Species composition and diversity of fish caught by midwater trawl nets in the Oman Sea: A case study of the Jask fishing grounds

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Abstract

Due to the limited information available on the catch performance of midwater trawl fisheries in Iranian marine waters, the present study was conducted to determine the catch composition and species diversity of fish captured by midwater trawl nets targeting lanternfish fishing grounds in the Oman Sea, specifically in the eastern part of Hormozgan Province (Jask region), during the winter of 2016–2017. A total of 14 aquatic species belonging to 14 families were identified from the fishing grounds, including 12 species of bony fishes representing 12 families and two species of cartilaginous fishes representing two families. Among the recorded species, the largehead hairtail (*Trichiurus lepturus*) constituted the highest proportion of the catch (55.7%), followed by lanternfish (*Benthosema pterotum*) with 43.5%, and blackmouth croaker (*Atrobucca nibe*) with 0.2%. The results further indicated that *Trichiurus lepturus*, *Benthosema pterotum*, *Atrobucca nibe*, and *Sphyraena putnamae* exhibited the highest frequency of occurrence (100%) across all sampling stations. In contrast, *Grammoplites suppositus*, *Epinephelus coioides*, and *Saurida tumbil* showed the lowest occurrence frequency (20%). Other species recorded during the survey included *Rastrelliger kanagurta* (80%), *Cynoglossus arel* (80%), *Gymnura poecilura* (60%), *Chiloscyllium arabicum* (60%), *Muraenesox cinereus* (40%), *Nemipterus japonicus* (40%), and *Acropoma japonicum* (40%). The findings demonstrate that the catch composition in the study area is strongly influenced by the relatively great fishing depth (mean depth of approximately 223 m), resulting in a community dominated by deep-water fish species.

Keywords: Midwater trawl, Frequency of occurrence, Lanternfish, Oman Sea, Hormozgan Province

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Introduction

The Persian Gulf and the Oman Sea, owing to their low-latitude locations, support high fish diversity (Jafari-Patcan *et al*., 2018; Eagderi *et al*., 2019, 2026). From an economic perspective, the fish resources of these waters are generally classified into four major groups: small pelagic, large pelagic, demersal, and midwater species (Shojae and Taghavi Motlagh, 2011). Almost all of these groups are commercially exploited in the Persian Gulf and the Oman Sea. Consequently, fishing activities affect not only the target and commercially valuable non-target species but also exert direct and indirect impacts on the entire marine ecosystem (Rice and Gislason, 1996).

Despite the ecological and economic importance of these marine ecosystems, relatively few studies have investigated their species diversity and habitat richness. Most previous research has primarily focused on catch composition and bycatch associated with different fishing gears (Hoseininejad *et al*., 2010; Fakhri *et al*., 2011; Raeisi *et al*., 2012; Radfar *et al*., 2013; Farimani *et al*., 2014). Furthermore, many biodiversity studies in Iran have been restricted to inland water ecosystems, probably because sampling in freshwater habitats is easier and more accessible than in marine environments (Eskandari *et al*., 2006; Rahmani *et al*., 2012; Asadi *et al*., 2014).

Although trawl fisheries are generally designed to target specific fish species, they inevitably capture a wide range of non-target species during fishing operations. While trawling may adversely affect marine habitats and biodiversity, it also provides valuable opportunities for investigating fish assemblages and marine biodiversity. Therefore, trawl surveys have been widely used in fisheries biology, population assessment, and marine ecological studies. Despite the long history of trawl fishing in the Persian Gulf and the Oman Sea, relatively little attention has been paid to the use of trawl catches to assess regional biodiversity and ecological characteristics. Therefore, the present study was conducted to investigate the species composition and diversity of fishes captured by midwater trawl vessels operating in the eastern waters of Hormozgan Province, Jask region in the northern Oman Sea.

Materials and methods

Sampling was conducted during the midwater trawl fishing season in the Jask region from early January to late March 2018 (winter 2017-2018). Fish sampling and species identification were carried out aboard commercial fishing vessels operating in the waters off Jask between the 1st and the 12th day of each month. Sampling was conducted within the geographical coordinates of 25°30′–25°37′ N and 55°17′–57°27′ E (Table 1).

Fishing operations were performed at depths ranging from 168 to 279 m, with each trawl lasting approximately 3.6 h at towing speeds between 2.7 and 3.3 knots. The midwater trawl net had an overall length of 100 m (from the trawl wings to the codend), while both the headline and footrope measured 74 m.

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Table 1: Geographic coordinates of the midwater trawling stations in the Oman Sea, Hormozgan Province (Jask region).

Start of trawling	End of trawling
25°32′ N, 57°25′ E	25°17′ N, 55°27′ E
25°37′ N, 55°17′ E	25°30′ N, 57°29′ E
25°29′ N, 57°27′ E	25°36′ N, 57°20′ E
25°37′ N, 57°19′ E	25°31′ N, 57°07′ E
25°35′ N, 57°11′ E	25°28′ N, 57°03′ E
25°26′ N, 55°03′ E	25°32′ N, 57°10′ E
25°34′ N, 57°12′ E	25°28′ N, 57°03′ E
25°36′ N, 55°12′ E	25°27′ N, 57°03′ E
25°27′ N, 57°03′ E	25°35′ N, 57°13′ E
25°34′ N, 55°10′ E	25°25′ N, 57°02′ E
25°24′ N, 57°03′ E	25°34′ N, 57°10′ E
25°34′ N, 55°03′ E	25°26′ N, 57°03′ E
25°26′ N, 57°06′ E	25°37′ N, 57°13′ E
25°37′ N, 57°16′ E	25°30′ N, 57°06′ E
25°37′ N, 57°20′ E	25°33′ N, 57°09′ E
25°33′ N, 57°08′ E	25°36′ N, 57°20′ E
25°38′ N, 57°13′ E	25°29′ N, 54°04′ E
25°29′ N, 57°09′ E	25°27′ N, 57°13′ E
25°38′ N, 57°19′ E	25°35′ N, 57°04′ E
25°30′ N, 57°05′ E	25°25′ N, 57°13′ E
25°33′ N, 57°12′ E	25°34′ N, 57°04′ E
25°31′ N, 57°06′ E	25°36′ N, 57°11′ E
29°37′ N, 57°20′ E	25°32′ N, 57°08′ E
25°32′ N, 57°17′ E	25°31′ N, 57°06′ E
25°30′ N, 57°05′ E	25°33′ N, 57°12′ E
25°39′ N, 57°13′ E	25°38′ N, 57°05′ E
25°31′ N, 57°09′ E	25°29′ N, 57°13′ E
25°40′ N, 57°14′ E	25°38′ N, 57°03′ E
29°39′ N, 57°13′ E	25°30′ N, 57°09′ E
25°29′ N, 57°04′ E	25°33′ N, 57°13′ E
25°38′ N, 57°14′ E	25°31′ N, 57°05′ E

The headline was equipped with 45 floats, each 32 cm in diameter, and the codend was 15 m long. The codend mesh size was 10 mm, constructed of polyethylene and protected externally by a cover net. The fishing vessel was a steel-hulled trawler equipped with two hydraulic winches for net retrieval. The net was deployed from the stern and hauled alongside the vessel. Navigation and fishing operations were supported by an echo sounder, GPS, and compass, with all operational data recorded.

Sampling was conducted at five fishing stations, with daily operations beginning at 06:00 and continuing until 16:00. After each haul, the catch was sorted on the vessel deck, and all fish specimens were identified using standard taxonomic identification keys (Fischer and Bianchi, 1984; Eagderi *et al*., 2019, 2026). Specimens were subsequently sorted by species, counted, and recorded on standardized data sheets. Catch per unit effort (CPUE) was calculated as CPUE = CW/T, where CPUE is catch

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per unit effort (kg h^{-1}), CW is catch weight (kg), and T is trawling duration (h). The frequency of occurrence (FO, %) of each species among sampling stations was calculated as:

$$FO(\%) = \frac{\text{Number of stations where the species was recorded}}{\text{Total number of sampling stations}} \times 100$$

Results

A total of 1,472 fish specimens representing 14 species were collected during the sampling period (Table 2). Overall, the largehead hairtail (*Trichiurus lepturus*), lanternfish (*Benthosema pterotum*), and blackmouth croaker (*Atrobucca nibe*) accounted for the highest proportions of the total catch, contributing 55.7%, 43.5%, and 0.2%, respectively (Table 3; Fig.1).

Table 2: Fish species recorded in the midwater trawl catches from the Jask fishing grounds, Oman Sea.

Scientific name	Common name	Number	Mean length	Frequency
Trichiurus lepturus	Largehead hairtail	800	37.5	100
Benthosema pterotum	Lanternfish	390	5.1	100
Atrobucca nibe	Blackmouth croaker	200	28.83	100
Sphyraena putnamae	Sawtooth barracuda	15	46.7	100
Rastrelliger kanagurta	Indian mackerel	15	12.5	80
Cynoglossus arel	Large-scale tonguesole	12	16	80
Gymnura poecilura	Longtail butterfly ray	12	106	60
Chiloscyllium arabicum	Arabian bamboo shark	8	56	60
Muraenesox cinereus	Daggertooth pike	7	59.1	40
Nemipterus japonicus	Japanese threadfin	7	11	40
Acropoma japonicum	Glowbelly	3	8.6	40
Grammoplites suppositus	Flathead	1	23	20
Epinephelus coioides	Orange-spotted grouper	1	26.3	20
Saurida tumbil	Greater lizardfish	1	22.5	20

Table 3: Catch composition recorded in the midwater trawl catches from the Jask fishing grounds, Oman Sea.

Species	Catch weight (kg)	Percentage (%)
Trichiurus lepturus	60123.9	55.7
Benthosema pterotum	46954.0	43.5
Atrobucca nibe	234.0	0.2
Other species	581.9	0.6
Total	**107893.8**	**100**

Regarding frequency across sampling stations, *T. lepturus*, *B. pterotum*, *A. nibe*, and *Sphyraena putnamae* were recorded at all stations, with 100% occurrence. In contrast, *Grammoplites suppositus*, *Epinephelus coioides*, and *Saurida tumbil* showed the lowest occurrence frequency (20%). Other species observed during the survey included *Rastrelliger kanagurta* (80%), *Cynoglossus arel* (80%), *Gymnura poecilura* (60%), *Chiloscyllium*

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arabicum (60%), *Muraenesox cinereus* (40%), *Nemipterus japonicus* (40%), and *Acropoma japonicum* (40%) (Table 2).

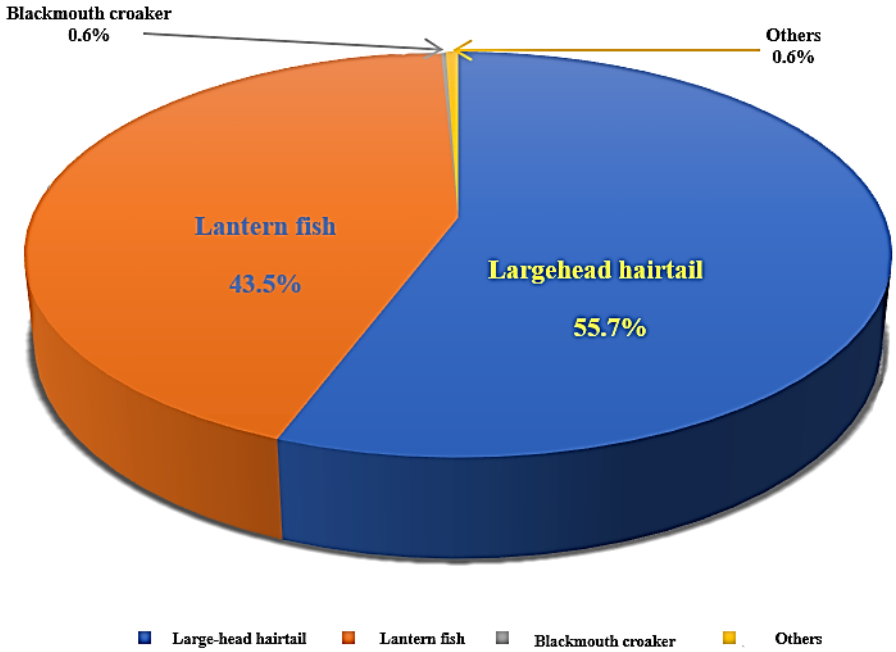

Figure 1: Percentage composition of fish species captured by midwater trawl in the waters off Jask, Hormozgan Province, Oman Sea.

Discussion

Species composition in trawl fisheries is generally characterized by relatively high biodiversity because trawl gear often captures both target and non-target species occupying different ecological niches (Pender *et al*., 1992; Stobutzki *et al*., 2001; Tonks *et al*., 2008; Hilborn *et al*., 2020). Nevertheless, previous investigations in the Persian Gulf and the Oman Sea have focused mainly on bycatch associated with shrimp trawl fisheries (Mohammad *et al*., 1989; Raeisi *et al*., 2012), whereas comparatively little information is available on the species composition of midwater trawl fisheries targeting pelagic fishes. Because trawl fisheries can substantially influence community structure by removing both target and incidental species, knowledge of catch composition is essential for evaluating fish assemblages, monitoring biodiversity, and implementing ecosystem-based fisheries management (Valinassab *et al*., 2006). Therefore, understanding species diversity and the relative abundance of individual species is of considerable importance for fisheries management and biodiversity conservation (Link, 2018).

Based on the results of the current study, the largehead hairtail accounted for 55.7% of the total catch, while the remaining species collectively accounted for 44.3%. Compared with the findings of Raeisi *et al*. (2012), the proportion of *T. lepturus* recorded in the present study was considerably higher. In their investigation, non-target aquatic

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organisms represented approximately 47% of the total catch (Raeisi *et al*., 2012). This discrepancy is most likely attributable to differences in fishing depth, as the trawling operations reported by Raeisi *et al*. (2012) were conducted in relatively shallow waters. The highest frequency observed in the present study was also recorded for *T. lepturus*, occurring at 100% of the sampling stations. Considering that this species represents the primary target of the trawl fishery, this finding was expected and is consistent with the results of Raeisi *et al*. (2012). Likewise, *T. lepturus* was encountered in every sampling event conducted during the present study.

The present study demonstrated that the fish assemblage captured by midwater trawling in the Jask fishing grounds was strongly dominated by the largehead hairtail, *T. lepturus*, which accounted for 55.7% of the total catch biomass and was present at all sampling stations. Such dominance is not unexpected, as *T. lepturus* is the principal target species of this fishery and one of the most abundant predatory fishes in the northern Oman Sea. The species is characterized by broad ecological tolerance, opportunistic feeding behaviour, and extensive horizontal and vertical movements, allowing it to exploit a wide range of prey resources. Furthermore, its schooling behaviour and distribution within the water column sampled by midwater trawls increase its susceptibility to capture (Martins *et al*., 2005). Similar dominance of *T. lepturus* has been reported in previous surveys conducted in the Persian Gulf and the Oman Sea (Valinassab *et al*., 2006; Shojae and Taghavi Motlagh, 2011; Raeisi *et al*., 2012), suggesting that the species constitutes a major component of the regional pelagic ecosystem.

The second most abundant species, *Benthosema pterotum*, accounted for 43.5% of the total catch biomass, underscoring its ecological importance in the study area. Lanternfishes are among the dominant mesopelagic fishes worldwide and constitute an important trophic link between zooplankton and higher-level predators (Irigoien *et al*., 2014). Their occurrence in high abundance within the catches probably reflects their schooling behaviour and diel vertical migration, during which they become vulnerable to midwater trawl gears. Consequently, fluctuations in the abundance of *B. pterotum* may have important ecological implications because many commercially important fishes depend on mesopelagic species as prey (Choy *et al*., 2012; Irigoien *et al*., 2014).

Only 14 fish species were recorded during the survey, indicating relatively low species diversity compared with previous studies conducted in the Persian Gulf. Foladi Sabet *et al*. (2014), for example, recorded 46 species in largehead hairtail trawl catches from the waters of Bushehr. Likewise, Raeisi *et al*. (2012) reported considerably higher species richness and greater occurrence frequencies for several non-target species. These differences are likely attributable to variation in fishing depth,

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habitat characteristics, fishing season, and geographical location. In particular, the greater sampling depth of the present study and the use of midwater trawls targeting pelagic fishes probably reduced the capture of demersal and benthic species, resulting in lower overall species richness. Similar effects of gear selectivity and fishing depth on catch composition have been widely documented in trawl fisheries (Stobutzki *et al*., 2001; Tonks *et al*., 2008). Catch per unit effort (CPUE) in the present study was estimated at 293 kg h^{-1}, which was lower than that reported by Raeisi *et al*. (2012). Differences in CPUE among studies may reflect spatial variation in fish abundance, habitat quality, fishing depth, seasonal changes in species distribution, and differences in fishing effort.

Compared with Raeisi *et al*. (2012), the proportion of *T. lepturus* in the present study was substantially higher, whereas the contribution of non-target species was considerably lower. Raeisi *et al*. (2012) reported that non-target organisms constituted approximately 47% of the total catch, whereas the present survey showed a catch overwhelmingly dominated by the target species. This difference most likely reflects differences in fishing grounds, water depth, and operational characteristics of the fishing gear. The higher occurrence frequencies reported by Raeisi *et al*. (2012) for species such as *Psenes* spp., *Scomberoides* spp., *Nemipterus* spp., silver pomfret, whitecheek shark, grunts, and black pomfret may also indicate lower gear selectivity and greater interaction with multiple ecological habitats.

Conclusion

The overwhelming dominance of *T. lepturus* and *B. pterotum* indicates that the pelagic fish assemblage in the Jask fishing grounds is characterized by relatively low species evenness and strong dominance by a few abundant species. Such assemblage structure has important implications for ecosystem functioning because changes in the abundance of these dominant species may influence predator-prey relationships and energy transfer within the pelagic food web. Continued monitoring of species composition and catch rates is therefore recommended to detect temporal changes in community structure and to support ecosystem-based management and sustainable exploitation of fishery resources in the Oman Sea.

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