whereas multifilament nylon nets are used for catching longtail tuna (*Thunnus tonggol*), kawakawa (*Euthynnus affinis*), striped bonito (*Sarda orientalis*), yellowfin tuna (*Thunnus abacares*) and skipjack tuna (*Katsuwonus pelamis*) in the offshore waters. Bigeye tuna (*Thunnus obesus*) is rarely caught by the gillnet fishing vessels in coastal and offshore waters, therefore, it does not contribute to the tuna landings of Pakistan. There are about 700 tuna gillnetters based mainly in Karachi along Sindh Coast and Gwadar along Balochistan Coast.

Information about tuna fisheries of Pakistan is known through the work of Khan (2016), Moazzam (2011, 2012a-c, 2014, 2017, 2018a-b), Moazzam and Ayub (2015, 2017), Moazzam *et al.*, (2016, 2017) and Nawaz and Moazzam (2014). These studies were based mainly on the fisheries statistical data being published by Marine Fisheries Department, Government of Pakistan and also on information collected through the Crew-based Observer Programme initiated by WWF-Pakistan in 2012.

Surface Gillnet Operation

Gillnets which were traditionally used by fishermen are placed on the surface of the sea with the help of floats (Styrofoam). The floats used to be placed after every 4.5 meters (50 eyes of nets). A weight of 2 kg (stone) was used to be tied to the footrope after every 60 m. After every 160 meters (length of 2 net panels) a large float (usually a plastic canister of 20 to 30 liter) is attached. This arrangement which is locally known as “Bither” enables the net to remain at surface (Fig. 1).



Fig. 1. Surface gillnet showing arrangements of floats on the headrope.

The surface tuna gillnets were observed to entangle a large number of ETP species including dolphins, sea turtles, mobulids, sea snakes, whale sharks, sunfishes and requiem sharks. It was estimated that annually about 29,000 sea turtles and 12,000 dolphins used to get entangled in the surface gillnet operations in the tuna fleet of Pakistan (Nawaz and Moazzam, 2014).

Considering such high mortality of ETP species, WWF-Pakistan tried many options including identification of hotspots of dolphins along the coast of Pakistan and persuading fishermen to avoid fishing in these hotspots, reducing soak time (which under normal condition is usually 12 hours) and use of LED lights. However, no tangible solution was found and none of these attempted options were acceptable by the fishermen.

Subsurface Gillnet Operation

While exploring various options that may help in reducing bycatch of ETP species, it was decided to conduct experiment on using subsurface gillnetting which is locally known as “Teelo”. This mode of operation of gillnet was sometimes used a few decades back by fishermen of Balochistan Province if they intend to target yellowfin tuna. Although at that time, tuna catch used to be salted dried and export to Sri Lanka, however, among salted dried tuna species, yellowfin used to fetch premium price in Sri Lankan market. However, the use of subsurface gillnet was not associated with reduce bycatch and also catches of some other prime species such as billfishes were observed to substantially reduced. The mode of operation and placement of net was quite different from subsurface net being used nowadays.

Considering that some ETP species including sea turtles and cetaceans are surface water dwelling, WWF-Pakistan worked closely with fishermen to do experiments on subsurface gillnet operation. Exploratory subsurface fishing on one of the gillnet vessel that was done in October 2014 indicated comparatively high catches of yellowfin and skipjack tuna (about 20

% higher than other) as compared to other vessels which were using surface gillnetting in the same area of fishing. These result prompted other fishermen to switch over to subsurface fishing to catch more yellowfin and skipjack. Later on it was also observed that catches of longtail tuna also are higher in subsurface gillnets as compare to surface gillnetting. This coincided with increase prices of yellowfin, skipjack and longtail tuna in the target market in neighboring country which hasten the speed of conversion to subsurface gillnetting.

Tuna gillnet fleet started shifting to subsurface gillnetting and phased out use of surface gillnets. After November 2014, all new panels added to the existing gillnets of tuna fleet were modified for subsurface operation. There were many vessels that used to have gillnet consisting both surface and subsurface panels during 2015 and by January 2016 entire tuna gillnet fleet of Pakistan shifted to subsurface gillnetting.

Length of subsurface gillnet is not changed and ranged between to 7 to 12 km. The net consists of headline and footrope. After every 8 meters (2 fathoms), two floats are attached through a rope which is about 1.5 to 2 meters long to the headline (Fig. 2). After every 35 to 50 meters one stone of about 2 kg is attached to foot rope. After every 160 meters (length of 2 net panels) a large float (usually a plastic canister of 20 to 30 litre) is attached, as also done in case of surface gillnets. Using this arrangements, the gillnet remains 2 meters below the surface during fishing operation (Fig.2).



Fig. 2. Floats attached to head-rope of subsurface gillnet

Merits of use of subsurface gillnet

Placing gillnet below 2 m proved to a success, as catches of target species of gillnet fisheries including yellowfin, and skipjack tunas increased substantially (Table-I). There is minor increase in the catches of longtail tuna. The catches of some important species such as billfish, Spanish mackerel and dolphinfish substantially decreased. However, high catches of target species i.e. yellowfin and skipjack tunas compensated for the losses incurred due to decreased catches of these two species group (Fig. 3).



Fig. 3. Subsurface operation keep the gillnet 2 m below the sea surface.

Table-I. Catch per unit effort (kg/day) of major species caught by tuna gillnetting

Species	Pre-Subsurface (catch per unit effort) kg/day	Subsurface (catch per unit effort) kg/day	Remarks
Yellowfin tuna	72.21	112.36	Major increase
Longtail tuna	23	24.16	Minor increase
Skipjack Tuna	6.65	35.21	Major increase
Sailfish	34.33	0.54	Major decrease
Marlin	0.59	0	Major decrease
Dolphinfish	39.17	4.96	Major decrease
Spanish Mackerel	7.06	1.41	Major decrease

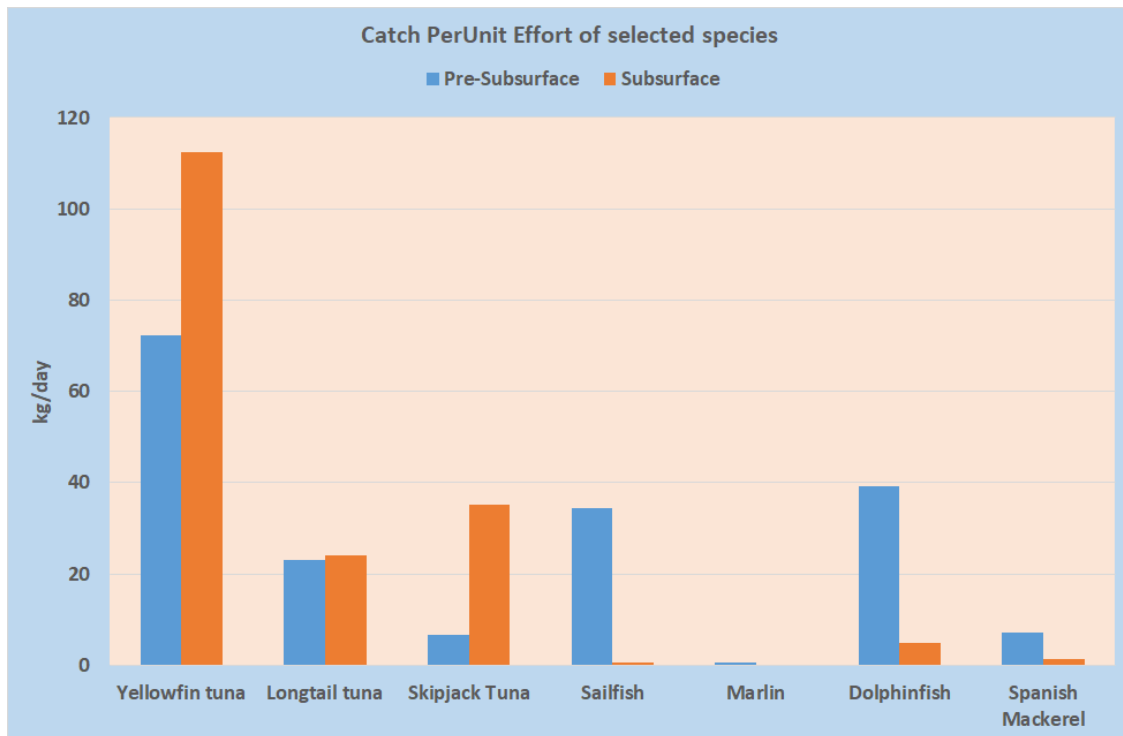


Fig. 3. Catch per unit effort (kg/day) of major species caught by tuna gillnetting

Yellowfin tuna

Yellowfin is the main target species of tuna gillnetting in Pakistan. It fetches high prices in the local; highest among all tuna species. A major increase in the catches of yellowfin tuna was noticed in case of subsurface gears. It is also worth mentioning that during 2016 to 2017, average weight of each tuna was higher (19.8/pc in 2015 vs 24.5 kg in 2016 and 2017). High catch rate and higher weight are the main reason that prompted entire fleet to shift from surface to subsurface gillnetting.

Skipjack Tuna

Skipjack tuna is found mainly in offshore waters and its catch rate in subsurface gears increase substantially (Fig. 3. Table-I). This is another species which fetches high prices in the local market. No major change in the size composition of skipjack was noticed which can be attributed to subsurface gillnetting.

Longtail Tuna

There was only minor increase in the catches of longtail tuna was noticed. Being a neritic species, it was observed to be widely distributed in the water column, therefore, no major increase in size composition was notice.

Bigeye Tuna

It was expected that subsurface operation of gulleets will yield some catches of bigeye tuna which is known to inhabit deeper waters but unfortunately no catches of bigeye were made by tuna gillnetters using subsurface gillnets..

Other Tuna Species

Frigate tuna (*Auxis thazard thazard*), bullet tunas (*Auxis rochei*), striped bonito (*Sarda orientalis*) and kawakawa (*Euthynnus affinis*), being neritic in distribution were not observed to be affected by subsurface fishing. However, data of these species are still being analysed to decipher any differences in catch rates in surface and subsurface gillnet operations.

Billfishes

Billfishes are known to be surface dwelling, therefore, as expected their catch rate was observed to substantially reduced in subsurface gillnet operation (Fig. 3-Table-I). Billfishes, like yellowfin and skipjack fetches high prices in local market, therefore, reduction in the catches of billfishes is one of the major issue with subsurface gillnetting. Higher catches of yellowfin and skipjack as well as prevailing high process for these two species, compensated for loss incurred because of low catches of billfishes.

Dolphinfish

Dolphinfish is known to be surface dwelling, therefore, as expected their catch rate was also decreased in subsurface gillnet operation (Fig. 3-Table-I). Previously (upto 2017) dolphinfish fused to fetch extremely low prices in local market, therefore, reduction in the catches of dolphinfish not considered as serious. However, since 2018, the prices of dolphinfish increased substantially in the local market because of its export to USA and other countries. Although higher catches of yellowfin and skipjack as well as prevailing high process for these two species, compensated for loss incurred because of low catches of dolphinfish. The gillnetters, now employ about 10 fishermen to catch dolphinfish using handline during daytimes when there was no other fishing activity is being done. Handline caught dolphinfish fetches comparatively higher prices as compared to gillnet caught dolphinfish.

Spanish Mackerel

Spanish mackerels are known to be surface dwelling in neritic waters , therefore, their catch rate was observed to substantially reduced in subsurface gillnet operation (Fig. 3-Table-I). Spanish mackerel fetches very high prices in local market, therefore, reduction in the catches of billfishes is one of the major issue with subsurface gillnetting. Higher catches of yellowfin and skipjack as well as prevailing high process for these two species, however, compensated for loss incurred because of low catches of billfishes.

ETP Species

There was major decrease in the catches of ETP species including cetaceans, sea turtles and pelagic sharks in subsurface gears (Fig. 7). For fishermen reduction in catch ETP species is considered to be a blessing because it saves time which otherwise would have lost in heaving the ETP species into fishing boat, their disentanglement and release or discard. The entanglement and mortality, for example, of cetaceans alone has been reduced from an annual level of about 12,000 in 2013 to mere 186 in 2018 (Fig. 4). Further reduction in dolphin mortality was observed in 2019 and 2020, however, data is being analysed.

Baleen Whales

No case of entanglement of baleen whales in tuna gillnet fishing gears was reported since 2016, therefore, it is not possible to determine the impact of subsurface gillnetting on large baleen whales. There were only a few strandings of baleen whales were reported from Pakistan coast, but in none of the cases the stranding or mortality was attributed to tuna gillnetting.

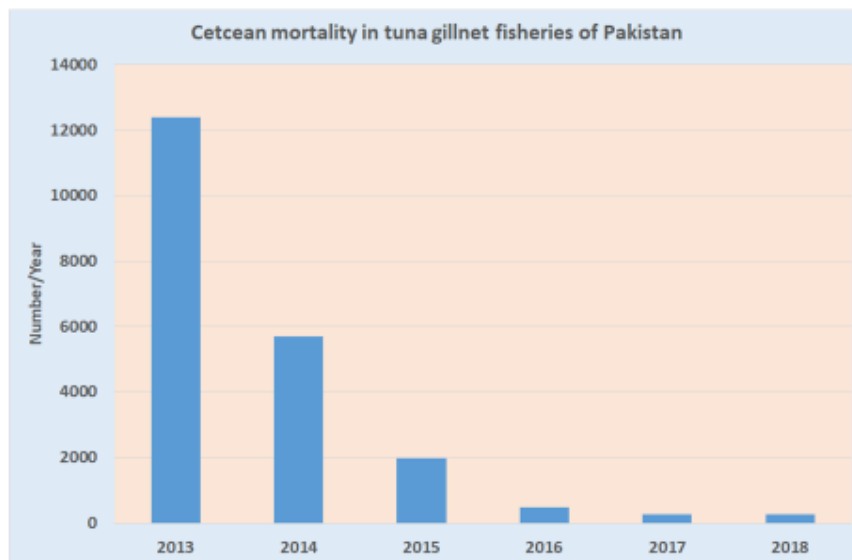


Fig. 4. Entanglement and mortality of dolphins in tuna gillnets of Pakistan

Toothed Whales

Limited data is available on entanglement of toothed whale including *Kogia sima*, *K. breviceps*, *Ziphius cavirostri* and *Indopacetus pacificus* which is being analysed to determine their interaction with subsurface gillnetting.

Other Benefits of Subsurface Gillnetting

- According to fishermen, chances of subsurface nets getting entangled in fishing operation is less as compared to surface gillnets. This greatly helps in the fishing operation especially entanglements in net loft during storage are minimized.
- The operation of subsurface gillnetting is comparatively hassle-free as compared to surface gillnetting because the chances of fouling during deployment and retrieval are reduced. The number of floats in subsurface gillnets is reduced and these float are placed in pairs attached to 2 m rope which make their entanglement rare as compared to surface gillnetting in which floats are placed every at 4.5 m on headline and their chances of getting snagged are much higher.
- Previously gillnets used to be placed on the sea surface, therefore, in case of high winds, laid down net is drifted to very long distances which is now practically eliminated because surface winds do not affect the subsurface nets and its drift is avoided.

- In case of rough seas coupled with high winds, the surface gill net gets roll down and sometime fishing operation has to be stopped. Straightening of such net, sometime requires many days during which fishing operation has to be stopped. The chances of subsurface gillnet getting roll down are minimum, therefore, the time loss because of such snags is minimized now.
- Loss of net in fishing operations are also minimized in case of subsurface net as compared to surface net, which is a great savings for the fishermen.
- Subsurface gillnets are cheaper because use of only a few floats, as compared to surface gillnets which have a float after every 4.5 meters.

Conclusions

Although the use of subsurface gillnets is adopted by entire fleet of tuna fleet of Pakistan, however, loss of dolphinfish and billfish is considered as a serious issue. Because of high prices of prime tuna species (yellowfin and skipjack) this loss is well compensated. Additional benefits such as lesser fouling and entanglement and ease of operation, fishermen have shifted from surface gillnetting to subsurface operation. Higher catches of yellowfin and skipjack tuna and higher prevailing prices for these two species, are the main motivational force which made this major modification in tuna fishing operation in Pakistan.

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