Depredation of purpleback flying squid (*Sthenoteuthis oualaniensis*) on tuna caught by gillnet fisheries in the Northern Arabian Sea: a major cause of concern for fishermen

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Abstract

Major concentrations of purpleback flying squid (*Sthenoteuthis oualaniensis*) are known in the Arabian sea and other parts of the Indian Ocean. This squid is considered to be important part of the diet of tuna species in the area especially in the mesopelagic zone it constitutes a major part of the diet of tuna species. A very few cases of depredation by cetaceans and sharks were reported from tuna gillnet fisheries of the Arabian Sea, however, oceanic squid (*Sthenoteuthis oualaniensis*) are observed to be heavily depredating on tuna caught in the gillnets especially in the Pakistani offshore waters. Tuna fleet that operates in offshore waters during winter (December to March) reported heavy depredation by purpleback flying squid. Although depredation by squid is reported throughout the year but such instances are more frequent and intense during full moon period in winter months. In case of cloud overcast during full moon period the intensity of depredation is reduced which tends to indicate that the purpleback flying squid (*Sthenoteuthis oualaniensis*) have diurnal vertical migration or visually attack the prey by locating them enmeshed on the gillnet. The paper present information about depredation of purpleback flying squid as reported by observers under WWF-Pakistan's Crew Based Observer Programme.

Introduction

Depredation which is the partial or complete removal of captured fish or bait from fishing gear by predators, is considered a serious issued faced by fisheries sector globally. Tuna fishing is also well known for the issue of depredation (Anonymous, 2007; Hamer *et al.,* 2015; Rabearisoa *et al*., 2012).

Depredation on longline gears are recorded for many marine species including by fish, marine mammals, birds, crustaceans and squids (Anonymous, 2007). The cetaceans mostly include false killer whales (*Pseudorca crassidens*), and short-finned pilot whales (*Globicephala macrorhynchus*) but other cetacean species including killer whales (*Orcinus orca*) also contribute to depredation (Anonymous, 2007; Hamer et al., 2015; Rabearisoa *et al*., 2012). The information about depredation on tuna caught by gillnet

fisheries is not adequately available. Lauriano *et al.*, (2009) have studied the dolphin depredation in the Italian artisanal fisheries. They observed that set gillnet and trammel nets were the types of the fishing gear most vulnerable to dolphin depredation; the interaction with these gear amounted to 66.4% while fish damage was reported in 72.2% of the cases. However, this study does not report depredation on tuna gillnetting.

WWF-Pakistan initiated crew based observer programme in 2012 which *inter alia* generated information on tuna species in coastal, offshore, Exclusive Economic Zone (EEZ) and in the Area Beyond National Jurisdiction (Moazzam, 2019). This programme revealed that the depredation on tuna and tuna like species in the gillnet fisheries of Pakistan is very high. There are only one of two records of shark depredation on tuna entangled in the gillnet fisheries, however, large scale depredation by purpleback flying squid (*Sthenoteuthis oualaniensis*) was observed which at time destroy upto 90 % of the catch of some hausl of gillnet operation. Squids are known to depredate on a number of species of marine fishes (Remeslo *et al.*, 2015) but such information about tuna and tuna like species is scanty. Present paper reports depredation of purpleback flying squid on tuna and tuna like species in the Northern Arabian Sea.

Materials and Methods

The information reported by observers under WWF-Pakistan crew based programme (Moazzam, 2019) was analyzed. The information about depredation by purple back squid was examined in detail to determine the extent of damage, seasonality of depredation and other related information.

Results and Discussions

Purpleback flying squid (*Sthenoteuthis oualaniensis*) is an oceanic squid which is found in pelagic and mesopelagic zone of the Arabian Sea (Fig. 1). The area is one of the richest regions for cephalopods in the Indian Ocean (Aravindakshan and Sakthivel, 1973). Belyaev (1962) pointed out the important role of cephalopods in the ecosystem of the Arabian Sea, based on the distribution of beaks in the sediments. Zuyev (1971) provided detailed descriptions of distribution and biology of ten neritic cephalopods of the suborder Myopsina and of one oceanic species (*Sthenoteuthis oualaniensis*) in the northwestern Indian Ocean, including the Arabian Sea.

Large concentration of this species was found in the offshore waters of Pakistan (Moazzam and Ahmed, 1994; Yamanaka *et al.*, 1976, 1977). This created interest for established of fisheries of purpleback flying squid in Pakistan (Aravindakshan and Sakthivel, 1973; Chesalin and Zuyev, 2002; Gutsal, 1989; Moazzam and Ahmed, 1994; Nesis, 1977; Okutani and Tung, 1978; Pinchukov,1994; Xinjun *et al.,* 2007; Yamanaka *et al.*, 1976, 1977, Zuev, *et al.*, 1985, 1994). However, no aimed fishing for purpleback squid could be established in Arabian Sea and Indian Ocean. The studies, however, proven, that there exists a large population of this squid in the Arabian Sea and other parts of the Indian Ocean.

Purpleback flying squid (*Sthenoteuthis oualaniensis*) is important from tuna fisheries point of view because it is one of the preferred diet of tuna especially yellowfin tuna in the area (Chesalin and Zuyev, 2002; Zuev, *et al.*, 1985, 1994) especially in the low oxygen zone of the Arabian Sea. The data obtained from the crew based observer programme revealed that this species is significantly more important for tuna fisheries (at gillnet fisheries) because of high rate of its depredation.

Fig. 1. Purpleback flying squid (*Sthenoteuthis oualaniensis*)

Fig. 2. Depredation of skipjack tuna (*Katsuwonus pelamis*) by purpleback flying squid (*Sthenoteuthis oualaniensis*)

Species Preference

Purpleback flying squid (*Sthenoteuthis oualaniensis*) depredates more frequently on skipjack tuna (*Katsuwonus pelamis*) which is frequented in the offshore waters. During the study about 55 % of the cases of depredation by squids were reported to be on skipjack tuna (Fig. 2). Yellowfin tuna (*Thunnus abacares*) was observed to be the

second most favorite species for depredation (Fig. 3-4). Juveniles yellowfin were preferred over adult.

Fig. 3. Juvenile yellowfin tuna (*Thunnus abacares*) depredated upon by purpleback flying squid

Fig. 4. Adult yellowfin tuna depredated upon by purpleback flying squid

Fig. 5. Common dolphinfish (*Coryphaena hippurus*) depredated upon by purpleback flying squid

Fig. 6. Indo-Pacific sailfish (*Istiophorus platypterus*) depredated upon by purpleback flying squid

In terms of preference, common dolphinfish (*Coryphaena hippurus*) is the next favorite choice (Fig. 5) followed by Indo-Pacific sailfish (*Istiophorus platypterus*) (Fig. 6) and marlins. Other species of fishes included sharks are rarely predated upon by purpleback flying squid.

Areas of Depredation

Purpleback flying squid is an oceanic species (Sivasubramaniam, 1964; Zuev, 1971; Zuev *et al.*, 1985, 1994) therefore, frequency of depredation is confined to gillnet operation in the offshore water. Pakistani fleets operates in coastal waters during August to October and during April and May (Moazzam and Nawaz, 2017) whereas the operations generally shifted to offshore waters during winter (November to March). Almost all cases of depredation by purpleback flying squid on tuna and tuna like species in offshore waters of Pakistan (EEZ and ABNJ) were reported during the winter months.

Periodicity of Depredation

Although depredation by squid is reported throughout the year but such instances are more frequent and intense during full moon period. It was also observed that in case of cloud overcast during full moon period the intensity of depredation reduces which tends to indicate that the purpleback flying squid (*Sthenoteuthis oualaniensis*) have diurnal vertical migration. It was also reported by fishermen that purpleback flying squid attack the prey by visually locating them enmeshed on the gillnet. In full moon period, the intensity of depredation is extremely high and in most cases, the depredated tuna species are completely devoured leaving behind only frame and skeleton (Fig. 7).

Fig. 7. Heavy depredation on yellowfin tuna by purpleback flying squid leaving only skeleton.

Fig. 8. Extent of depredation by purpleback flying squid on catch of tuna gillnet vessel

Intensity of Depredation

Timing of depredation by *Sthenoteuthis oualaniensis* is not adequately known but according to fishermen the squid starts attack on the enmeshed tuna and tuna like species after the appearance of full moon which continue till early morning. In case of Pakistan the gillnet is laid down in the early evening (04:00 PM) and heaving of nets usually started at 04:00 AM in the morning, therefore, the soak time is 12 hours. The attack by purpleback flying squid is usually more intense between 11:00 PM and 04:00 AM. In some cases, purpleback flying squid were observed to continuing devouring tuna species when the fishing net is hauled on board.

Fig. 9. Limited depredation on skipjack tuna by purpleback flying squid

Fig.10. Entire catch devoured by purpleback flying squid leaving only skeleton.

Intensity of Depredation

Depredation by purpleback flying squid can be extremely intense on some occasions whereas in some cases only a few specimens of tuna and tuna like species are depredated upon (Fig. 9) whereas in most cases the damage in extremely intense (Fig. 8-10). In some cases, entire catch of the gillnet is heavily depredated upon and not a single specimen was spared. In most cases about 60 to 70 % of some hauls are heavily predated upon. The intensity of the depredation possibly depends on the population density of purpleback flying squid in a particular area or time of the night. This cannot be attributed to any other factor. Since tuna and tuna like species depredated upon by purpleback flying squid are not accepted for sale in the fish markets, therefore, fishermen discard all damaged pieces of catch which is serious economic loss to the fishermen.

Discussions

As far as the knowledge of depredation by squids on tuna species is not reported. Remeslo et al. (2015) reported depredation of colossal squid (*Mesonychoteuthis hamiltoni*) and the Antarctic toothfish (*Dissostichus mawsoni*). No report of depredation by squid is made from Indian Ocean. Heavy depredation by purpleback flying squid is reported for the first time from Arabian Sea and possibly from any other parts of the Indian Ocean.

Since tuna and tuna like species depredated upon by purpleback flying squid are not accepted for sale in the fish markets, therefore, fishermen discard all damaged pieces of catch which is serious economic loss to the fishermen. There seems to be no solution for the controlling or minimizing depredation by purpleback flying squid. In case of even of extremely high intensity of depredation by purpleback flying squid fishermen, at time, leave the area and move toward coastal waters but this seems to be no easy solution because during winter tuna catch is higher in offshore waters. In coastal waters, tuna fishing cannot be done economically in winter months.

To avoid intense depredation, in some cases, fishermen stop fishing for a few days of the full moon period when there were intense depredations by purpleback flying squid. This seems to be a better strategy as compared to moving to coastal waters and is generally adopted by fishermen.

Considering this to be a opportunity, WWF-Pakistan is now working very closely with tuna fishermen to start jigging for purpleback flying squid and commercially harvesting this species. This will compensate for the damage incurred by the depredation of the squid. There seems to be market for purpleback flying squid in some countries including Japan and USA especially for its fillets.

Considering that the depredation from purpleback flying squid is possibly unique to the northern Arabian Sea, there is need to further investigate depredation by squids on tuna species in other parts of the Indian Ocean.

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