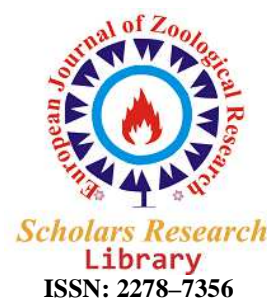




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Biomass and CUPA estimation and Distribution pattern of Haemulids and Sphyraenids in the northwest of Persian Gulf

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ABSTRACT

It is reported on results of a trawls survey in 2011 to assess the amount of biomass and Catch Per Unit of Area (CPUA) and also to determine the distribution pattern of two main families of demersal fishes as one the most important and commercial fish species in the northwest of Persian Gulf. Samples were collected at a total 65 trawl stations selected a stratified random procedure. The catch rates of CPUA and biomass of two target fishes were estimated to be approximately 186.5 kg/nm², 2476.8 tons for Haemulidae family and 130.8 kg/nm² and 1737.6 tons for Sphyraenidae family, respectively. The highest value of CPUA of Haemulids was recorded in the east of the study area (stratum D, approximately 1097.4 kg/nm²) and the highest biomass was found in strata C & D. On the other hand, the highest CPUA and biomass were recorded in stratum C. It was concluded that strata C and D (namely from Dayer to Genaveh) contain the best fishing area from point of higher density and distribution of Haemulids and Sphyraenids in the covering area, and from point of depth distribution, they are found in depths less than 20 m and more than 30 m, respectively.

Keywords: CPUA, Biomass, Distribution, Fishing area, Persian Gulf

INTRODUCTION

The fisheries and exploitation of marine fishes, represent the second most important natural resources (next to oil), and the most important renewable natural resources [1] in the Persian Gulf and about 100,000 fishermen are active and employee in this industry both as traditional and industrial fisheries in this area [2]. The Persian Gulf is in the subtropical zone, lying almost entirely between the latitudes of 24° 00'N and 30° 30'N, and longitudes 48° 00'E to 56° 25'E (Fig. 1). It is a semi-enclosed water body with average depth of 35 m connected to the Oman Sea through the Strait of Hormuz, which is 56 km at its narrowest point [3] and then is connected to the open sea of the Indian Ocean through the Arabian Sea. The most common fishing methods are gillnet, trap, two-boat purse seine, hook and line, and shrimp trawl to catch different ecological group fishes with emphasize on demersal fishes [4]. As an important fisheries management policy, the fish trawling has been banned from 1993 due to rehabilitation and to decrease the fishing effort [5]. The amount of total catch in the Persian Gulf for years 2009, 2010 and 2011 were estimated 227000; 245100, and 275500 tonnes, respectively in which the quota of the northern Persian Gulf were 94890, 104700, and 97000 tonnes [2] namely 42, 43 and 35 percent of the whole northern Persian Gulf, Iranian waters.

Haemulids and Shyraenids are two the most important demersal and Pelagic fishes both in traditional and industrial fisheries [1, 4-7] with total catch of 1825, 2899, and 1816 tons for years 2009, 2010, and 2011 for Haemulids species and 539, 987, and 992 tons for Shyraenids species in the northwest of Persian Gulf [2].

In order to have sustainable exploitation of marine fish resources, it is advised to monitor the aquatic resources and find out the trend of catch per unit of effort, catch statistics as fishery indices and also to carry out research cruises to estimate other expertise indices such as catch per unit area or CPUA [8] for further management advises.

The first studies on demersal fishes in the study area were carried out in 1976-1979 under a United Nations Food and Agriculture Organization regional project covering all southern and northern Persian Gulf and Oman Sea waters using four research vessels [9]. Further studies in the northern Persian Gulf waters to estimate the biomass of demersal fishes took place between 1994 and 1995 based on seasonal cruises [10]. Then from year 2002, it was decided in order to provide further advise for the management of demersal resources, a comprehensive research project, covering all Iranian waters of the Persian Gulf and Oman Sea, was designed [5] using swept area method [8].

The main objectives of this research are to estimate the amount of catch per unit area (CPUA) and biomass of two main commercial families of Haemulids and Shyraenids for different strata and depth layers in the northern Persian Gulf and to have a comparison with previous estimations to find any ascending or descending trend of changes. The other important objective is to prepare the distribution pattern and determine the main fishing area of target fishes.

MATERIALS AND METHODS

The study area was restricted to the Iranian waters of the northern Persian Gulf (Khuzestan and Bushehr provinces waters), between longitudes 49° 00' E borderline of Iran and Kuwait in the west and 52° 45' E, Ras-Naiband in the east as borderline of Bushehr and Hormuzgan provinces; and isobaths of 10 to 50 m depth (Fig.1). The total area was stratified into 5 strata (A to E) and then each stratum was classified into three depth layers: 10-20, 20-30, and 30-50 m.

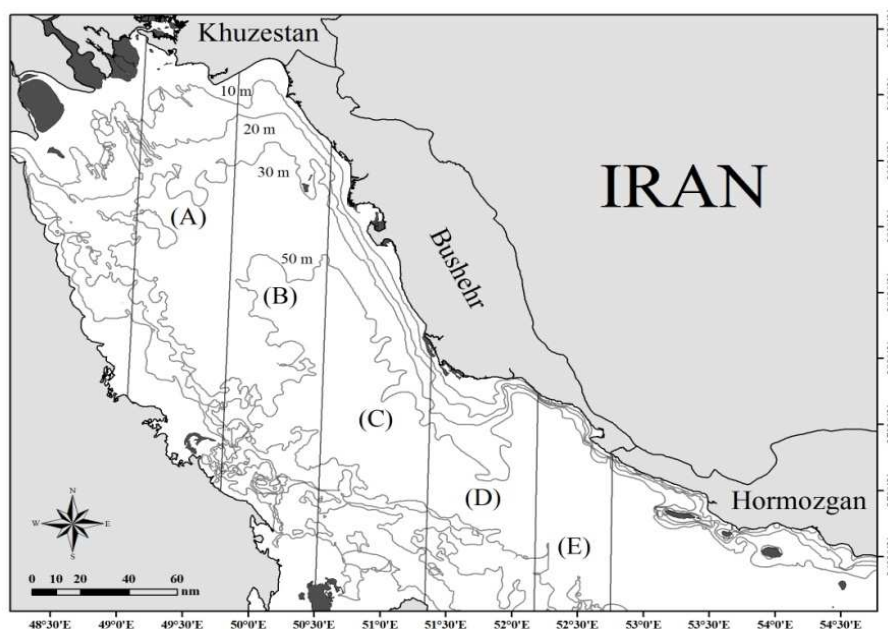


Figure 1. Map of the study area for assessment the Haemulids and Sphraenids stocks

The total area and area of each stratum or depth layer was calculated with a planimeter (Tables 1, 2). A total of 65 trawl stations were selected randomly and the number of hauls in each substratum being proportional of the stratum and depth layer.

Table 1. The number of trawl stations and area of each stratum in the northwest of Persian Gulf

Stratum	A	B	C	D	E	Total
Area (nm ²)	621.7	1415.6	1415.1	909.1	227.5	4589.0
Proportion of total area (%)	13.5	30.8	30.8	19.8	5.1	100
Station	3	19	21	16	6	65

Table 2. The number of trawl stations and area of each depth layer in the northwest of Persian Gulf

Stratum	10-20m	20-30m	30-50m	Total
Area (nm ²)	1554.8	1102.5	1931.7	4589.0
Proportion of total area (%)	33.9	24.0	42.1	100
Station	23	19	23	65

A total of two cruises were in 2011 using R/V Ferdows-1. This vessel is a stern bottom trawler was equipped with a fish bottom-trawl net (headline 72m and mesh size of cod end 80mm). For each trawl, date, time, duration, bottom depth, GPS position, towing distance, and towing speed were recorded in special log sheets. Each trawl lasted 1h following which the net was transferred on board and then the following operations consist of separation, identification, counting and weighing of Haemulids and Sphyraenids were done.

The amount of biomass and CUPA index were estimated based on Sparre and Venema [8] using following formula: Swept area of each haul was estimated as:

$$a = d * h * X_1$$

Where: d: towing distance (nautical mile, nm) registered by Simrad Plotter; a: swept area (nm²); d: towing distance (nm); h: headline (m) and divided on 1852 to change it to nautical mile (nm); X₁: wingspread coefficient = 0.65 [4].

The catch per unit area (CPUA) is then given by:

$$CPUA = Cw / a$$

Where: Cw = catch amount of Haemulids and Sphyraenids separated from the total catch;

$$a: \text{ swept area (nm}^2\text{)}$$

and after estimating the mean CPUA, the total biomass(B) is estimated as:

$$B = CPUA * A / 0.5$$

Where: A: total area (nm²); and 0.5: catch coefficient [8].

Statistically, there was no normal distribution in CPUA values for Haemulids and Sphyraenids, therefore the non-parametric test of Kruskal-Wallis was used to determine any significant difference between strata and depth layers; and if there were significant differences, then Man-Whitney test was applied for comparing the mean CPUA for different strata and depth layers. Also, the Arc-GIS software (Version 9.2) was used for preparing the distribution pattern maps accompany with Inverse Distance Method.

RESULTS

Two fish families of Haemulidae and Sphyraenidae were target of this investigation of which amongst the total collected samples, the main identified species of *Pomadasy kaakan* (javelin grunt), *P. stridens* (striped piggy) and *Plectorhinchus pictus* (trout switlip) belong to Haemulidae family and species of *Sphyraena jello* (pickhandle barracuda) and *S. obtusata* (obtuse barracuda) belong to Sphyraenidae family. The highest frequency of Haemulids was *P. stridens* (58.1%) and *P. kaakan* (38.8%), respectively and for Sphyraenids was for *S. jello* with 90% frequency as the most dominant species. The total mean CPUA and biomass were estimated 186.5 kg/nm² and 2476.8 tons and

it contains a frequency of 5.2% of total catch of demersal fishes. These values for Shyraenidae family were 130.8 kg/nm², 1737.6 tons and 3.6%, respectively.

The highest mean CUPA of Haemulids was found in stratum D (Bordkhood to Dayer) with 603.6 kg/nm² (Fig. 2) and the highest biomass were in strata D and C (Dayer to Genaveh) with values of 1097.4 and 1069.5 tons, respectively (Table 3). This comparison was done for different depth layers and the maximum CUPA (259.7 kg/nm²) and biomass (1032.2 tons) were observed in shallow waters of 10-20 m depth (Fig. 3). There was a descending trend of CUPA of Haemulids with increase of depth; with the lowest CUPA of 146.2 kg/nm² in 30-50 m depth but the amount of biomass with 919.7 tons in this depth layer was approximately two times more than 20-30 m depth layer.

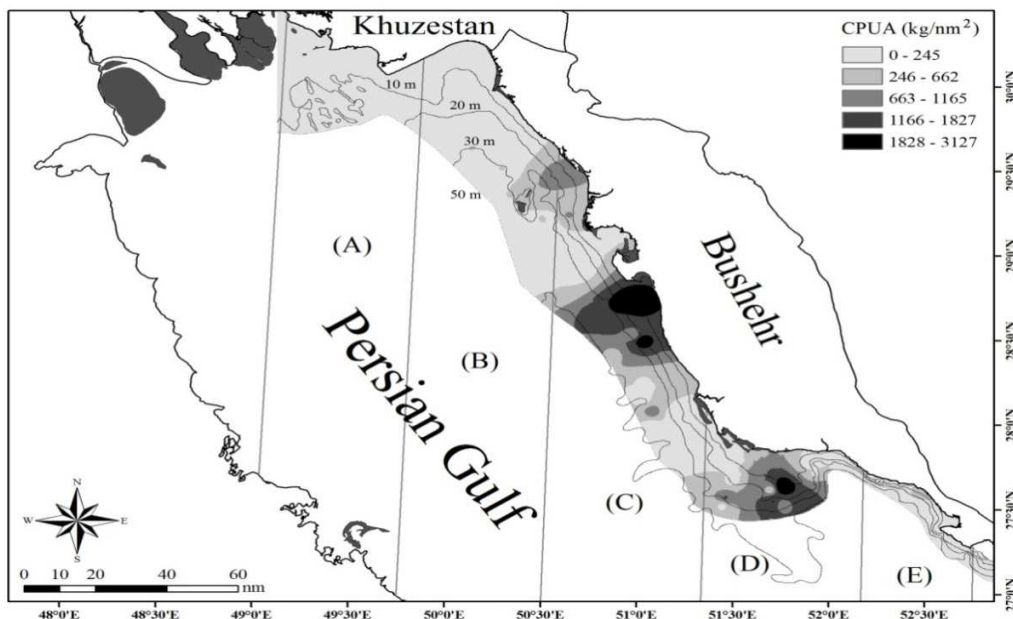


Figure 2. The distribution pattern of Haemulids species in the northwest of Persian Gulf

Table 3. Biomass (tons) of Haemulids and Shyraenids for different strata in the Northwest of Persian Gulf

Stratum	A	B	C	D	E	Total
Haemulids	-	274.0	1069.5	1097.4	35.8	2476.7
Sphyraenids	-	404.6	949.8	279.0	104.1	1737.5

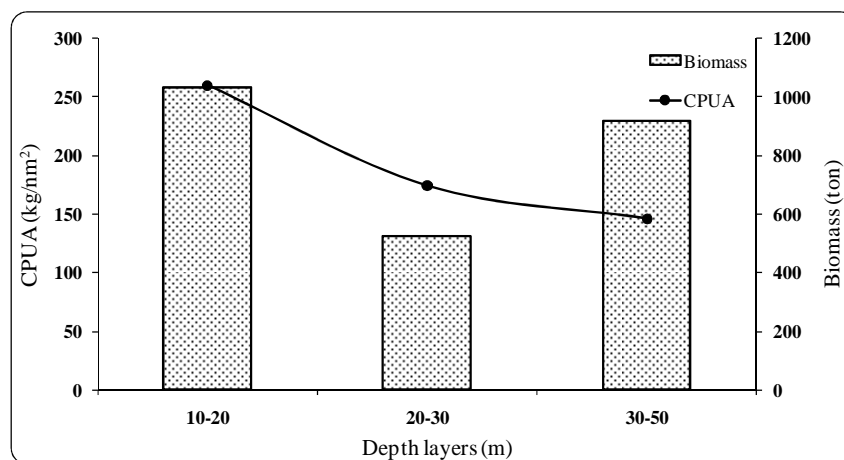


Figure 3. CUPA and biomass of Haemulids for different depth layers in the northwest of Persian Gulf

There was no significant difference ($P > 0.05$) for mean CPUA of Haemulids for different depth layers but among different strata was significant ($P < 0.05$) especially for strata C (Genaveh to Bordkhood) and E (Dayer to Ras-Naiband).

The highest mean CPUA for Sphyraenids in the northwest of Persian Gulf was 335.6 kg/nm² belongs to stratum C, and the strata B and D had the same value of mean CPUA (Fig. 4). The highest biomass with 949.8 tons was observed in stratum C, following with stratum B as the second ranking (Table 3). With increasing the depth there was an ascending trend of mean CPUA for Shyraenids (on the contrary of results for Haemulids). The maximum biomass and mean CPUA with the values of 1737.6 tons and 130.8 kg/nm² were found for 30-50 m depth layer (Fig. 5). The other two depth layers of 10-20 and 20-30 m approximately had the same biomass. Also, there was no significant difference ($P > 0.05$) between mean CPUA of Shyraenids for depth layers but it was significant ($P < 0.05$) for different strata especially C (Genaveh to Bordkhood) and D (Bordkhood to Dayer).

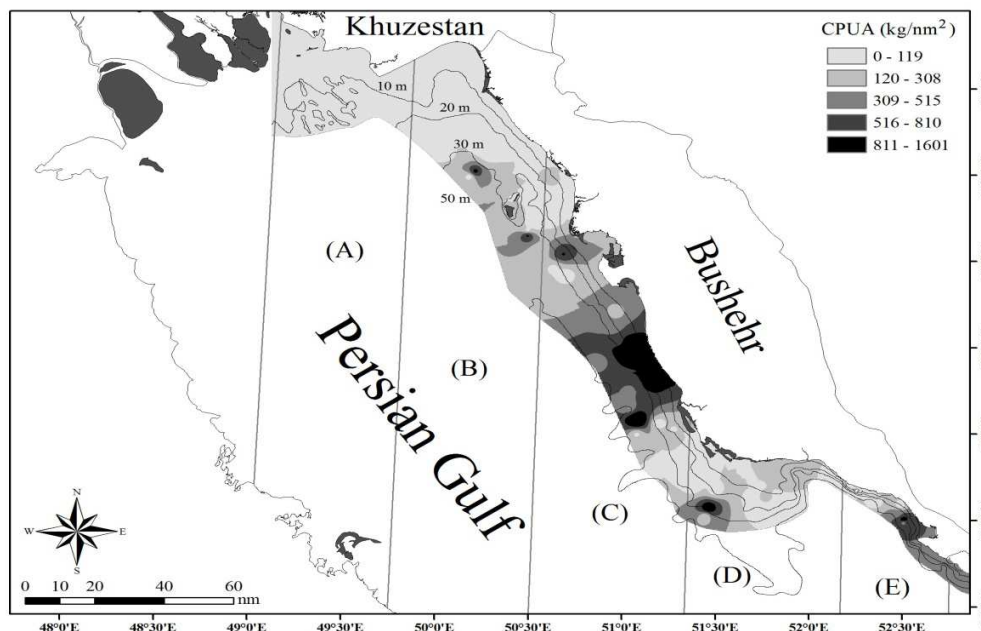
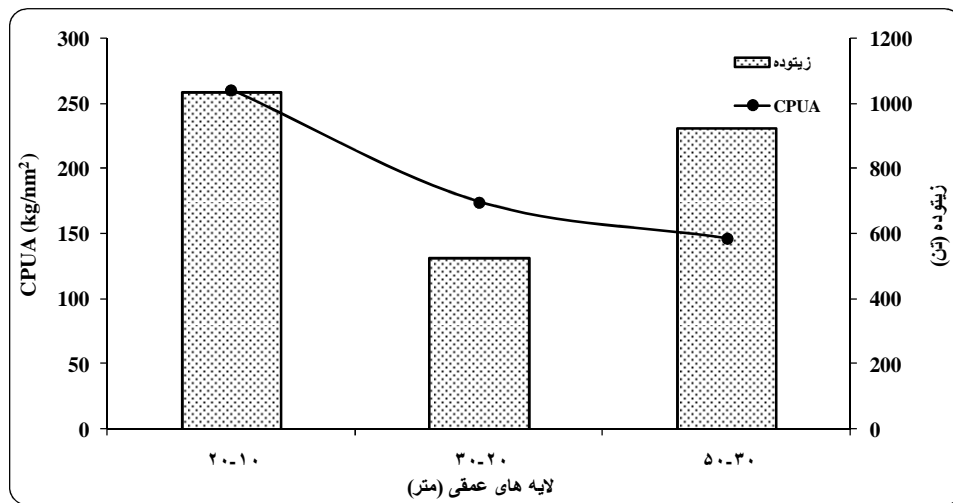


Figure 4. The distribution pattern of Sphyraenids species in the northwest of Persian Gulf

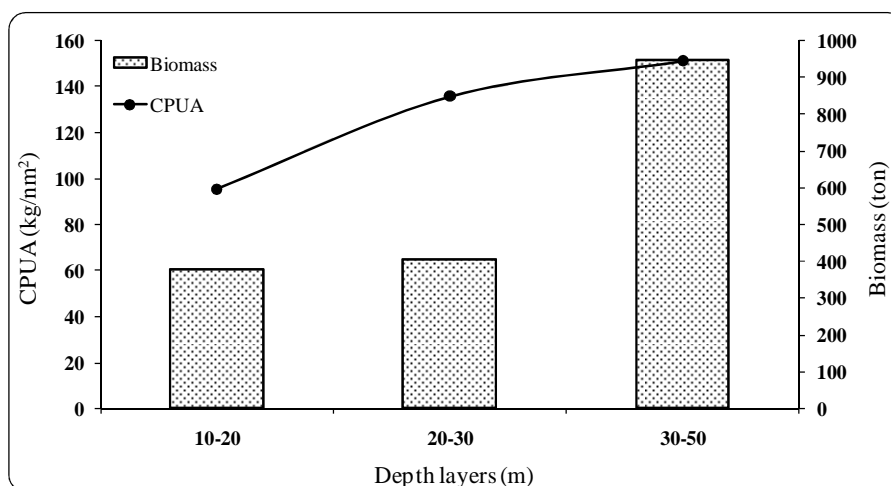


Figure 5. CPUA and biomass of Sphyraenids for different depth layers in the northwest of Persian Gulf

DISCUSSION

The lowest biomass of Sphyraenids and Haemulids was estimated for stratum E (Dayer to Ras-Naiband) in which is due to lower area of this region with only 227.5 nm² namely 5.0% of total of study area (Table 1) comparing to other strata for instance stratum B with 1415.6 nm². The strata C and B have the same area and each contains about 31% of total area, considering this important point that stratum C has higher values of CPUA and biomass than stratum B and consequently it can be concluded that distribution and density of Sphyraenids and Haemulids are higher in stratum C in which can be considered as the main fishing ground of these two species group.

The previous studies during years 2003-2010 showed that excluding years 2003 and 2004 (in which the stratum B [Doheh-Daylam to Genaveh] had higher mean CPUA), the highest amount of biomass and mean CPUA of Haemulids were estimated for strata C and D (Genaveh to Dayer) [6]; and it is in agreement of findings of this research in which reveals the maximum CPUA and biomass for stratum D (Table 3; Fig. 2).

The maximum CPUA of Sphyraenids' species for years 2008 and 2010 was estimated for stratum E with values of 1379.3 and 2787.8 kg/nm², respectively and on the other hand for years 2003 to 2007 and 2009 was for stratum D [4,6]. Also the highest biomass was found in 2010 with amount of 1268.4 tons for stratum E and for other years was in stratum D. But according of obtained results of this study the maximum biomass and CPUA were estimated for stratum C (Table 3; Fig. 4).

As an overall review on previous studies and including the obtained findings of this investigation, it can be concluded that the strata C and D (Genaveh to Dayer) located in Bushehr Province have higher abundance of Sphyraenids and Haemulids in the northwest of Persian Gulf and they have higher distribution in these areas and they are considered as the main fishing grounds for these two species group to advise and lead the fishermen to have their more commercial fishing activities in two above-mentioned strata. One of the main reason of lower abundance of Haemulids and Sphyraenids in the strata A and B located in Khusetan province can be due to different reasons of overexploitation, use of non-standard fishing gears, higher catch per unit of effort (cpue) such as number of fishermen, number of boats and number of fishing gears esp. gillnets. King [11] believes that the overexploitation cause lack of having a safe and suitable ecosystem and consequently cause the obligatory migration of fishes to other areas and shifting to a new fishing grounds.

In years 2003 and 2008, the maximum CPUA and biomass of Haemulids were found in 30-50 m depth layer [4, 12] and in 2004 to 2007 was in 10-20 m depth layer with another finding for years 2009-2010 for 20-30 m [6]. In this research the highest amount of these two values were found in 10-20 m depth layer. Meanwhile an overall view shows no specified abundance pattern for different depth layers but it can be mentioned that the most abundant of Haemulids species group are found in depths of 10 to 30 m.

Excluding year 2009 that the maximum CUPA of Shyraenids with 128.5 kg/nm² was estimated for 10-20 m depth layer [6], for the other study years of 2003 to 2010 have been in depths of more than 20 m; and in all previous studies (excluding only two years), the most biomass was estimated in 30-50 m depth layer and it is in agreement with findings of this research showing the highest amount of biomass and CUPA for 30-50 m depth layer (Fig. 5) as the best recommended depths for commercial fishing.

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