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Short Communication: CPUE, CPUA and distribution patterns of four demersal fishes in coastal waters of the northern Persian Gulf, Iran

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Abstract. *Zeinali F, Kamrani E, Parsa M. 2017. Short Communication: CPUE, CPUA and distribution patterns of four demersal fishes in coastal waters of the northern Persian Gulf, Iran. Nusantara Bioscience 9: 12-17.* CPUE, CPUA and distribution patterns of *Pampus argenteus*, *Otolithes ruber*, *Nemipterus japonicas* and *Saurida tumbil* along the coastal waters of Hormozgan province were investigated. The mean CPUE values for *P. argenteus* in 0-10 m and 10-20 m depth layers was significantly different (P<0.05). The highest and lowest mean CPUE of *S. tumbil* were observed in 20-30 m and 0-10 m depth layers, respectively. The highest mean CPUA for *P. argenteus* was found in 0-10 m depth layer, with a descending trend with increasing the depth. The highest CPUA of *O. ruber* was observed in 10-20 m depth layer, but the mean CPUA values was not significant among depth layers (P>0.05). The mean CPUA for *N. japonicas* was relatively high in 30-40 m depth layer and markedly lower in 0-10 m depth layer as the shallowest depth layer. The highest and lowest mean CPUA of *S. tumbil* were observed in 20-30 m depth layer and 0-10 m depth layer, respectively.

Keywords: Demersal fishes, distribution, Iran, Persian Gulf

INTRODUCTION

The waters of the Persian Gulf and Oman Sea are environmentally unique with an unusual faunal assemblage (Carpenter et al. 1997; Valinassab et al. 2006). The Persian Gulf and Gulf of Oman consist of subtropical seas lying almost entirely between the latitudes of 24˚ N and 30˚ N and longitudes of 49˚ E to 61˚ 25′ E (Reynolds 1993).

In Iran, fish resources have been categorized into four main ecological groups based on their habitat including small pelagic fish, large pelagic fish, demersal fish and coral-reef associated fish (Valinassab et al. 2006; Kamrani et al. 2010). The waters of the Persian Gulf and Oman Sea are relatively rich in fisheries resources. Demersal fish are one of the most important groups for both artisanal and industrial fisheries in the Persian Gulf and Oman Sea.

Trawl nets are one of the most common type of fishing gears in the Persian Gulf and Oman Sea waters and are principally used for commercial fishing of demersal fishes (Valinassab et al. 2008). In the case of demersal species, trawls have been generally used as samplers under the assumption that they tend to represent the abundance of individuals present in an area that is "swept" as they are dragged on the seafloor (Pezzuto et al. 2008).

Studies on distribution patterns of some fishes in the Persian Gulf and Oman Sea have been carried out by researchers (Valinassab et al. 2006; Noroozi and Valinassab 2007; Parsa et al. 2014; Ghotbeddin et al. 2014), but no detailed data are available on the distribution patterns of demersal fish in these areas. Therefore, this study, provides the first detailed information on the catch per unit effort (CPUE), catch per unit swept area (CPUA) and distribution patterns of four important species including: Silver pomfret (*Pampus argenteus*; Euphrasen, 1788), Tiger-toothed croaker (*Otolithes ruber*; Bloch & Schneider, 1801), Japanese threadfin bream (*Nemipterus japonicus*; Bloch, 1791) and Greater lizardfish (*Saurida tumbil*; Bloch, 1795) in coastal waters of Hormozgan province, north part of Persian Gulf, by using catch per unit of effort (CPUE), catch per unit of swept area (CPUA) and Arc GIS Software, which provides useful data for management purposes.

MATERIALS AND METHODS

Study area

This study was carried out between September and October 2013 in coastal waters of Hormozgan Province (in an area extending from Bandar Abbas: 26˚ 25′ E,-57˚ 29′ N to Sirik: 27˚ 07′ E,-56˚ 06′ N), located in the northern Persian Gulf, Iran (Figure 1). A stratified random sampling was undertaken by dividing the area into four depth layers including 0-10 m, 10-20 m, 20-30 m and 30-40 m.

Procedures

Sampling was done on board R/V (Research Vessel) "Tabas" equipped with a 1600 HP engine. This vessel is a stern trawler with 503 gross registered tonnage, 22.55 m length, 7.4 m width, 3.6 maximum draft and was equipped

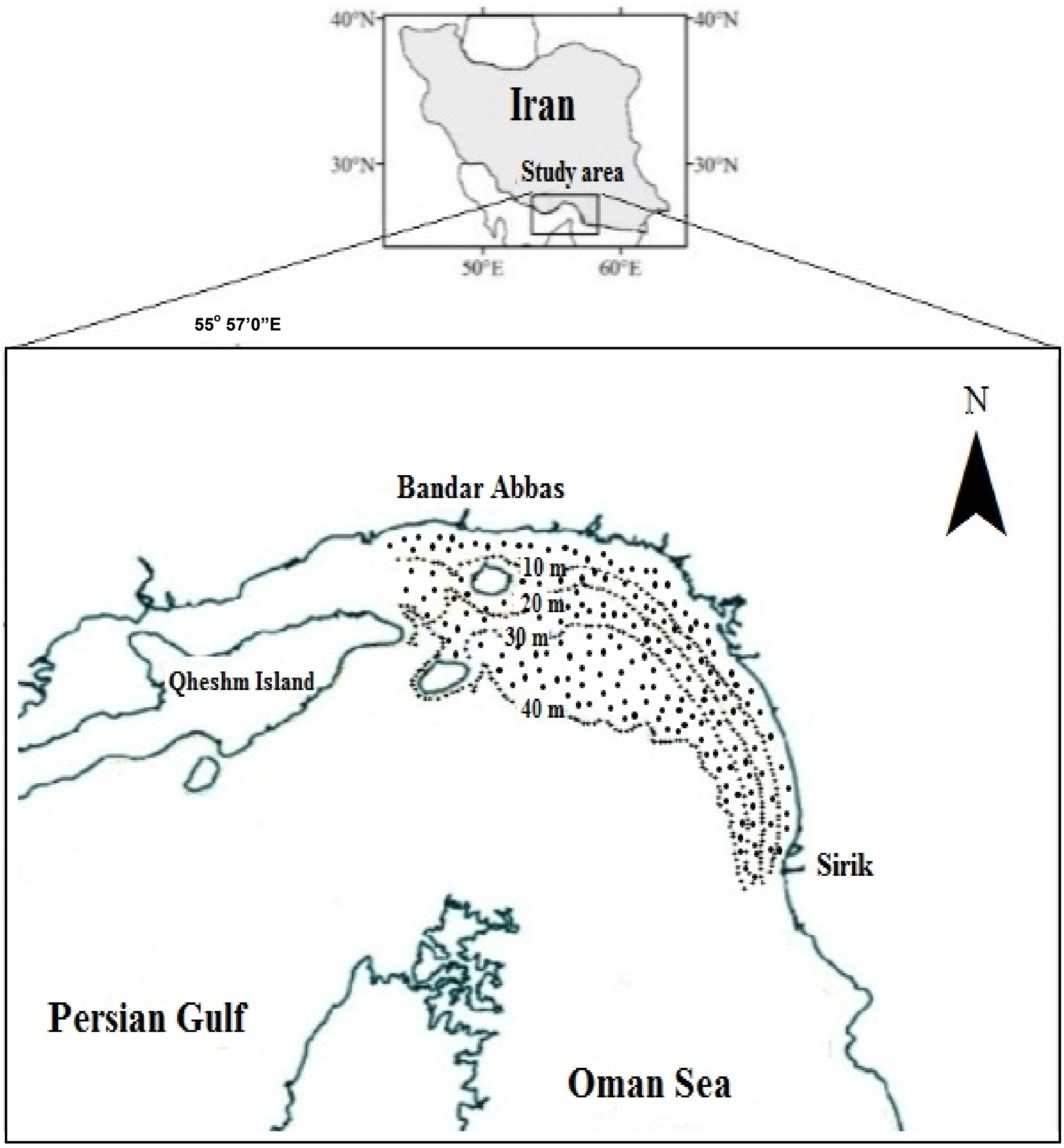

Figure 1. Map of Hormozgan Province showing the fishing ground where the study was conducted

with a Global Positioning System (GPS), echo sounder system and a bottom-trawl net. Using stratified random sampling method and bottom trawling nets with a 40 mm mesh size from wings to sac and 30 mm at the cod end, a total of 175 bottom trawl hauls were taken in defined stations. For each trawl the following data were recorded in vessel Log Sheet: date, time, bottom depth, GPS position, towing distance and towing speed. The average towing speed ranged from 3.2 to 3.4 knots. The towing duration of each haul was two hours.

The equation of Gulland was used to assess CPUE index for each hauling:

$$CPUE = \frac{Cw}{h}$$

Where, Cw is the weight of catch (Kg) and h is the tow times (hours) (Gulland 1983). For calculating the catch per unit of swept area (kg/n.m.^{2}), the following equation was used (Sparre and Venema 1992):

$$CPUA = \frac{Cw}{a}$$

Where, Cw is the catch weight (kg) and a, is the swept area at each station. For each trawling, the swept area was computed using the following formula:

$$a = D.h.X_2$$

Where, D is the towing distance, h is the length of head rope and X_2 is the fraction of the head rope length (the value of X_2 was taken to be 0.5 in this study).

The towing distance was estimated in units of nautical miles (nm), by:

$$D = 60 \times \sqrt{(Lat1 - Lat2)^2 + (Lon1 - Lon2)^2 \times Cos^2\left(0.5 \times (Lat1 + Lat2)\right)}$$

Lat1: Latitude at start of haul (degrees), Lat2: Latitude at end of haul (degrees); Lon1: Longitude at start of haul (degrees), Lon2: Longitude at end of haul (degrees).

Data analysis

The CPUE of species was determined using the weight of species captured per 2 hours. The normality of CPUE data and homogeneity of variances were tested using the Kolmogorov - Smirnov test and Levene test in SPSS19 (KS= 0.713- 0.989, P= 0.282-0.689). Regarding to normality of catch data, the differences in CPUE and CPUA among different depth layers were tested using one-way ANOVA and Duncan test. Moreover, the spatial distribution patterns of fish were obtained by smoothing the fish density data, using the Arc-GIS software and Inverse Distance Weighting (IDW) method.

RESULTS AND DISCUSSION

In the present study, CPUE, CPUA and distribution patterns of *P. argenteus*, *O. ruber*, *N. japonicas* and *S. tumbil* were determined in coastal waters of Hormozgan province located in the northern Persian Gulf, Iran. According to Nguyen (2005), the catch rate (kg per trawling hour) is the basic quantity to calculate stock density in surveys, and these estimates are in turn utilised to derive other estimates such as abundance indices and biomass estimates for commercially important fish stocks. Catch per Unit of effort (CPUE) is often the main piece of information used in fisheries stock assessment. CPUE is usually assumed to be proportional to abundance and therefore included in the stock assessment as a relative index of abundance (Hinton and Maunder 2003). Moreover, an understanding of catch rate and catch per unit of effort is fundamental for assessing and managing fish stocks.

The mean CPUE values in different depth layers are shown in Figure 2. The total catch and total mean catch of all the four species were calculated as 13609 kg and 3402.25 kg, respectively. The highest mean CPUE of *P. argenteus* was observed in shallow coastal areas with bottom depth less than 10 m (4.05±0.89 kg/h) and significantly declined as depth increased (F= 9.232, P<0.05). The highest mean CPUE of *O. ruber* was observed in 10-20 m depth layer (2±0.24 kg/h) but mean CPUE values did not show a statistically significant amount of difference among depth layers (F= 2.298, P>0.05). The highest mean CPUE of *N. japonicas* was observed in 30-40 m depth layer (9.2±1.45 kg/h) that is in

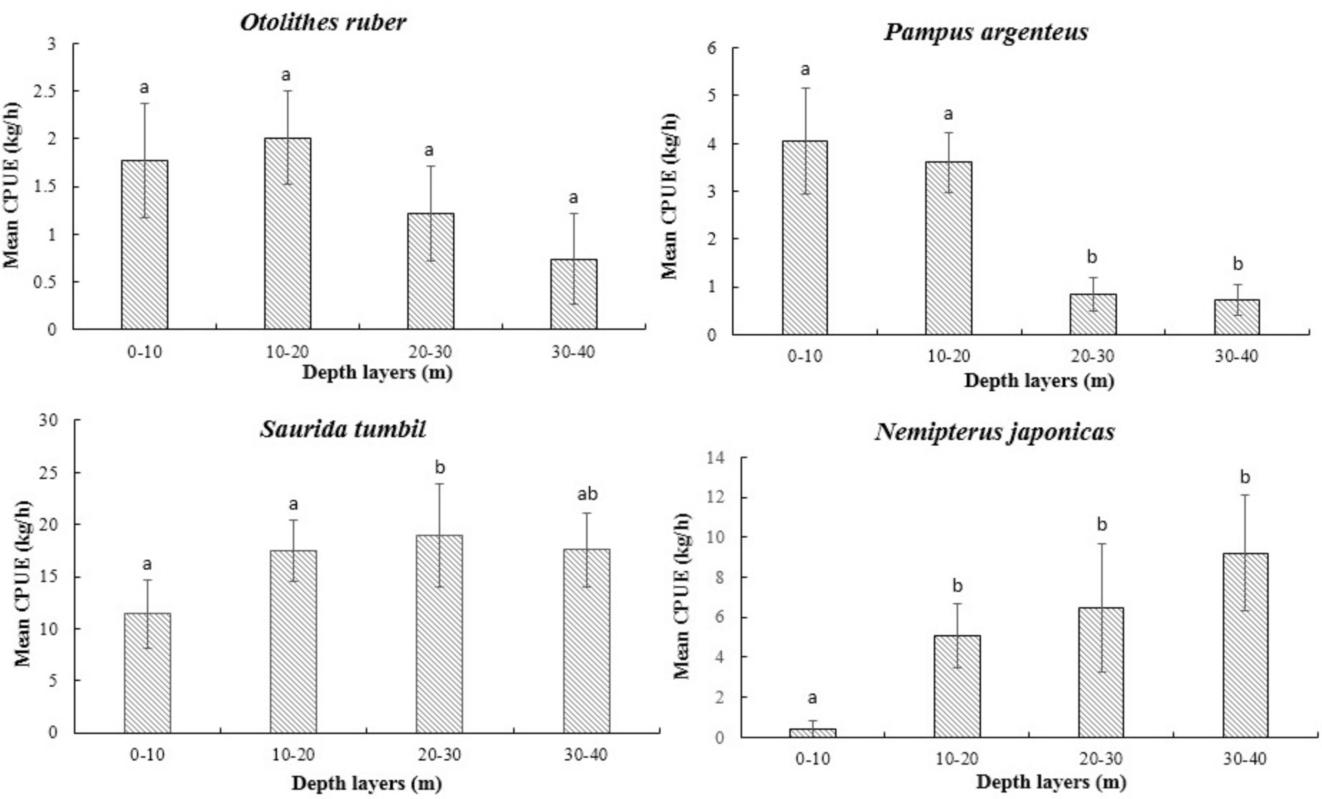

Figure 2. Mean CPUE (±S.E) for species in different depths. Values with the different alphabetic letters are significantly different (P<0.05)

agreement with the findings of Parsa et al. (2014), in southern Persian Gulf (waters of Bushehr province). The mean CPUE of *N. japonicas* showed significant difference between 0-10 m depth layer and other depth layers (F= 4.511, P<0.05). Noroozi and valinassab (2007) reported that the highest catch amount and CPUE of *N. japonicas* were in 20-30 m depth layer, the same area in Persian Gulf. The highest and lowest mean CPUE of *S. tumbil* were observed in 20-30 m (18.95±2.56 kg/h) and 0-10 m (11.41±1.62 kg/h) depth layers, respectively. The mean CPUE of *S. tumbil* and *N. japonicas* tended to be higher offshore than inshore and significant differences verified for these two species according to statistical analysis.

Munro and Somerton (2002) stated that catch patterns for a trawl survey are dependent on the density of fish available to the volume sampled by the trawl and the trawl efficiency for a particular species. Catch rates, or catch per unit effort (CPUE), for survey trawls have been shown to be correlated with environmental variables such as wind and wave height (Wieland et al. 2011), temperature (Ryer and Barnett 2006), salinity (Smith et al. 1991), and near-bottom light (Kotwicki et al. 2009).

The use of catch per unit swept area (CPUA) as a measure of relative fish abundance is a common index used in stock assessment, whether calculated from commercial or research survey data (Haggarty and King 2006). Biomass and CPUA estimates are commonly used as stock indices for management of demersal resources (Sparre and Venema 1992). Determination of fish distribution and community structure are important first steps to improve our understanding and knowledge of marine ecosystem (Anderson et al. 1998).

Figure 3 shows the mean CPUA in different depth layers. The highest and lowest mean CPUA of *S. tumbil* were recorded in 20-30 m depth layer (150.45±20.33 kg/nm^2) and 0-10 m depth layer (90.56±12.88 kg/nm^2), respectively (F= 1.831, P<0.05). The highest CPUA of *O. ruber* was observed in 10-20 m depth layer (15.94±1.92 kg/nm^2), but the mean CPUA values were not significant among depth layers (F= 2.298, P>0.05). Our results are comparable to the results of Mohammadkhani and Yelghi (2010) who studied the distribution of *O. ruber* in waters of Oman Sea. They found that the highest abundance and distribution of *O. ruber* is in 10-20 m depth layer.

The mean CPUA for *N. japonicas* was relatively high (73.05±11.54 kg/nm^2) in 30-40 m depth layer and markedly lower in the shallowest depth layer (0-10 m, 2.97±1.76 kg/nm^2) (F= 4.511, P= P<0.05). Our mean CPUA results for the *N. japonicas* were consistent with findings of Parsa et al. (2014) in that the highest mean CPUA was in 30-50 m depth layer in southern Persian Gulf (waters of Bushehr province). The highest mean CPUA for *P. argenteus* was found in 0-10 m depth layer (32.17±7.09 kg/nm^2) and tended to decrease with depth, resulting in a significant interaction among depth layers (F= 9.232, P<0.05). The mean CPUA values of *S.tumbil* and *N. japonicas* showed an increasing trend with increasing the depth.

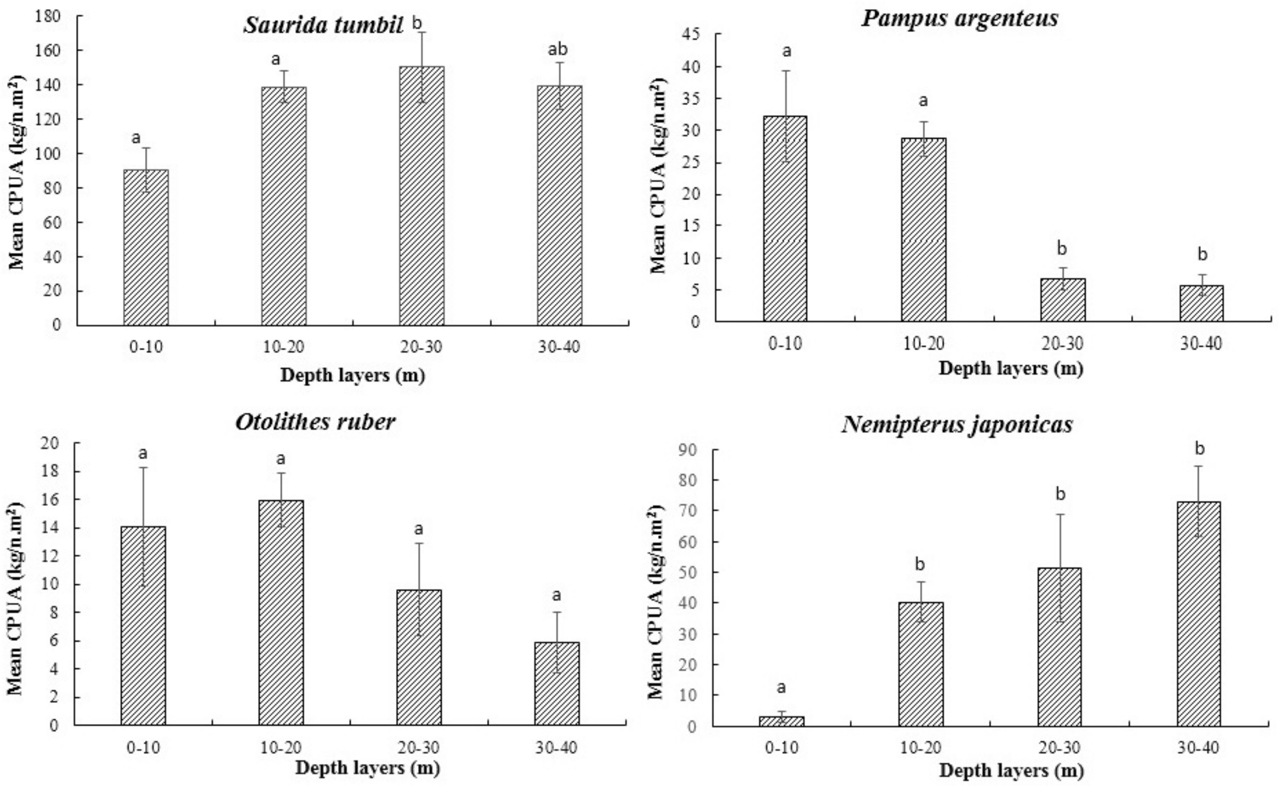

Figure 3. Mean CPUA (±S.E) in different depth layers among the species. Values with the different alphabetic letters in rows are significantly different (P<0.05).

Figure 4 represents the spatial distribution patterns of species in the study area. CPUA index was used to mapping the distribution patterns of species using the Inverse Distance Weighting (IDW) interpolation method in GIS software. Of the various interpolation methods, IDW is a technique easy to use and highly accessible and can be considered as a potential alternative to traditional survey mapping (Roberts et al. 2004). According to Figure 4, mapping the distribution patterns showed that species were distributed in different depth layers. The highest abundance and distribution of *P. argenteus* and *O. ruber* was observed near the shallow part of the study area and coastal sides. In contrast, most of the *N. japonicus* and *S. Tumbil* abundance was found in deeper areas of study region.

Swain and Wade (1993) declared that preference depth layer of different species might be associated with environmental conditions (biotic and abiotic factors) such as prey and predator, temperature, salinity and type of sea bottom. In the present study, the number of trawl hauls was much higher than other surveys in the same areas. Pennington and Volstad (1994) suggested that increasing the number of stations would result in an increase in the precision of the survey estimates of abundance and biomass.

Valinassab et al. (2006) stated that *N. japonicus* and *S. tumbil* are the most abundant demersal fish, and *P. argenteus* and *O. ruber* are the most important commercial species account for a very small proportion of the total catch in the Persian Gulf and Oman Sea. The decrease of *P. argenteus* and *O. ruber* catch amount due to overexploitation suggest that fishing is affecting community structure. Information about distribution patterns of many demersal species in the Persian Gulf and Oman Sea is lacking. Therefore, results of this study provide valuable information on distribution of four commercial demersal fish in northern Persian Gulf. In order to access a sustainable management on fish resources, fishery managers should protect the fishing areas in the future.

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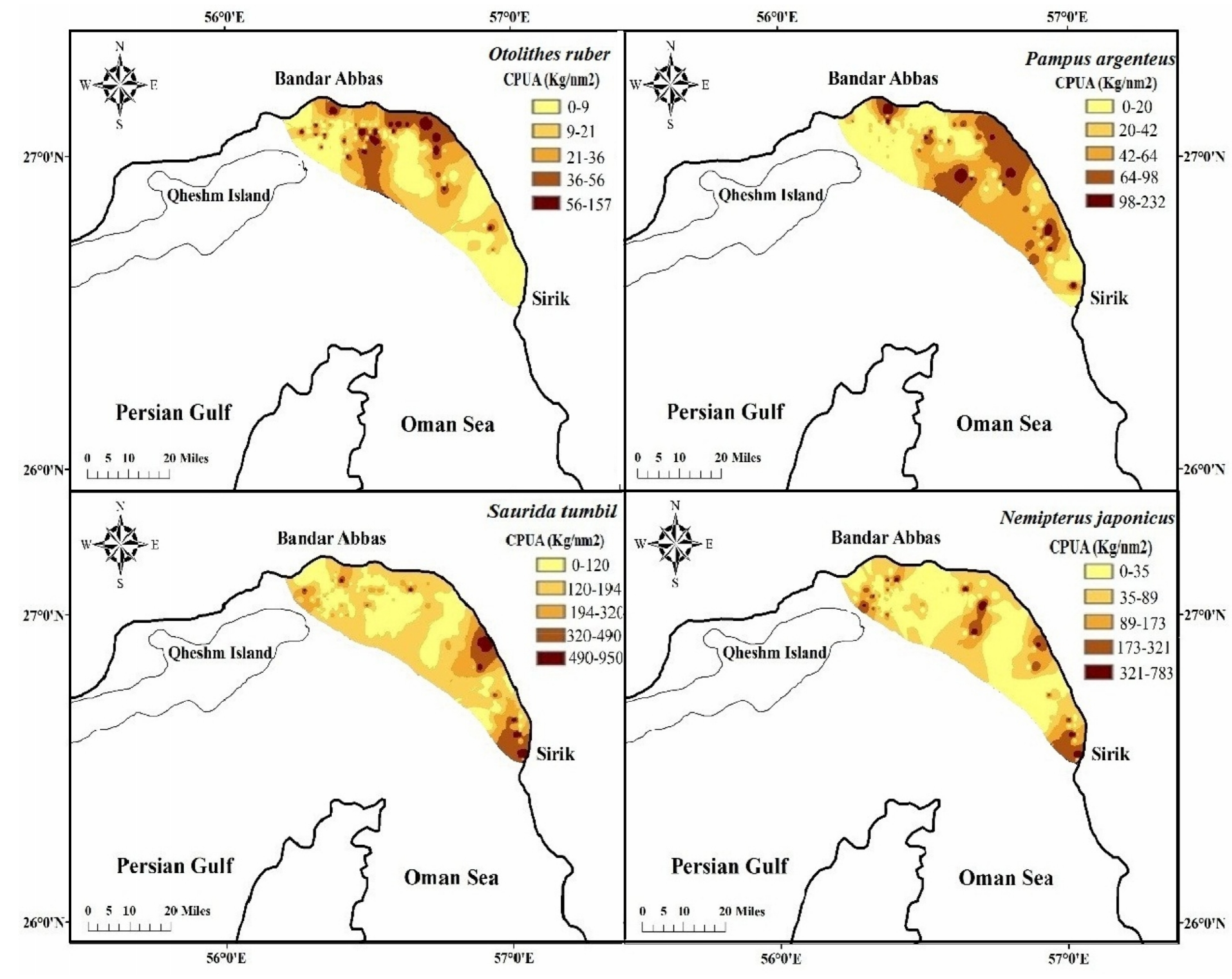

Figure 4. Spatial distribution patterns of *P. argenteus*, *O. ruber*, *N. japonicas* and *S. tumbil* in coastal waters of Hormozgan province, northern Persian Gulf, Iran

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