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Original Article

Interpreting biomass and catch per unit area (CPUA) to assess the status of demersal fishes in Oman Sea

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Abstract: This study aimed to assess the biomass and catch per unit area (CPUA) of demersal fish resources in the northern part of the Oman Sea based on trawl survey. The study area was stratified into five stratum (I, II, III, IV and V) covering the depth layers of 10-20, 20-30, 30-50 and 50-100 m. A total number of 68 stations were monitored during the study period. The highest values of biomass were belong to stratum V and IV in the east coast of the Oman Sea and the highest species biomass was belong to batoid fishes (8054.4 tons). The lowest CPUA was recorded in the central region of the study area (stratum III, approximately 8212 kg/nm^2) and the highest CPUA was on both sides of the study area (the east and west coast). Moreover, the highest CPUA (2031 kg/nm^2) was observed in 20-30 m depth layer. The results showed the changes in biomass and CPUA based on different depths and the most abundant species groups were *Trichiurus lepturus* (50-100 meter), *Sphyraena jello* (30-50 meters), *Caranx ignobilis* (20-30 meters), and *Pomadasys kaakan* (10-20 meters).

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Introduction

Estimation of fish abundance is essential for fisheries management purposes. Catch per unit area (CPUA) and biomass as important indices of stock assessment are fundamental elements of knowledge for an effective fishery management (Monjezi Veysi et al., 2017). Increase fishing pressure is threatening the sustainability of demersal resource in Oman Sea. Currently, there are few effective management control in this area. Due to vulnerability of aquatic systems, it is necessary to monitor the changes in aquatic stocks and trends.

Bottom research trawler as regional fishery survey in different populations is a method to achieve this goal. The first study of the bottom trawls as regional fishery in the Persian Gulf and Oman Sea emerged during 1976 to 1979 (Kesteven et al., 1981). In recent years, Valinassab et al. (2006) assessed the abundance of demersal fishes in the Persian Gulf and Oman Sea and total demersal fish biomass was estimated as 73,000 tonnes in Persian Gulf and approximately 39,000 tonnes in the Oman Sea. They reported the most abundant species groups were rays, catfish, grunts, nemipterids and carangids.

Furthermore, several studies have been conducted on catch per unit area and biomass of demersal fishes such as S*aurida tumbil* (Ghotbeddin et al., 2015), *Trichiurus lepturus* (Raeisi et al., 2012), some members of the families viz. Haemulids, Nemipterids and Ariids (Monjezi Veysi et al., 2017) and *Grammoplites suppositus* (Mirzaei et al., 2017) in northern part of the Persian Gulf and Oman Sea. In this order, this study aimed to estimate the biomass and catch per unit area (CPUA) of demersal fishes in northern part of the Oman Sea to provide basic information for better understanding of their biological parameters, population dynamics and stock enhancement.

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Table 1. Number of trawl stations, stratum area, and location of each stratum in Oman Sea

Strata	10-20 m	20-30 m	30-50 m	50-100 m	Start	End	Area (nm2)	Total stations
I	3	3	4	5	58°55'E	59°25'E	116	15
II	2	3	3	4	59°25'E	59°55'E	180.9	12
III	2	3	3	3	59°55'E	60°25'E	235	11
IV	2	4	4	5	60°25'E	60°55'E	268.5	15
V	3	4	4	4	60°55'E	61°25'E	363.8	15

Materials and Methods

This study was conducted in northern region of the Oman Sea from the Meidani (58°55'E) to Gwatre Bay (61°30'E) using Kavian trawler vessel equipped with fish bottom-trawl net (with headline of 72 m) during a period of 30 days in September 2015. The study area divided into five stratums (I, II, III, IV and V) and each stratum was divided into four substrata on the basis of depth i.e. 10-20, 20-30, 30-50, and 50-100 m (Fig. 1, Table 1).

The study area, stratum area and different depth were calculated using a platometer. A total number of 66 stations were chosen based on the random stratified sampling method (Valinassab et al., 2006). Each trawl session lasted for 60 min at speed of 3 knots. Furthermore, the sampling date, sampling time, towing distance, towing speed, water depth, and geographic location were recorded at each sampling station. The whole catch was transferred on board and all sizeable fishes were separated, counted and weighed. The remaining small fishes were placed in the same shape baskets and chosen some baskets and then using the number and weight of fishes in each basket to calculate an estimate of the entire population (fishes) in each station (Smith and Heemstra., 2012; Bianchi., 1985).

The following equation was used to calculate CPUA in trawl survey (Valinassab et al., 2006):

$$CPUA=Cw/a.$$

Where the Cw is catch weight (kg), and a is swept area (nm^2) for each hauling that is calculated by $a= D.h.X_1$, where D is the distance covered (nm), h= the headline height (m), and X_1=the wing spread coefficient (is equal to 0.6). In addition, the biomass was calculated based on Sparre and Venema (1998) as follows: $b=CPUA / X_2$, where CPUA is catch per unit area in each station at different stratum, and X2= equal to 0.5 as the catch coefficient. Moreover, the total biomass is calculated by equation of $B=CPUA\times A /X_2$, where A is the total area (nm^2) (Maunder et al., 2006).

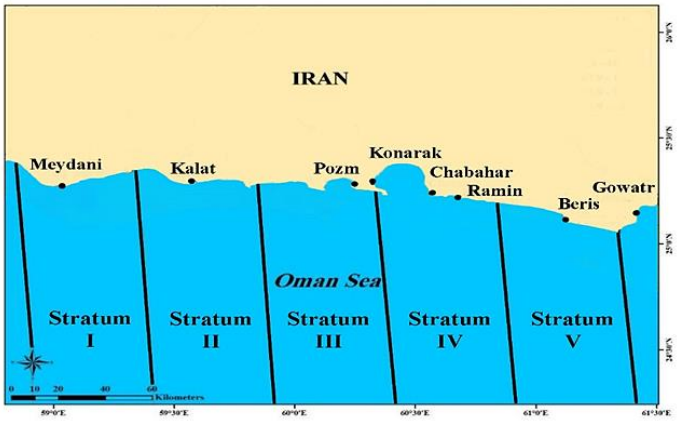

Figure 1. Map of the sampling area in northern part of the Oman Sea.

Results

Sampling was carried out at 68 defined stations in different area in northern part of the Oman Sea by covering 10-100 m depths (20-10, 30-20, 50-30, and 100-50 m). A total of 135 species were identified during 30 days study period.

Total biomass of the demersal fish was estimated 33560.3 tones. The maximum and minimum biomass was 10034.4 and 3640.3 in stratum V and III, respectively. Furthermore, the highest and lowest biomass values were observed in 50-100 and 10-20 m depth, respectively (Figs. 2, 3). Among the catch species, batoid species had the highest biomass (8054.4 tons) in total catch (24% of total biomass). After batoids, the highest biomass in separate depth layers belongs to Largehead hairtail (*T. lepturus*) (50-100 meter), Pickhandle barracuda (*Sphyraena jello*) (30-50 meters), Giant trevally (*Caranx ignobilis*) 20-

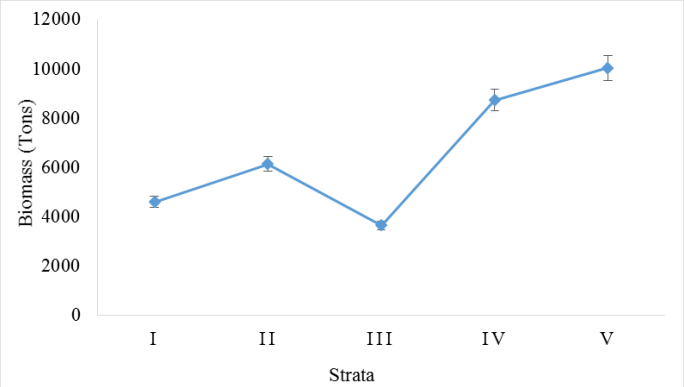

Figure 2. Biomass (tone) in different stratum at the northern coast of the Oman Sea.

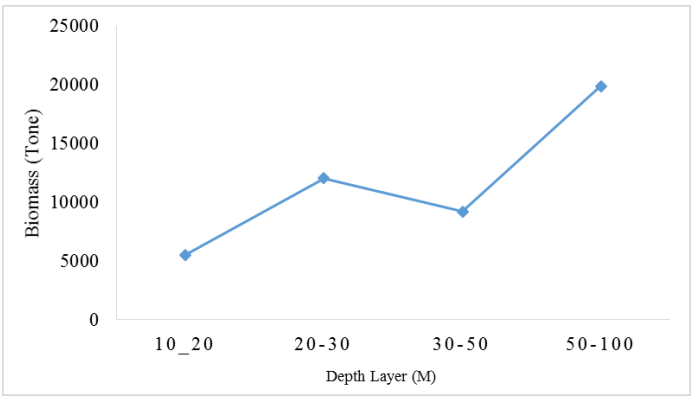

Figure 3. Biomass (tone) in different depth layer at the Northern coast of the Oman Sea.

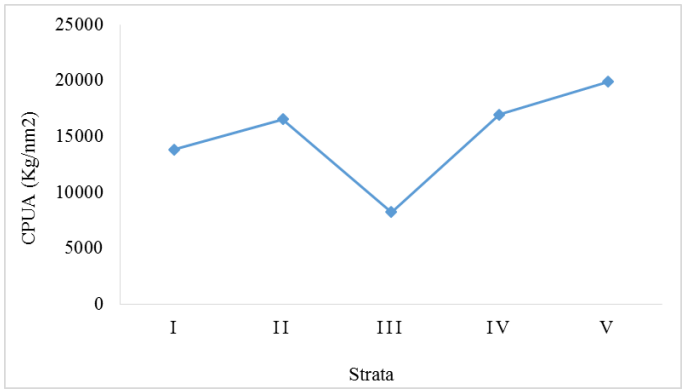

Figure 4. Catch per unit area (kg/ nm2) in different stratum at the Northern coast of the Oman Sea.

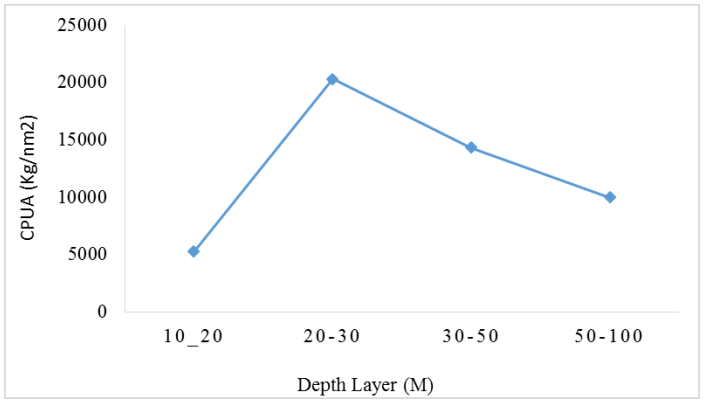

Figure 5. Catch per unit area (kg/ nm^2) in different depth layer at the Northern coast of the Oman Sea.

30 meters, and Javelin grunter (*Pomadasys kaakan*) (10-20 meters).

The mean CPUA was estimated 75436 nm^2 during study period. The highest mean CPUA value observed in stratum V (19884 nm^2) and lowest one in stratum III (8212 nm^2). The results showed that the abundance was higher in the western part of the studied area. The highest and lowest mean CPUA values were 20311.4 and 5258.7 kg/ nm^2 in 20-30 and 10-20 m depth layers, respectively (Figs. 4, 5).

Discussions

Biomass and CPUA are employed as stock indices for managing of the demersal fish species. The present study was conducted to evaluate the CPUA and biomass of the demersal fishes in different stratums and depth layers in northern part of the Oman Sea and findings showed higher biomass of the stratums I, II, IV, and V. In addition, the results of this study revealed a better condition regarding the abundance of marine resources in the western and eastern regions of the studied area which indicate an ecologically rich area with high primary production and appropriate habitats for aquatic marine species.

Comparison of biomass in different depth layers showed that maximum biomass was at the depth of 50 to 100 m. This result is contrary to that of Valinassab et al. (2006) who found the highest biomass value at 10-20 meter depth layer. Differences between biomass in these two layers during the last decade might be due to overexploitation, use of non-standard fishing equipment and gears, more catch per unit of effort (CPUE) i.e. increasing number of fishermen, boats, ships, and fishing gears especially gillnets along the coastal waters (10-20 meter depth layer) leading lack of opportunity for regeneration of fish populations in this area. Another explanation for differences between biomass in10- 20 meter depth layer and 50-100 meter depth layer is the difference in the extent of these two areas.

Differences in mean CPUA values between different depth layers can be due to horizontal distribution of species. Changing trends in mean CPUA at different stratum showed that the stratums I and II in the east coast and stratums IV and V in west coast of the Oman Sea represent more favorable fishing conditions. These results are in line with Valinassab et al. (2006) who also found changes in mean CPUA at different stratums (I (7524.9), II (9975.5), III (6365.6), IV (13943.4), and V (9001.9)) in the Oman Sea. Furthermore, these results are in agreement with Abbaspour et al. (2010) findings which showed mean CPUA in west (I=13808, II=11782) and east (IV=11482, V=9609) coast is more than central (III=5703) part of Oman sea. This results can be explained due to high fishing effort of artisanal (gillnet) and industrial (trawl vessels) fisheries in this region. The mean CPUA in different depth layers of the Oman Sea during 2004 to 2008 showed that is reduced with increasing water depth; its value in 10-20 m depth layer was 3.8 times higher than that of 50-100 m (Valinassab, 2011). However, according to the present study, the highest CPUA was found in 20-30 m depth layer, which was 8.3 times higher than that of 10-20 m.

Our findings suggests that immediate management is required to optimal exploitation of the studied fishes, such as limited fishing season during spawning and limit the catch on heavily-fished waters. Furthermore, imposed a ban on bottom trawls and other unselective fishing gear would be beneficial to avoid damage to the fishing industry and the marine environment by catching juvenile fish, damaging the seafloor, and leading overfishing.

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