8(2): 153-160 (2014) DOI: 10.3153/jfscom.201419

Journal of FisheriesSciences.com

E-ISSN 1307-234X

ORIGINAL ARTICLE/ORİJİNAL ÇALIŞMA

FULL PAPER TAM MAKALE

STOCK ASSESSMENT OF BARTAIL FLATHEAD (*Platycephalus indicus* Linnaeus, 1758) IN NORTHWEST OF PERSIAN GULF, IRAN

Seyed Ahmadreza Hashemi[1]*, Seyed Aminollah Taghavimotlagh[2], Arezoo Vahabnezhad[2]

[1]Department Fisheries, Gorgan University of Agricultural Sciences and Natural Resources, Iran

[2]Fisheries Research Organization, Tehran, Iran

[3]Fisheries Research Organization, Tehran, Iran

Received: 24.01.2013 / Accepted: 01.02.2014 / Published online: 05.03.2014

Abstract: *Platycephalus indicus* (bartail flathead) is dominant species of Platycephalidae family in Iran's southern waters, especially Khuzestan province and mainly is captured by bottom trawl and gillnet. The population biology of this species in the northwest waters of Persian Gulf (Iran) was investigated to derive information required for its management. Parameter values of the von Bertalanffy growth Function fit to size at length frequency data (males and females combined) were: k = 0.5year^{-1}, L_∞ = 62.16 cm, t_o = −0.26 years. The estimated valve of total mortality, natural mortality, fishing mortality and Exploitation ratio (males and females combined) was: Z= 2.59 year^{-1}, M= 0.77 year^{-1}, F= 1.82 year^{-1} and E= 0.70, respectively. Exploitation rate, U and Annual total stock at beginning of year were 0.64 and 1194 T respectively. Annual average standing stock, b= 420 T, MSY= 544 T and MCY=362 T were estimated respectively. Result in this study showed exploitation ratio the bartail flathead stock is lower MSY and upper MCY. The results of the study highlight critical resource base issues and provide the direction for the future management of this species in the northwest waters of Persian Gulf.

Keywords: Bartail flathead, Population biology, Assessment, Persian Gulf

* **Correspondence to:** **Seyed Ahmadreza HASHEMİ,** Department Fisheries, Gorgan University of Agricultural Sciences and Natural Resources, Iran, P.O Box 4919-43464.

Tel: +989177055568

E-mail: Seyedahmad83@yahoo.com

Journal abbreviation: **J FisheriesSciences.com**

Öz:

Kuzey Batı Basra Körfezinde *Platycephalus indicus* Linnaeus, 1758′ in stok değerlendirmesi

Platycephalus indicus türü dişi ve erkek bireylerinin boy frekans verilerinden hesaplanan Von Bertalanffy büyüme eşitliği parametreleri sırasıyla k = 0,5 yıl^{-1}, L_∞ = 62,16 cm (Çatal boy), t_o=−0.26 yıl olarak bulunmuştur. Toplam Ölüm Oranı Z=2,59 yıl^{-1}, Doğal Ölüm Oranı M=0,77 yıl^{-1}, Balıkçılıktan Kaynaklanan Ölüm F=1,82 yıl^{-1}, Sömürülme Oranı E=0,70, stoka katılan birey başına düşen bağıl ürün miktarı (Y/R)' = 0,019 ve biyomasa katılan birey başına düşen bağıl ürün miktarı (B'/R) = 0,10 olarak; yıllık ortalama kalıcı stok ile ilgili parametreler ise sırasıyla, b=40 ton, MSY=544 ton ve MCY=362 ton olarak hesaplanmıştır.

Anahtar Kelimeler: *Platycephalus indicus, Populasyon biyolojisi, Stok tahmini, Basra körfezi*

Introduction

About 25 species of Platycephalidae belonging to 10 genera have been identified around the world (Smith and Heemstra, 1986). *Platycephalus indicus* (Linnaeus, 1758) is a benthic fish found on sand or muddy bottom in vary shallow area of estuary and near shore to depth of 25 m. This species is dominant species of Platycephalidae family in Iran's southern waters, especially Khuzestan province and mainly is captured by bottom trawl and gillnet (Parsamanesh *et al.*, 2000). The amount of catch for this species in Northwest of Persian Gulf was recorded as 410 and 917 tons between 2000 and 2010 (Mohammadi *et al., 2011). P. indicus* (Bartail flathead) has played economically a great role in the Northwest of Persian Gulf fishery and also known as a target species for capture in Persian Gulf region countries. It has cost about 6 US $/kg. Studies on the age and growth of *P. indicus* have been reported earlier in Persian Gulf (Nasir, 2000) in Kuwait waters ,(Marais, 1984), in Hong Kong waters (Wu, 1984) and in coastal waters of west Kyushu, Japan (Masuda *et al*., 2000). This is the first study which was carried out on the growth of *P. indicus* from Northwest of Persian Gulf waters. The present study is based on twelve months data collection from Khuzestan Coastal Waters between January 2010 and December 2010. The objectives of this study is to provide information pertaining to biological reference points and other population dynamics information required for management of this species in northwest of Persian Gulf .

Materials and Methods

The length frequency data was regularly collected from Liphe-Busafe and Bahrekan landing between 29° 44'-07'N and 48° 45' - 49° 50' W (Figure 1). A total of 469 specimens of *P. indicus* were captured between Jan 2010- Dec 2010 using bottom trawl and gill net. Total length (±1.0 mm) and weight (±0.001 g wet weight) were measured and sex recorded for each fish in the laboratory.

Parameters of the length weight relationship were obtained by fitting the power function $W = a \times TL^b$ to length and weight data where: W is the total wet weight, a is constant determined empirically, TL is the total length (Biswas, 1993). In order to verify if calculated b was significantly different from 3, the t-test was employed (Zar, 1996).

The length frequency thus collected was grouped into 10 mm class intervals. The growth estimates were made by ELEFAN employing FiSAT II program developed by Gayanilo *et al* (2002*)*. The total mortality coefficient was estimated by length converted catch curve of Pauly (1980):

$$Ln\left(\frac{N}{\Delta t}\right) = a + b \times t$$

Where, b=Z (Total mortality rate) with the sign changed. The instantaneous rate of natural mortality (*M*) was estimated using the following multiple regression model (Pauly, 1980):

Log (M) = -0.0066-0.279 log ($L\infty$) +0.6543 log (K) + 0.4634 log (T)

The mean annual environment temperature (T) used in the estimation was 23° C (according to Iran Environment Public Authority). Fishing mortality rate (F) was calculated as (Sparre & Venema, 1998): F = Z - M.

The parameter t_0 of the growth equation was estimated using the following equation (Pauly, 1980):

Log (t_0) = -0.3922- 0.2752log (L_∞) -1.038log (K)

In order to facilitate the comparison of the results with those of other studies, growth perfor-

mance index (Φ) was estimated by the following equation (Pauly and Munro, 1984):

$$\Phi = \log (K) + 2\text{Log} (L_\infty)$$

The exploitation rate (U), was estimated by: $U=F (1-e^{-z})/z$ (Pauly, 1983). The annual total stock at the beginning of the year was estimated by: Y/U where Y is the annual average catch of the species (Nurulamin *et al*., 2000). Annual average standing stock was estimated by: b= Y/F (Nurulamin *et al*., 2000). MSY was estimated by the equation: MSY=0.5×Z×B (Nurulamin *et al*., 2002 and 2004).

Figure 1. Location of two landing sites of bartail flathead in Khuzestan Coastal Waters (Iran)

MCY was estimated by the equation: MCY=2/3 × MSY (Jenning *et al*., 2000). The relative yield per recruit (Y'/R) and relative biomass per recruit (B'/R) were conducted to obtain reference points and determined the exploitation status. The model of Pauly and Soriano (1986) was used to predict the relative yield per recruit (Y/R) as follows:

$$Y'/R = EUM/k [1–(3U/1+m) + (3U^2/1+2m) + (U^3/1+3m)]$$

where: $m = (1 – E)/ (M/k) = k/Z$, $U = 1 – (L_c/ L_\infty)$, $E = F/Z$ and $B'/R = (Y'/R)/F$ (Gayanilo *et al*., 2003). The relative biomass per recruit (B'/R) was estimated by: B'/R= (Y'/R)/F (Gayanilo *et al*., 2003).

Results and Discussion

Length frequency distribution

From the total number of caught fishes, 248 were males and the remaining were females (1: 0.92). According to Table 1, mean ±S.D length values for this species were 353±180 and maximum and minimum total length was 57 mm and 1886 mm respectively. Mean ± S.D weight values were 384±130g and maximum and minimum weight were 140 g and 600 g respectively (Table 1). Average length and weight in females were higher than in males.

The length-weight relationship were calculated as $W=0.000009\ TL^{2.95}$ ($n=248$, $R^2=0.83$) for males, $W=0.000005TL^{3.07}$ ($n=198$, $R^2= 0.82$) for females and $W=0.000004TL^{3.10}$ ($n=470$, $R^2 =0.86$) for total fishes (Fig 2a,b). Verifying calculated b with 3, using t-test there was significant difference between calculated b and 3 ($P<0.05$).

Growth Studies

The growth parameters of von Bertalanffy equation (males and females combined) were as, L_∞: 62.16 cm and K: 0.5 ($year^{-1}$) and t_0: -0.26 ($year^{-1}$). The 95% confidence regions around the von Bertalanffy growth function parameter estimates for both sexes suggesting that the growth

characteristics between males and females were not similar (Table 2, Fig 3a,b).

The value of growth performance index, Φ', estimated from the growth parameters was 1.19, which gave the Von Bertalanffy growth equation for this species as: Lt=62.16 (1-exp(-0.5 (t+0.26))). The Φ' for males and females studied fishes were found to be 0.91, 1.2 respectively (Table, 2).

Table 1. Average values (±S.D.) of size corresponding of bartail flathead in Khuzestan Coastal Waters.

Month	Number of captured	Male	Female	Mean W ±S.D (g)	Min – max	Mean TL ±S.D (mm)	Min – max
January-2010	114	82	32	356±72	255-550	362±72	113-1163
February	31	23	6	294±20	224-380	179±20	64-395
March	31	11	17	280±23	201-358	153±23	57-347
April	63	40	23	361±14	266-535	389±72	114-1170
May	33	19	11	317±59	237-550	254±20	57-8410
June	30	19	11	315±43	236-550	264±23	84-1490
July	15	1	13	446±72	317-590	677±72	207-1238
August	13	2	10	357±20	280-515	418±60	141-1097
September	22	6	3	290±23	140-372	185±23	58-344
October	33	6	23	389±72	277-555	525±72	70-1540
November	35	11	23	333±88	235-490	309±40	71-817
December-2010	55	24	28	298±53	285-600	539±63	146-1886
Average	-	-	-	**130±384**	**140-600**	**180±353**	**57-1886**

Table 2. Estimate growth, mortality and yield of bartail flathead in Khuzestan Coastal Waters.

species	L_∞	K	t_0	Φ'	M	F present	Z	E present	Y'/R	B'/R
Female	64.14	0.36	0.37-	0.91	0.7	1.17	1.86	0.63	0.017	**0.1**
Male	59	0.52	-0.26	1.2	0.91	1.85	2.64	0.72	0.019	**0.1**
Both	**62.16**	**0.5**	**-0.26**	**1.19**	**0.77**	**1.82**	**2.59**	**0.70**	**0.019**	**0.1**

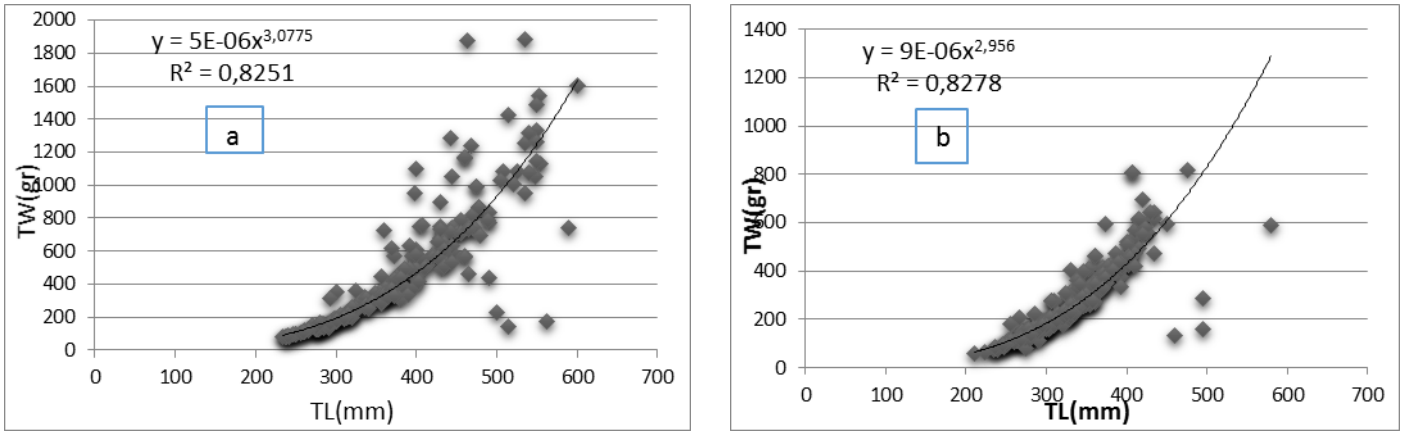

Figure 2. The length-weight relationship curve for female (a) and male (b) fish of bartail flathead in Khuzestan Coastal Waters .

Mortality estimate, relatively yield, relative biomass per recruit:

The annual instantaneous rates of fishing induced mortality (F), natural mortality (M) and total mortality (Z) are given in Table 2.

The total mortality coefficient (Z) was calculated as 2.59 year^{-1} by Pauly's length converted catch curve method (Fig 4). The annual mortality coefficient (M) was estimated as 0.77 year^{-1} by Pauly's method. The fishing mortality (F), thus obtaiend was 1.82 year^{-1}. the exploration rate was calculated as 0.70.

Fishery Assessment

The relative yield-per-recruit (Y'/R) and biomass-per-recruit (B'/R) were determined as a function of L_c/L_∞ and M/K. L_c estimated at 17.5 cm and and L_c/ L_∞ and M/K were 0.27 and 1.54 respectively. Relative yield per recruitment (Y'/R) calculated as 0.019 and relative biomass per recruitment, (B'/R) calculated as 0.10 for bartail flathead using both sex data (Fig.5). The Y'/R and B'/R for males and females is shown in Table 2. The size at which yield per recruit would be maximized (L_{max} = 29.1 cm) approximated the mean size of fish that were 0.99 years old and was considerably greater than the mean size at first capture.

Exploitation rate and annual total stock at beginning of year were calculated as 0.64 and 1194 respectively. T and Annual average standing stock, b: 420 T, MSY= 544 T and MCY=362 T were estimated respectively.

Perhaps, the earliest report on the growth study of *P. indicus* from the Persian Gulf is by Bawazeer (1989). He employed ELEFAN method and estimated the infinity length and K as 48.90 cm and 0.34 y^{-1} in Kuwait waters respectively. In the present study L_∞ and K was higher infinity length and growth coefficient which was reported by Bawazeer (1989). There are no available growth data from other studies for *P. indicus* in the studied area. The ages of flathead (*Platycephalus indicus*; Japanese name: Magochi) were (fitted to the von Bertalanffy growth equations) L_t=430.3 (1−exp(−0.667 (t+0.093))) for males, and L_t=551.5 (1−exp(−0.478 (t+0.125))) for females(Masuda *et al*., 2000). Tirasin (1993), indicated that growth parameters differed depending on species, population, age groups in the same population and even sexes. So the differences seen in different locations may be accepted as normal.

Maximum age (T_{max}) for male and female was found to be as 8.335 and 5.76 year respectively. Our results indicated that males have revealed higher growth condition and have short lifetime than female. Absorbed energy is used for body maintenance, activity, reproduction and less than 1/3 for growth. In difference species growth ratio and life cycle is different (King, 2007).

Bawazeer (1989) reported Age at zero length (t_0) of this species as calculated as -0.64 year which less than our result (-0.26). Negative t_0 values indicated juveniles grew more quickly than the predicted growth curve for adults (King, 2007). Values of Φ' for *P. indicus* has 2.91 in Kuwait waters (Bawazeer, 1989) which compere with present study show the high growth performance value.

The b values in the weight-length relationship were measured close to 3 for *p. indicus* fishes that indicating that weight increased isometric with length (King, 2007). Naik *et al* (1990) have estimated the value of b for Indian waters (the Netravati Gurpur Estuary, Mangalore) 2.99 and 2.91 for male and female respectively. Bawazeer (1989) reported the b value of weight-length was 3.32 for total fish of this species in Kuwait waters. The variation of b in the different regions could be by seasonal fluctuations in environmental parameters, physiological conditions of the fish at the time of collection, sex, gonad development and nutritive conditions in the environment of fish (Biswas, 1993).

The result of exploration ratio revealed that there is Pressure on stock of this species in northwest waters of Persian Gulf side. According to Gulland (1971, 1979), the yield is optimized when F=M. These results are important for fisheries management authorities as they suggest that the resource is heavily overexploited and in addition to a revision of mesh size regulations, a substantial reduction in fishing effort would also be required if management objectives are to be achieved (Hashemi and Kashi, 2012).

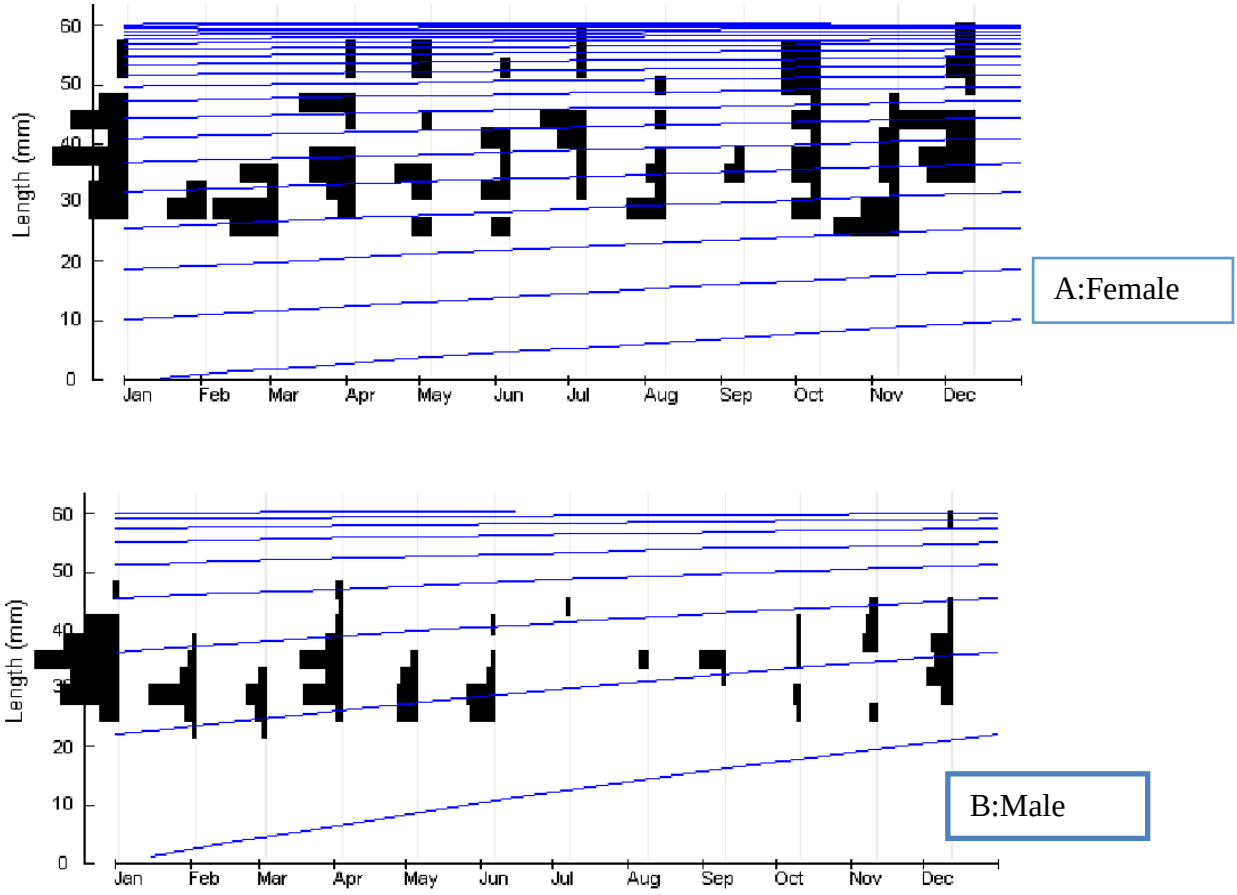

Figure 3. Growth curve of bartail flathead by ELEFAN I estimated on the restructured length-frequency diagram ($L\infty$=64.14 cm and K=0.36 yr^{-1} (A: Female) and $L\infty$=59 cm and K=0.52 yr^{-1} (B: Male)).

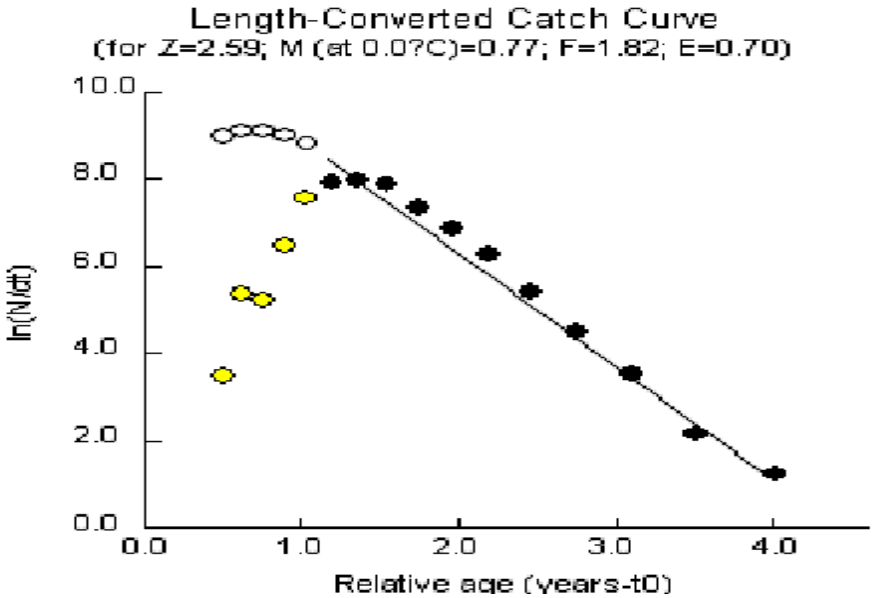

Figure 4. FiSAT graphic output of the catch curve analysis for bartail flathead.

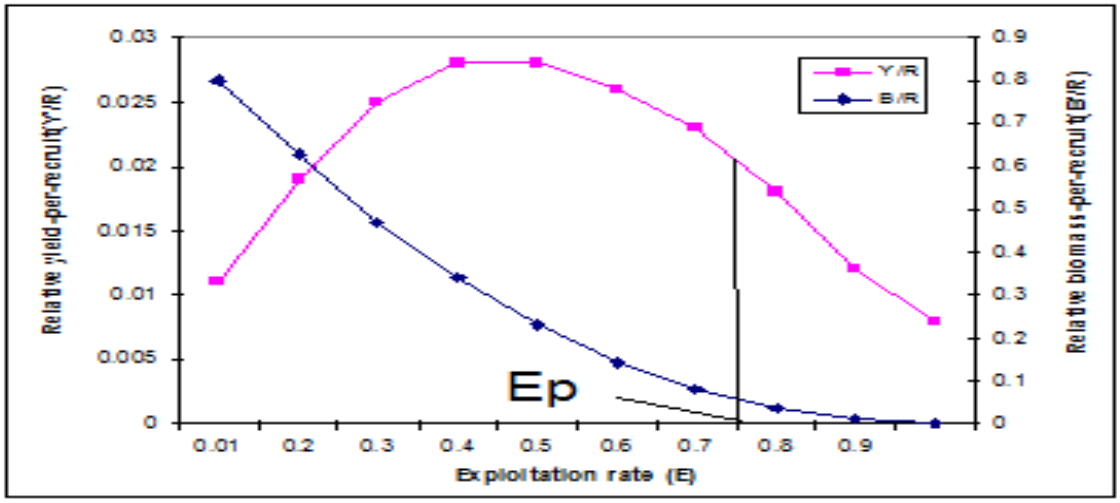

Figure 5. Relative yield and biomass per recruit curves (descending lines) for bartail flathead showing the existing exploitation rate (*E*p).

Result in this study showed exploitation ratio the bartail flathead stock is lower MSY and higher MCY. Increase in the size at first capture would be associated with an increase in yield at the existing fishing mortality rate. However, the existing fishing mortality rate (1.82 year^{-1}) was greater than that which would maximize yield per recruit, clearly demonstrate that growth over fishing is occurring for this species. The relative biomass per recruit at the estimated fishing mortality rate was particularly low at less than 15% of the unexploited level. If the critical spawning stock biomass is between 20 and 50% of the unexploited level, as suggested by King (2007), recruitment over fishing is also likely to be occurring for *P. indicus*. In conclusion, any increase in the existing fishing level/exploitation would most likely result in a reduction in the yield per recruit and thereby hamper the optimum level. It is necessary to immediately impose fishing regulation on the stock.

Acknowledgements

The present study was carried out within the framework of the research project "Determination of the ecological relationship among economic fishes in the coastal area of the Persian Gulf" funded by Iranian Fisheries Research Organization (IFRO) and Iran National Science Foundation. Special thanks for presentation of material and spiritual supportive aids and services for this national project and all colleagues that helped during field work.

References

Bawazeer, A.S., (1989). The stock and fishery biology of Indian flathead (wahar) Platycepahlus indicus (Linnaeus), family Platycephalidae in Kuwait waters, *Kuwait Bullten Marine Science*, **10**: 169-178.

Biswas, S.P., (1993). Manuel of methods in fish biology, fish biology & Ecology laboratory, Dibruyarh University, Dibrugarh. pp157.

Gayanilo, F.C., Soriano, P., Pauly, D., (1996). The FAO-ICLARM Stock Assessment Tools (FiSAT) Users guide. FAO Computerised In formation Series (Fisheries), No. 8. Rome, FAO, 266p.

Gayanilo, F. C., Pauly, D., Parre, P., (2002). The FAO-ICLARM Stock assessment Tool (FiSAT) users guide. Rome. ITALY. pp 230.

Gulland, J.A., (1971). The fish resources of the ocean.west byfleet survey. Fishing News books Ltd., for FAO:255 p.Revised edition of FAO Fish.Tech. pap. (97):425p.

Gulland, J.A., (1979). Report of FAO/IOP workshop on the fishery resources of the western Indian Ocean South of the Equator. Rome, FAO, IOFC/DEV/79/45: 1-37.

Jenning, S. Kasier, M., Reynold, J., (2000). Marine Fisheries Ecology. Black well Science. pp 391.

Hashemi, S., Kashi, M., (2012). Population Biology and Assessment of Southern Meagre *(Argyrosomus hololepidotus)* in Coastal Waters (Persian Gulf), *American-Eurasian Journal of Agricultural & Environmental Sciences*, **12**(10): 1329-1334.

King, M., (2007). Fisheries biology & assessment and management. Fishing news press, pp 340.

Martine, W.R., (1949). The mechanics of environmental control of body form in fishes, *University Toronto stud. Bio I.*, **58**:1-91.

Masuda, Y., Ozawa, T., Onoue, O., Hamada. T., (2000). Age and growth of the Flathead, *Platycephalus indicus*, from the coastal waters of west Kyushu, Japan, *Fisheries Research*, **46**: 113-121.

doi: 10.1016/S0165-7836(00)00138-7

Mohammadi, G.H., Gholami R., Alvi, A., Moghamesi, S., Ofipor, M., (2011).Study of some biological characteristics of economical fishes (Tiger tooth Croacher, Silver pomfert, Yellow fin sea bream, Hilsa shad, Indo-pacific king mackerel, Narrow-barred Spanish,…) in the coastal waters of the Persian Gulf South of Iran aquaculture fishery research center, Ahwaz. Iran. p. 124.

Naik, S.K., Shanbhogue, S.L., Jayabalan, N., Krishna-Bhat, C., (1990). Observations on Platycephalus indicus from the Netravati Gurpur Estuary, Mangalore, *Environment and Ecology*, **8**(4): 1311-1313.

Nasir, N.A., (2000). The food and feeding relationships of the fish communities in the inshore waters of Khor Al-Zubair, Northwest Arabian Gulf, *Cybium*, **24**(1): 89-99.

Nurulamin, S.M., Rahman, M.A., Hadler, G.C., Mazid, M.A., Milton, D.A, Blaber S.J.M., (2002). Population Dynamics and Stock assessment of Hilsa shad, Tenualosa ilisha in Bangladesh, *Asia Fisheris Science*, **15**: 123-128.

Nurulamin, S.M., Rahman, M.A., Hadler, G.C., Mazid, M.A., Milton, D.A., Blaber, S.J.M., (2004). Stock assessment and Management of Tenualosa ilisha in Bangladesh. *Asia Fisheris Science*, **17**: 50-59.

Parsamansh, A. Shalbaf, M. Eskandari, Gh. Kash, M., (2000).Survey fish stock assessment in Khuzestan province, South of Iran aquaculture fishery research center, Ahwaz. Iran. p. 69.

Pauly, D., (1980). On the inter-relationships between natural mortality, growth performance and mean environmental temperature in 175 fish stock. *Journal du Conseil*, **39**(3): 175-192.

doi: 10.1093/icesjms/39.2.175

Pauly, D., (1983). Length-converted catch curves: a powerful tool for fisheries research in the tropics (part 1), *Fishbullten*, **1**(2): 9-13.

Pauly, D., Munro, J.L., (1984). Once more, on the composition of growth in fish and in vertebrates, *Fishbullten*, **2**(1): 21-25.

Pauly, D., Soriano, M.L., (1986). Some practical extensions to Beverton and Holt's relative-ield-per-recruit model. In The First Asian Fisheries Forum, pp. 491e496. Ed. by J. L. Maclean, L. B. Dizon, and L. V. Hosillo. Asian Fisheries Society, Manila. 727 pp.

Smith, M., Heemstra, P.C., (1986). Smith's Sea Fishes. Springer Velage, Berlin Heidelberg, New York, London, Paris, Tokyo, pp: 1047.

doi: 10.1007/978-3-642-82858-4

Sparre, P., Venema, S.C., (1998). Introduction to tropical fish stock assessment, FAO Fisheries technical paper, Roma, 450 pp.

Tirasin, M., (1993). The studies on growth parameters of fish population (in Turkish), The Scientific and Technical Research Council of Turkey, *Journal of Zoology, C.* **29**: 29-82.

Wu, R.S., (1984). The feeding habits of seven demersal fish species in a subtropical estuary, *Asian Marine Biology*, **1**: 17-26.

Zar, J.H., (1996). Biostatistical analysis. 3rd edition. Prentice-Hall Inc., New Jersey, USA. 662P.