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Identification of by-catch species of tuna purse seiners in Iranian waters of Oman Sea

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Introduction

One of the most visible direct impacts of fishing is the capture of non-target species, known collectively as by-catch. By-catch includes species that are unwanted and discarded (discards) and species that are retained and sold (byproduct) (Stobutzki *et al*., 2003).

Although tuna purse seine fisheries have been shown to be selective, leading to lower levels of by-catch than other fisheries (Alverson *et al*., 1994; Kelleher, 2005), several species can be incidentally caught and, in some cases, discarded at sea. These include vulnerable and sensitive species such as turtles, mammals, and sharks (Minami *et al*. 2007; Romanov, 2008b). Tuna purse seine fisheries probably apply the most intensive direct human impact on the tropical epipelagic ecosystems in all oceans. Because of the worldwide scale of purse seine fisheries, an assessment of their impact on associated and dependent species is essential (Romanov, 2002a).

The Oman Sea, with an area of 94,000 km^2 and a depth reaching 3,200 m, can be assumed to be oceanic in its nature as it is connected to the Indian Ocean by the Arabian Sea (Ghotbeddin *et al*., 2014). The tuna purse seine fishery is a commercial and industrial fishery in the Iranian waters of Oman Sea. The main target species of the tuna purse seine fishery in waters of Oman Sea are large pelagic fish such as longtail tuna (*Thunnus tonggol* Bleeker, 1851), Yellowfin tuna (*Thunnus albacares* Bonnaterre, 1788) and skipjack tuna (*Katsuwonus pelamis* Linnaeus, 1758). In Iranian waters of Oman Sea, studies on the by-catch of the purse seine fishery are scarce. Therefore, the present study aims to identify the by-catch composition of

the tuna purse seine fishery in the Iranian waters of the Oman Sea, which presents beneficial data for management purposes.

Materials and methods

The study was carried out between September and October 2015 in the Iranian waters of Oman Sea (Fig. 1). An observer programme was conducted to identify the by-catch composition of the tuna purse seine fishery. Investigations were carried out on board a commercial purse seiner vessel "Parsian Shila" (1800 Gross registered tonnage) with 99.5 m overall length, 4-5m width, equipped with a Global Positioning System (GPS), Sonar, echo sounder and a purse seine net.The purse seine net had a float line about 1886 m long with about 300 buoys (a buoy every 50cm) and a lead line of about 2026 m. The maximum altitude of the net (stretched net depth) is about 210 m and stretched mesh size varying between 16 and 18 mm.

A total of 64 purse seine hauls was sampled. For each purse seine haul, the by-catch species were separated from the total catch, counted and identified to species or genus according to Fischer and Bianchi (1984), Carpenter *et al*. (1997) and Nelson (2006). The length frequency of by-catch species were measured with 1 cm precision.

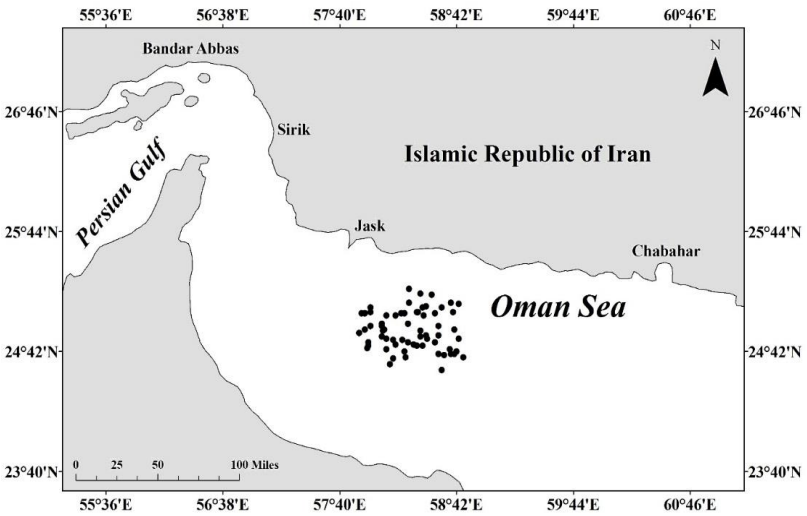

Figure 1: Map of Oman Sea where study carried out.

Results and discussion

By-catch species, number and length frequency are given in Table 1. The by-catch species composition included bony fishes: frigate tuna (*Auxis thazard*), common dolphinfish (*Coryphaena hippurus*), Indo-Pacific sailfish (*Istiophorus platypterus*), black marlin (*Makaira indica*), sawtooth barracuda (*Sphyraena putnamiae*), pickhandle barracuda (*Sphyraena jello*), sharksucker (*Echeneis naucrates*), rainbow runner (*Elagatis bipinnulata*), pilot fish (*Naucrates ductor*), bigeye scad (*Selar crumenophthalmus*), Sharks and rays: Milk shark (*Rhizoprionodon acutus*), whale shark (*Rhincodon typus*), pelagic thresher (*Alopias pelagicus*),

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longtail butterfly ray (*Gymnura poecilura*) ,devil ray (*Mobula diabolus*), spotted eagle ray (*Aetobatus narinari*) and Turles: green sea turtle (*Chelonia mydas*).

Table 1: By-catch species composition of tuna purse seine fishery in Iranian waters of Oman Sea.

Fish groups	Scientific name	Common name	Number	Number (%)	Length (cm)
Tunas					
Scombridae	*Auxis thazard*	Frigate tuna	18	22.79	25-66 FL
Bony fishes					
Coryphaenidae	*Coryphaena hippurus*	Common dolphinfish	9	11.4	65-92 FL
Istiophoridae	*Istiophorus platypterus*	Indo-Pacific sailfish	10	12.66	116-223 FL
Istiophoridae	*Makaira indica*	Black marlin	4	5.07	195-255 FL
Sphyraenidae	*Sphyraena putnamiae*	Sawtooth barracuda	4	5.07	78-105 FL
Sphyraenidae	*Sphyraena jello*	Pickhandle barracuda	1	1.26	120 FL
Echeneidae	*Echeneis naucrates*	Sharksucker	2	2.54	48-59 TL
Carangidae	*Elagatis bipinnulata*	Rainbow runner	3	3.8	75-93 FL
Carangidae	*Naucrates ductor*	Pilot fish	1	1.26	31 FL
Carangidae	*Selar crumenophthalmus*	Bigeye scad	1	1.26	22 FL
Sharks					
Carcharhinidae	*Rhizoprionodon acutus*	Milk shark	19	24.05	158-247 TL
Rhincodontidae	*Rhincodon typus*	Whale shark	1	1.26	373 TL
Alopidae	*Alopias pelagicus*	Pelagic thresher	1	1.26	261 TL
Rays					
Gymnoridae	*Gymnura poecilura*	Longtail butterfly ray	1	1.26	26 DL
Mobulidae	*Mobula diabolus*	Devil ray	1	1.26	87 DL
Myliobatidae	*Aetobatus narinari*	Spotted eagle ray	1	1.26	47 DL
Turtles					
Chelonidae	*Chelonia mydas*	Green sea turtle	2	2.54	-

The by-catch was composed of 17 species belonging to 13 families, of which 10 species were teleostei from 13 families, 6 species were elasmobranch from 6 families and one species was *Chelonia mydas* belonging to turtles. The most number of by-catch were *Rhizoprionodon acutus* (24.05%) and *Auxis thazard* (22.79%). Among the teleostei species, Carangidae had the most species (3 species), followed by the Istiophoridae (2 species) and Sphyraenidae (2 species).

Among the species registered during this study, the majority were pelagic. Over the study period, a total of 2 individual of turtle (Chelonidae: *Chelonia mydas*) were caught and all of the turtles were discarded alive. Fig. 2 shows the percentage of by-catch groups from tuna purse seine fishery in Oman Sea. Bony fish with 67.11%, elasmobranches with 30.35% and turtles with 2.54% constituted the total by-catch individual.

In this study, by-catch composition of the tuna purse seine fishery in the Iranian waters of the Oman Sea was identified.

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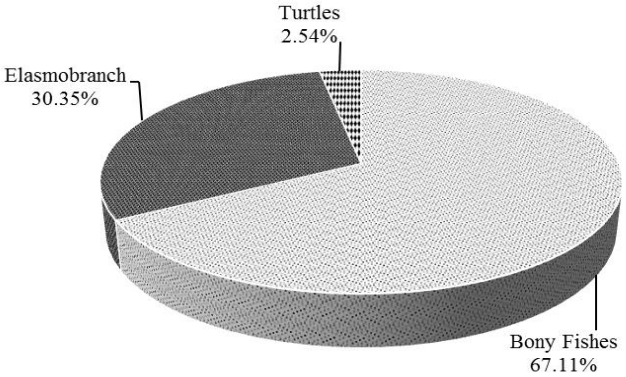

Figure 2: Percentage of by-catch groups from tuna purse seine fishery in Oman Sea.

According to Hall and Mainprize (2005), management and mitigation of by-catch is the most pressing issue facing the commercial fishing industry worldwide. Rochet and Trenkel (2005) declared that incidental by-catch and associated discarding are difficult to estimate on the basis of log- book information; because they are poorly reported by fishing masters and their importance varies according to several interrelated factors.

Studies on identification and investigation of by-catch species in tuna fisheries have been carried out in different regions. Romanov (2002a), in a study conducted in the tuna purse seine fisheries of the western Indian Ocean, reported that the most frequently found species in the by-catch of purse seiners were sharks (*Carcharhinus falciformis* and *Isurus oxyrinchus*), rainbow runner (*Elagatis bipinnulata*), dolphinfish (*Coryphaena hippurus*), triggerfish (*Canthidermis maculatus*), wahoo (*Acanthocybium solandri*) and billfishes (*Istiophorus platypterus* and *Makaira indica*).

Amanda *et al*. (2012) identified the bycatch species of purse seine fishery in the Indian Ocean (Bony fish: 19 species,Sharks and rays: 8 species and Turtles: 4 species) and declared that the dominant species of bycatch were rays (*Mobula* spp.) juveniles of skipjack tuna (*Katsuwonus pelamis*), frigate tuna (*Auxis thazard*) and bullet tuna (*Auxis rochei*) that these species constituted 59% of total bycatch.

Understanding and identifying the by-catch species from Iranian tuna fishing vessels is critical and Fisheries Organizations will always be under pressure to manage harvesting of fish resources. With responsible fishing, all fisheries sections (fishermen, researchers and Fisheries Organizations) can benefit and protect fish stocks. Information about by-catch species of purse seine in Iranian waters of Oman Sea is lacking and this paper is the first report about by-catch species in this area. Therefore, results of this study provide valuable information in order to manage reduction of by-catch in purse seine fisheries and access a sustainable

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management on fish resources in Iranian waters of Oman Sea.

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