Research Paper

Study Demersal Fish Catch in Waters of the South of Iran (the Persian Gulf and the Oman Sea) with Emphasis on Waters of Sistan and Baluchistan Province

S. A. R. Hashemi[1]*, M. Doustdar[2]

1- Assistant Prof, Offshore Fisheries Research Center, Iranian Fisheries Science Research Institute, Agricultural Research, Education and Extension Organization, Chabahar, Iran.
2- Assistant Prof, Iranian Fisheries Science Research Institute, Agricultural Research, Education and Extension Organization, Tehran, Iran.   *(Corresponding author: Seyedahmad91@gmail.com)

Introduction

One of the major cases in the catch field is the amount of overfishing and the percentage of different places and species. Generally, global statistics show that the highest percentage of overfishing is in the FAO 47th Area (the Southeast of the Atlantic Ocean) and a group of benthic fish although the rate varies in different places and species. The United Nations' goal of sustainable development in Oceans is to reach Zero-overfishing by 2030. To do so, the fishing effort to be within the scope of sustainable biological exploitation of aquatic reserves (FAO, 2018).

The first estimations of Demersal fish in the Persian Gulf and the Oman Sea were done under the title UNDP/FAO in 1976-1979 (Sivasubramaniam, 1981). Afterward, Demersal stocks in iranian waters of the Oman Sea (Sistan and Baluchistan province) were estimated in 1998 (Mohammadkhani *et al.*, 2001) then Demersal fish monitored in 2001 by Swept Area Method (Daryanabard *et al.,* 2004) and waters of Hormozgan province in regions of Sirik to Jask scrutinized (Dehghani et al., 2004). Between 2004 -2015, the amount of biomass and the average of benthic reserves catch per unit area investigated by Swept Area Method in the Persian Gulf and the Sea of Oman (Valinassab*, et al.,* 2015). Also, Abbaspour Naderi (2017) studied a trend of 10-year-changes in the Oman Sea aquatic benthos and prediction of their exploitation pattern. The purpose of the study is to estimate the amount of overfishing and trend of their changes during the last 2 decades in the area of the study.

Material & Methods

Model of Catch-MSY Maximum Sustainable Yield (CMSY) Graham-Schiffer's surplus production model is a simple method having wide applications for biomass estimations, and it is used in this approach and its formula is as follows: $B_{y+1} = B_y + rB_y (1- B_y/k) e^{s1} - C_t e^{s2}$ that in this regard, **-B_y:** biomass in time series, y: year, **-r:** (instantaneous) future growth rate, **-K:** transport capacity that is equal to the original biomass or intact biomass, and at the beginning of modeling is equal to between 1-2 times maximum catch as minimum transport capacity and 4 -12 times maximum catch as the maximum transport capacity as the model input, -Cy is catch in time series and **y** year (Froese *et al.,* 2016). In this method, the values of future growth rate and transport capacity are calculated by the formula of depletion (D) and stock saturation (S): $D = 1 - S = (1-B_y/K_y)$.

The rate of fishing mortality maximum sustainable yield (F_{msy}) is calculated by the formula: $F_{msy} = r/2$ and the maximum sustainable yield calculated by the formula: MSY $= rk/4$ as well as biomass of the maximum sustainable yield calculated by the formula: $B_{msy} = K/2$. Fishing status is usually assessed based on the value index of biomass available to the biomass of the maximum sustainable Yield (B/B_{MSY}) (Zhou *et al.,* 2017), the value of B/B_{msy} is less and is equal to 1, which means overfishing or over-optimal fishing status. The values less than 0.2 means extremely decreasing status in reserves (collapsed) (Anderson *et al.,* 2012; Branch *et al.,* 2011). The data analysis was done using R Studio (1.1.446) and SPSS (21) Software and obtained by a significance level of 0.05 and a confidence level of about 95%.

Results & Discussion

The ratio of stocks with unsustainable biological levels (over-exploited reserves) to sustainable biological levels (less exploited and fully exploited reserves), is one of the most important issues in the discussion of sustainable exploitation and sustainable development of the sea and waters of the south of Iran, and especially in the case of demersal fish, it seems that this ratio (the ratio of unsustainable biological reserves) has changed significantly and reached from about 16% in 2008 to more than 45% in 2018. In the case of benthos in the waters of Sistan and Baluchestan province, this increase is more extreme. Reserves with unsustainable biological level were about 10% in 1974 and reached about 33% in 2016.

Stocks with sustainable biological level were 90% in 1974 and reached about 67% in 2016. The highest proportions of unsustainable biological stocks are found in the Mediterranean Sea, the Black Sea, the southeast of the Pacific Ocean, and the southwest of the Atlantic Ocean (FAO, 2018).

Fishing status is usually assessed based on the value index of biomass available to the biomass of maximum sustainable yield (B/ B_{msy}) and divided into three general sections: A value of B/B_{msy} is greater and equal to 1.5, which means less than optimal fishing status, between 1.5-0.5, means full

exploitation status and between 0.5-0.2, means more than optimal fishing status; and values less than 0.2, means extremely decreasing status in reserves (Anderson *et al.,* 2012; Branch *et al.,* 2011). There are different divisions to study the amount of overfishing in the world. According to the division of Pauly and Lam (2016), five sections of this case with different colors (blue=minimum, green=low, yellow= average, orange=high, red=maximum) are recorded (Table 1).

Table 1: Distinct Classification of Overfishing Percentage Based on Numbers and Weights (Pauly & Lam, 2016).

Most	High	Average	Low	Minimum	Index
100-59	59-51	51-46	46-34	34-0	Percentage of Overfishing (Based on Numbers)
100-47	47-31	31-18	18-10	10-0	Percentage of Overfishing (Based on Weights)

Considering the amount of overfishing (weights) total fishing in the south of Iran and Sistan and Baluchistan province, there has had an average to high status (orange to red) in the amount of overfishing. Further, it is seen for the amount of overfishing (weights), demersal fishing in the south of Iran and Sistan it is seen for the amount of overfishing (weights), demersal fishing in waters of the south of Iran, and waters of Sistan and Baluchistan province, with high status (orange) and most status (red) respectively. The increase in the amount of overfishing has been worrying in recent years, particularly in the case of demersal. Valinassab, *et al.* (2010) estimated commercial demersal stocks in waters of the Persian Gulf and the Oman Sea by swept area method for Khuzestan, Bushehr, Hormozgan, and Sistan and Baluchistan provinces, which are 9890, 29122, 22084, and 12573 tons respectively (total more than 73.000 tons) and reported the commercial demersal stocks in the Persian Gulf more than two times the commercial demersal stocks in the Oman Sea.

(Instantaneous) the growth rate is one of the important parameters in fisheries management and modeling. It has become a determining factor in population growth, fishing pressure sustainability, recovery and regeneration of depleted populations (Zhou *et al.,* 2016). Classification of species based on future growth rate is as follows: values of Intrinsic growth rate 0.5-1-6 indicate species with high flexibility, values of 1-2 indicate species with average flexibility, values of 0.5-0.05 indicate species with low flexibility, and those of less than 0.1-0.015 indicate a species with low flexibility (Froese *et al.,* 2016; Martell & Froese., 2013). There was a significant relationship between r parameter and other parameters of life history, especially natural mortality (M) and this relationship was reported in the case of bony fish r =1.73 M and cartilaginous fish r=0.76 M (Zhou *et al.,* 2016). In the studies of Froese and Pauly (2015), the value of the parameter is equal to approximately 2, the rate of fishing mortality maximum sustainable yield is 2, natural mortality (M) is 3, Van Bertalanfi's curve growth coefficient (K) obtained through 3 divided by regeneration ($_{Tgen}$) and 9 divided by the maximum lifetime (T_{max}) in the formula: $r \approx 2F_{msy} \approx 2$ (M$\approx$3 K$\approx$ 3 /$_{Tgen}\approx$ 9/T_{max}).

Conclusion

Amount of overfishing (weights) total fishing in the south of Iran and Sistan and Baluchistan province has had an increasing trend during the last 2 decades and showed an average to high status (orange to red). Further, it is seen for the amount of overfishing (weights), Demersal fishing in the south of Iran and Sistan and Baluchistan province, with high status (orange) and most status (red) respectively. Considering the mentioned status and conditions, it seems that the amount of demersal fishing is not in a fit state, so measures should be taken to decrease in fishing the aquatic species.

Keywords: *Benthos, CMSY Overfishing*, *Persian Gulf & Oman Sea,* Ss

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