Issues related to adoption of subsurface gillnetting to reduce bycatch in Pakistan

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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. Their numbers may be equally higher in other countries of the northern Arabian Sea where a large gillnet fleet is based.

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, longtail 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 and large scale adoptability by the tuna fishermen. By 2017, the entire tuna fleet was converted from surface to sub-surface gillnetting in Pakistan.

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 chances of entanglement to much less than surface gillnetting in which floats are placed every at 4.5 m on headline where chances of getting snagged are much higher. Less entanglements of ETP species help in saving time which otherwise lost during disentanglement and process of discard. Considering these merits, the gillnet fishermen of Pakistan shifted from surface to subsurface gillnetting within a span of less than two years. This method of fishing is getting popularity in other regional countries. Crew-based observers posted by WWF-Pakistan reports that the success of subsurface gillnetting in Pakistan has induced fishermen from regional countries with whom they have regular interaction to adopt this method.

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). In addition, fishing vessels from Oman and Yemen are also using gillnet for catching tuna in their offshore and nearshore waters.

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.

Despites, wide acceptability there are some issues with the operation of subsurface gillnetting; there are some of its facets which need to be looked into. This is necessarily required because there is a possibility, although remote, that fishermen may revert back to surface operation of gillnets which may affect this bycatch reduction strategy being adopted by fishermen with the help of WWF-Pakistan. Government of Pakistan fully endorse the conversion from surface to subsurface gillnet operation. Present paper looks into merits and demerits of the subsurface gillnetting for tuna fisheries in Pakistan.

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).

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).

The surface tuna gillnets were observed to entangle a large number of ETP species including sea turtles, dolphins, 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.

Fig. 1. Surface gillnet showing arrangement of floats on the headline.

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. Billfishes (in salted dried market known as "Kopra") also used to fetch good prices, therefore, using subsurface gillnet has never been a popular fishing mode for the gillnet fishermen.

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 liter) is attached, as also done in case of surface gillnets. Using this arrangements, the gillnet remains about 1.5 to 2 meters below the surface during fishing operation (Fig.2).

Fig. 2. Floats attached to headline of the subsurface gillnet

Fig. 3. Subsurface operation keep the gillnet about 1.5 to 2 m below the surface.

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, longtail and skipjack tunas increased substantially (Fig. 4-6) 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 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
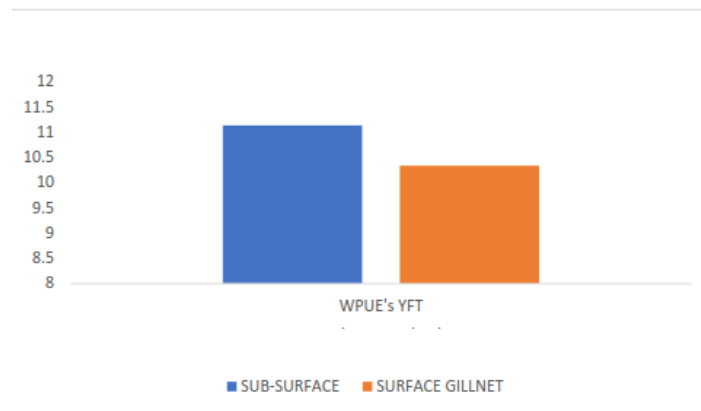

Fig. 4. Weight in Kg (yield) per unit of effort for Yellowfin tuna in surface and sub-surface gillnet (after Shahid, *et al.,* 2018)
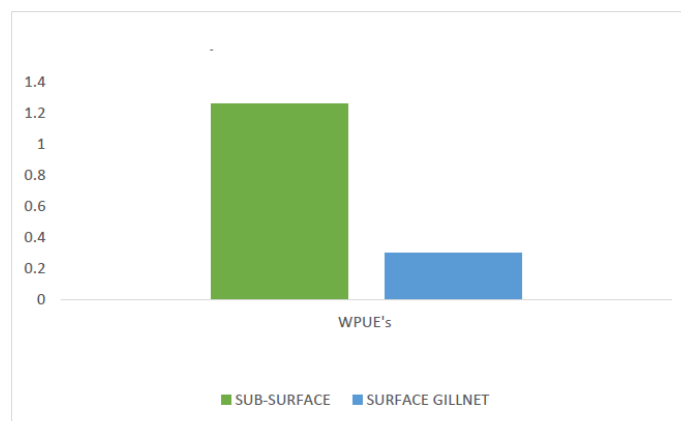

Fig. 5. Weight in Kg (yield) per unit of effort for skipjack tuna in surface and sub-surface gillnet (after Shahid, *et al.,* 2018)
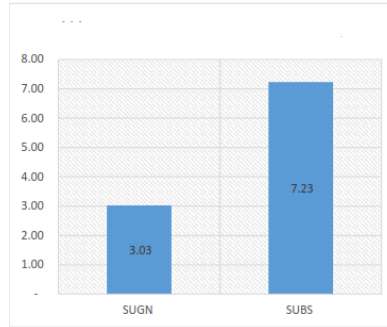
Fig. 6. Weight in Kg (yield) per unit of effort for longtail tuna in surface and sub-surface gillnet (after Kazmi *et al.,* 2019)
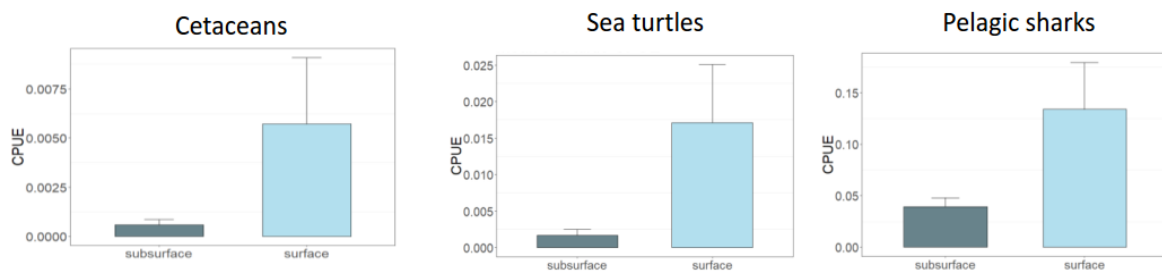

Fig. 7. Catch per unit of effort for ETP species tuna in surface and sub-surface gillnet (after Shahid, *et al.,* 2018)

ETP species is considered to be a blessing because it saves time which 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. 8). In addition, fishermen consider sea turtles and dolphins as sacred animals and they literally mourn the death, at least, of dolphins. The tuna fishermen, thus, rejoice less entanglement and mortality of dolphins with subsurface arrangements.
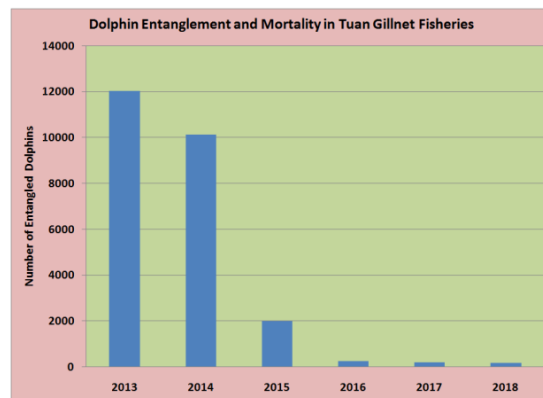

Fig. 8. Entanglement and mortality of dolphins in tuna gillnets of Pakistan

According to fishermen, chances of subsurface nets getting entangled in fishing operation is lesser than 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 much less 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.

Demerits of use of subsurface gillnet

The catches of the surface dwelling species such as dolphinfish (*Coryphaena hippurus*) and billfishes (including sailfish, marlins and swordfish) is substantially reduced in subsurface gillnet operations as compared to surface placement of nets. Dolphinfish fetches high prices in local market whereas billfishes get good prices in markets of neighboring country. The fishermen, thus, are not happy with reduction in catches of these two species groups. The loss incurred because of less catch of dolphinfish and billfish, however, is well compensated with high catches of yellowfin, longtail and skipjack tuna.

The subsurface gillnet cannot be deployed from fishing boats which are have high freeboard such as the largest category of tuna gillnet vessels which have onboard

freezing facilities. These vessels mostly operate in ABNJ and in EEZ of other countries (mainly Somalia). Almost all of these vessels are owned by boat owners from the neighboring country, although a few are double registered in Pakistan and neighboring country. The rope used to keeping the net at a depth of 1.5 to 2 m in case of subsurface, get snagged during deployment in the high freeboard vessels.

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. In the peak seasons of billfish catches (March and April), fishermen desperately want to shift to surface gillnetting but this cannot be done without stopping fishing operations for few weeks which they cannot afford. A few fishermen have tried to reduce the length of the rope to 0.5 meters but it did not help because it resulted in major reduction in the catches of prime tuna species.

The price factor is also an important issue. At present, the landing prices of prime tuna species (yellowfin, longtail and skipjack) are high as compared to previous years. However, if the prices of these tuna species are dropped, then fishermen may consider the option for shifting to surface gillnetting. Because of devaluation of currency in the neighboring country in last two years has resulted in reduction in prices of tuna and tuna like species, however, the fishermen were able to sustain such reduction in prices. However, if the currency if further devalued which may result in decrease in prices of tuna species, there may be a possibility of considering the option of shifting to surface gillnetting. Most of the fishermen, however, consider that there are a number of merits of using subsurface gillnetting, therefore, no fishermen will change to surface operation. According to them, now the entire fleet is shifted to subsurface gillnet and it will be not easy to shift to surface gillnetting. The tuna fishermen are well aware that the fishing boats of the neighboring countries also shifted to subsurface gillnet operation because of the merits of this mode of operation.

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