Iran. J. Ichthyol. (2022) 9(1): 43-53
P-ISSN: 2383-1561; E-ISSN: 2383-0964

ORIGINAL ARTICLE

Growth and mortality of new exploited stock of the blackmouth croaker, *Atrobucca nibe* (Jordan & Thompson, 1911) from the Oman Sea

Ali SALARPOURI*[1], Siamak BEHZADI[1], Tooraj VALINASSAB[2], Farhad KAYMARAM[2], Arezu VAHABNEZHAD[2], Mohammad MOMENI[1]

[1]Persian Gulf and Oman Sea Ecological Research Institute, Iranian Fisheries Science Research Institute (IFSRI), Agricultural Research, Education and Extension Organization (AREEO), Bandar Abbas, Iran.
[2]Iranian Fisheries Science Research Institute (IFSRI), Agricultural Research, Education and Extension Organization (AREEO), Tehran, Iran.

Correspondence
salarpouri@pgoseri.ac.ir

Article history:
Received 29 November 2021
Accepted 10 May 2022
Online 15 May 2022

Abstract

Some population dynamic parameters of Blackmouth croaker, *Atrobucca nibe* (Jordan & Thompson, 1911), were investigated monthly from September 2013 to August 2014 in the Northwest of the Oman Sea. A total of 1685 length-frequency data were collected by the midwater trawl method. The average total length was 28.7±5.9cm; ranging from 18.0 to 47.5 cm. The most frequent length class was calculated 24-26cm. The length-weight relationship was found as $W= 0.00895L^{3.0256}$, showing an isometric growth. Growth parameters of $L\infty$ and K were estimated at 50 cm and 0.20 yr^{-1}, respectively. Parameters of t_0, T_{max} and Ø were calculated -0.70 year, 14 years and 2.69, respectively. This species has two recruitment periods, a major peak occurred at 23.14%. Three cohorts were distinguished annually with a mean length of 24.16, 34.41 and 41.48 cm. Total, natural and fishing mortality rates were calculated 0.54, 0.46 and 0.08 y^{-1} respectively. Due to the calculated exploitation rate (0.14) in the period of study, the stock of *A. nibe* in the Oman Sea was not under the pressure. The probability of capture (L50) was determined 33cm in total length, was less than the reported L_{M50} (35 cm) of *A. nibe* in the Oman Sea, and it was found that the used gear mesh size was not suitable for *A. nibe* fishery.

Keywords: *Atrobucca nibe*, Growth parameters, Mortality rates, Exploitation rate, Oman Sea.

INTRODUCTION

Croakers (Family: Sciaenidae), with 275 species, are an important group of tropical and temperate marine fishes distributed all around the world (Johnson et al. 1998), and 19 species occur in the Persian Gulf and Oman Sea (Eagderi et al. 2019). The Blackmouth croaker, *Atrobucca nibe*, a member of the Sciaenidae family, is a demersal species that lives in coastal waters from 45 to >200m depth (Sasaki 2001), on seaweed and gravel beds (Yamada et al. 1995). The Blackmouth croaker is a small, moderately deep-bodied species; its body cavity, gill chambers and linings of the mouth are black, and the lateral line scales reach the tip of the caudal fin (Fischer & Bianchi 1984).

The distribution of *A. nibe* has been reported from the Oman Sea, the western Indian Ocean, India, China, Japan, the Philippines, Mozambique, and South Africa. This species is also found from southern parts of Indonesia to the northern areas of Australia (Heemstra 1986; Van der Elst & Borchert 1993). The Blackmouth croaker was distinguished as an important bycatch of Myctophids fishery trawlers fleet and was introduced as a new commercial fish resource in the Northwest of the Oman Sea (Valinassab & Salarpouri 2017). The fisheries operation for Myctophids started with 18 fleets in 2009 and raised to 92 fleets in 2017 (Salarpouri 2020). A new resource of Blackmouth Croaker was found as a new target for the commercial fishery (Valinassab & Salarpouri 2017). A yearly average of 1000 tonnes of Blackmouth croaker were caught as bycatch of Myctophids, with a maximum of 3270 tonnes in 2009. The spawning season of *A. nibe* in the Oman Sea was in June and October, but spawning might occur in all year long; this species is an abstemious feeder, which mainly feeds on lanternfish (65%) (Salarpouri et al. 2021). Blackmouth croaker is one of the most important bycatches of lanternfishes midwater trawler fleet, and the total catch of Blackmouth croaker raised

DOI: https://doi.org/10.22034/iji.v9i1.880

to 1177 tonnes from the Northwest Oman Sea (Zanganeh 2020). There are very few studies on these species, however, studied reproduction biology and feeding habits biology of *A. nibe* from the Oman Sea were studied by Salarpouri et al. (2021) and Valinassab et al. (2006) and Mosafer et al. (2017) studied on population genetic of *A. nibe* from the Oman Sea. Fennessy (2000) estimated the growth parameters of *A. nibe* from South Africa, Murty (1980) studied reproduction season and length-weight relationship from India, and some evidence on overfishing and stock reduction of *A. nibe* from Hong Kong waters were reported by Kawasaki (1987) and Pitcher et al. (1998). Yamada and Tokimura (1994) declared *A. nibe* an endangered and vulnerable species from the South China Sea and the Yellow Sea. Little is known about the Blackmouth croaker, therefore this is the first study on population dynamic aspects of *A. nibe* in the northwest of the Oman Sea

MATERIAL AND METHODS

Study area: Oman Sea, which divides Iran and the Arabian Peninsula and forms the link between the Persian Gulf and the Arabian Sea. It is 560 km long and at its widest point 320 km. From a hydrological point of view, it is just a northern protuberance on the Indian Ocean. The Oman Sea is relatively rich in fisheries resources, with considerable quantities of mesopelagic fish (Myctophids) occurring on and seaward the continental slope and through the deep zone of the Oman Sea waters (Valinassab, 2005). The main fishing areas for *A. nibe* in the Oman Sea were located northwest of Jask region (Fig. 1).

Sampling method: R/V Ferdows1 was used for this research; this vessel is a 673 GRT stern trawler with 45.4 m length. The vessel was equipped with a midwater trawl with a small codend mesh size of 10 mm. Fishing operations were performed from 150 m up to 400 m depths. The towing speed ranged 2.5-3.5 knot, and towing time were regulated for 2 hours. The samples were obtained onboard at monthly intervals. A total of 1685 individual *A. nibe* were captured using simple random sampling from 24 trawl hauling points

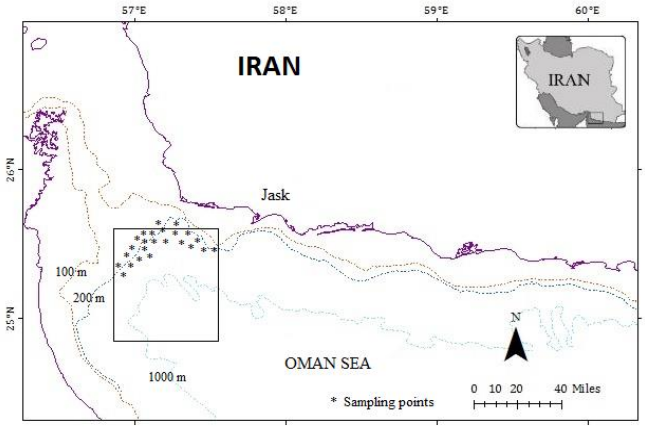

Fig.1. Map of the study area, location of the sampling sites of *Atrobucca nibe*.

in the northwest of the Oman Sea from September 2013 to August 2014. The total length of each fish was taken from the tip of the upper jaw to the tip of the caudal fin. All individuals were collected to measure length, and the corresponding number of length-weight was recorded 640 individuals.

Data analysis: Total length (TL) to the nearest "cm" and total weight (TW) to the nearest "g" were recorded for each fish. The chosen sample size provided a reasonable database for analysis (Gulland and Rosenberg, 1992). The length-weight relationship was described using the relationship $W = aL^b$ (Le Cren 1951), where W is the weight (g), L is length (cm), and b are regression coefficients; growth type (isometric and allometric) was determined by Student's t-test (Pauly & Munro 1984). The length–frequency data were pooled into groups with 2 cm length intervals using Sturges (1926) method. The von Bertalanffy growth equation was defined as follows:

$$L_t = L\infty\ [1-\exp\ (-k\ (t- t_0))]$$

Where Lt is the total length (cm) of a fish at age t, L∞ is the asymptotic length (cm), K is the growth coefficient (yr^{-1}), and t_0 is age (year) when L=0 (Sparre & Venema 1998), t_0 was calculated from Pauly (1983) empirical function:

$$\text{Log10}\ (-t_0) = -0.3922 - 0.2752\ \text{Log10}\ (L\infty) - 1.038\text{Log10}\ (K)$$

The monthly length–frequency distributions were analyzed using the appropriate routines and subroutines of the FiSAT program (Gayanilo et al.

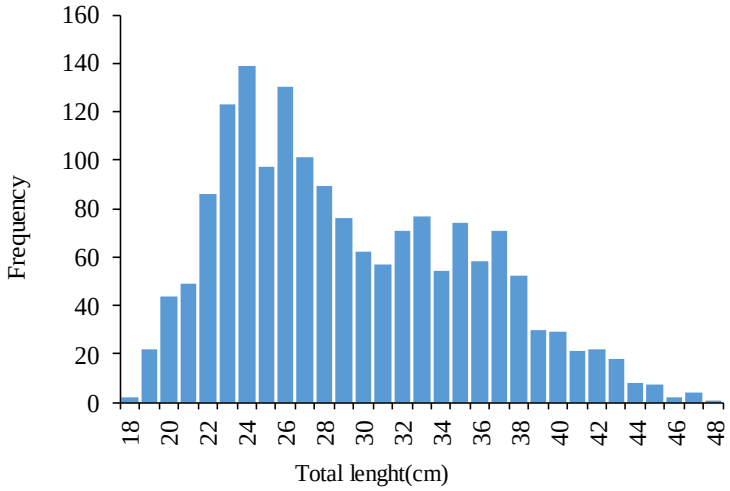

Fig.2. Length-frequency distribution for *A. nibe*

2003). Several techniques are available for estimating L∞ independently. Alternatively, an approximate L∞ may be based on the largest fish in catch samples. As the largest fish found (L_{max}) is often about 95% of the estimated L∞, then $L\infty=L_{max}/0.95$ (King 2013). The estimate (K) was ascertained by the equation of (Pauly 1989). The resultant growth estimates were then used as seed values in the ELEFAN I program (Pauly et al. 1981) for estimating the best combination of L∞ and K. The longevity of the *A. nibe* were calculated as $t_{max}=3/k + t_0$ (Pauly, 1983). Bhattacharya's method was used to identify the mean size of different cohorts, in this study the cohorts were identified seasonally (Pauly & Caddy 1985; Sparre & Venema, 1998). Bhattacharya's (1967) method was proposed by its author as a graphical method for the separation of normally distributed groups from a mixture of normal distributions. The instantaneous rate of total mortality (Z) was estimated by the length converted catch curve method. The ascending left arm of the length converted catch curve incorporated in the FiSAT II tool was used to estimate the length probability at first capture (Lc50) (Pauly 1983; Gayanilo et al. 2003). Natural mortality, fishing mortality, and exploitation rates were all calculated as given by FiSAT (Pauly 1983; Gayanilo et al. 2003). For the calculation of the natural mortality, the mean environmental temperature, in this case, 20 ºC (Ebrahimi et al. 2012) was incorporated into the Pauly (1980) formula as found in FiSAT. Pauly's empirical formula was used to determine natural mortality:

$$\text{Log10 (M)} = -0.0066 - 0.2791 \text{ Log10 (L}\infty\text{)} + 0.6543 \text{ Log10 (K)} + 0.4634 \text{ Log10 (T)}$$

The exploitation rate (E) was estimated using the formula E = F/Z.

RESULTS

The total length ranged from 18.0 to 47.5cm, with mean±SD 28.7±5.9cm. The total weight ranged from 52.5 to 865.5g, with mean±SD 308.7±170g. The length-frequency class is given in Figure 2; the most frequent length class was calculated 24-26cm. The length-weight relationship was estimated for 640 specimens (both sexes) as $W= 0.00895L^{3.0256}$ (Fig. 3). The slope (b) was close to the theoretical value of 3 for both sexes, the t-test indicated no significant differences relative to the value of 3 for combined sexes ($P>0.05$). Thus, the growth type for both sexes was isometric. The growth parameters of *A. nibe* are estimated from monthly length frequency. The asymptotic length, $L\infty$ was 50cm; growth rate, K was 0.20 per year, t_0 was -0.70; without respect to seasonal oscillation. The above estimates of growth parameters were obtained from length-frequency analysis using the ELEFAN I program incorporated in FiSAT II, and the growth curve obtained is shown in Figure 4. The potential longevity of *A. nibe* was estimated at 14 years. This represents the maximum life span of *A. nibe* in its natural environment. The growth performance index, Ø was 2.56.

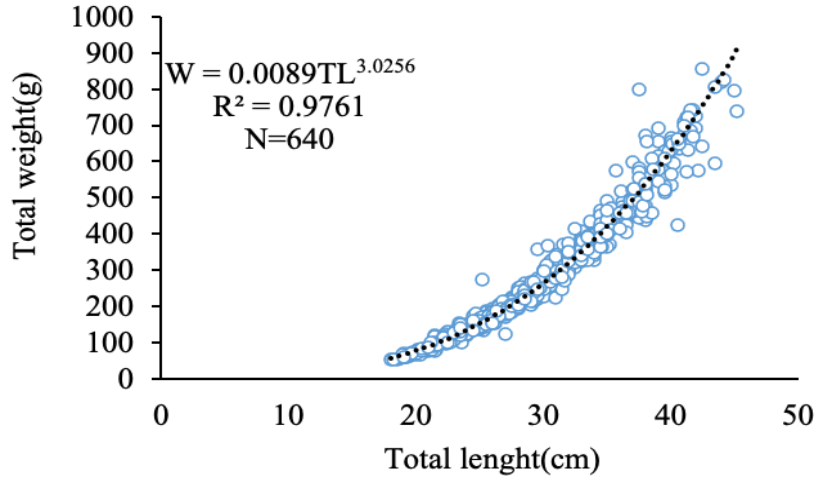

Fig.3. Length-frequency distribution for *A. nibe*

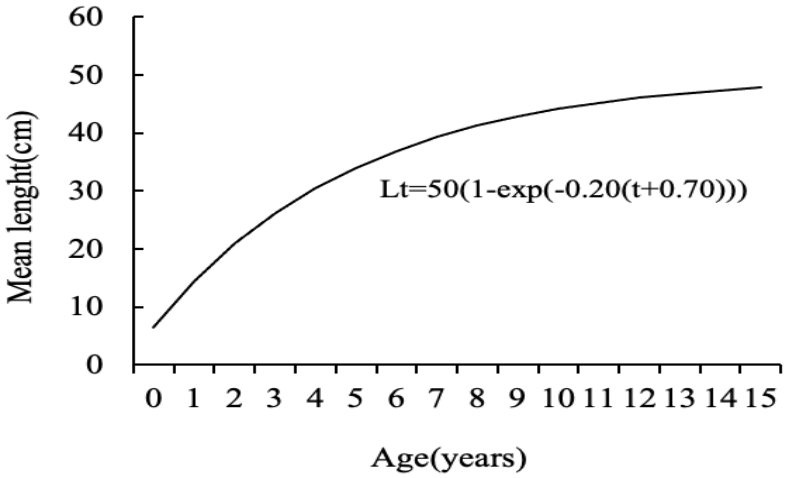

Fig.4. Length-weight relationship curve for *A. nibe*.

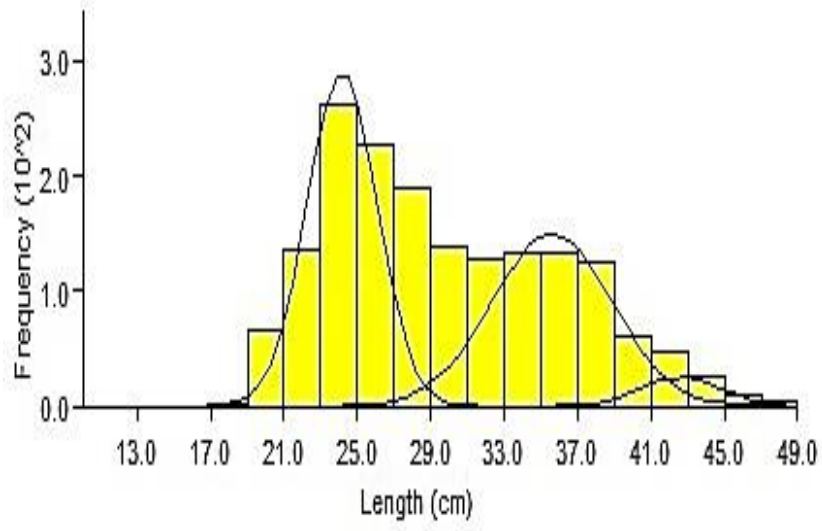

Fig.5. The growth curve fitted from mean lengths in the length frequency distributions for *A. nibe* from the northwest Oman Sea.

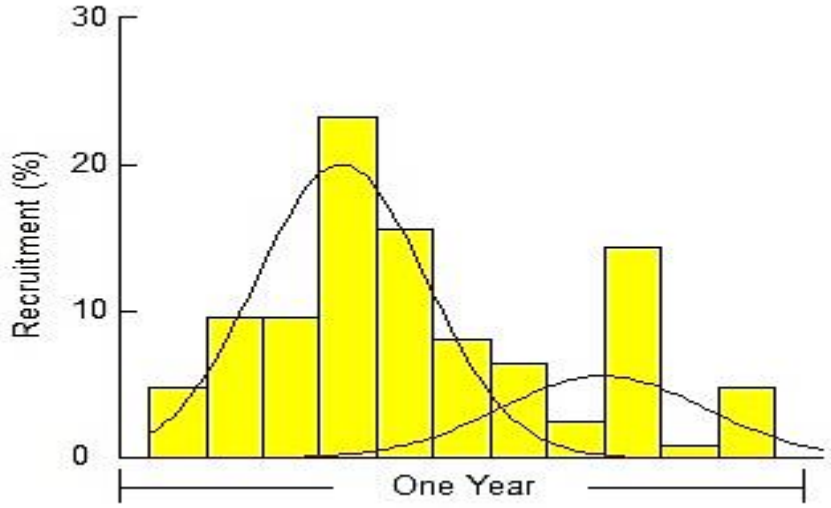

Fig.6. Recruitment pattern of *A. nibe*, indicating double peaks per year in the NW Oman Sea.

Table 1. Number of cohorts with mean length and relative age of *A. nibe* identified by Bhattacharya method.

Season	Group	Mean lenght (cm)	SD	Relative age (year)	Population size (n)	Separation index
Summer	1	23.84	1.84	2.54	281.40	n.a
	2	29.23	2.97	3.69	235.43	2.04
	3	37.77	2.24	6.34	87.90	2.21
Autumn	1	24.59	2.17	2.68	275.93	n.a
	2	31.00	3.08	4.14	79.43	2.09
	3	41.38	2.19	8.09	5.75	2.30
Winter	1	23.87	2.05	2.54	135.60	n.a
	2	35.80	3.10	5.59	359.49	2.52
	3	43.30	1.63	9.34	46.22	2.14
Spring	1	27.11	1.45	3.21	89.75	n.a
	2	34.41	3.17	5.13	93.90	2.19
	3	41.00	1.58	7.90	10.76	2.10
All year	1	24.16	1.91	2.60	693.38	n.a
	2	35.60	3.27	5.52	613.13	2.48
	3	42.64	2.25	8.88	69.44	2.08

The annual and seasonal cohorts are separated and given in Table 1; three cohorts were distinguished annually on Bhattacharya's method with mean lengths 24.16, 34.41 and 41.48 cm (Fig. 5). The recruitment pattern is given in Figure 6, indicating double recruitment peaks per year. The major recruitment peak occurred at 23.14%.

From the length-converted catch curve procedure total mortality *Z*, was estimated at 0.54 per year, while natural mortality (*M*) of 0.46 per year was estimated from Pauly (1980) empirical formula (Fig.7). The fishing mortality (*F*) of 0.08 per year was obtained. The exploitation rate (*E*) was estimated as 0.14 per year. The length of capture was calculated as L_{25}=23.5, L_{50}=33 and L_{75}=36 cm (Fig. 8).

DISCUSSION

In this study, the average length and the maximum length (SL) of *A. nibe* were recorded 28.7±6.2cm and 45cm, respectively. Sasaki (2001) was reported an

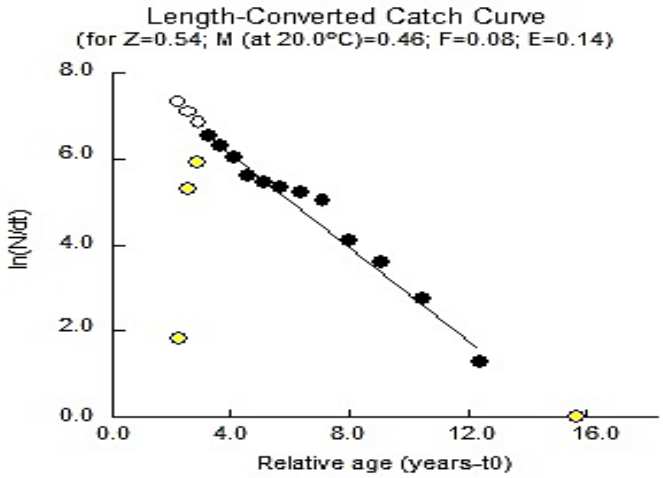

Fig.7. Length-converted catch curve for *A. nibe*. Regression statistics: y-intercept, a = 8.34; slope, b = -0.54; r2 = 0.98; n = 12; Z =0.54 (0.48-0.59) per year.

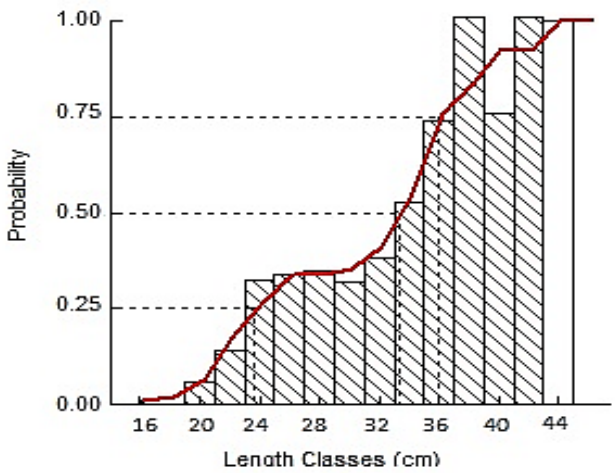

Fig.8. Probability of capture of each length class of *A. nibe* (L25=23 cm, L50=33 cm, L75=36 cm).

Table 2. Comparison of growth performance of *Atrobucca* sp. (Mean=2.69, range = 0.30, CV=3.75, Sd. =0.10, Variance=0.01).

Species	*Ø*	*L*∞	*K*	t_0	T (ºC)	Area	References
A. alcocki	2.60	47.5	0.18	-0.19	26	Pakistan	Memon et al. 2016
	2.69	37.1	0.35	2	20	Taiwan	Matsui & Amio 1951
	2.86	37.1	0.52	-0.01	20	Taiwan	Matsui & Takai 1951
	2.58	40.1	0.24	-0.89	20	Japan	Matsui & Takai 1951
	2.67	43.2	0.25	-	20	Japan	Sato 1963
A. nibe	2.82	46.9	0.30	-1.09	20	Japan	Matsui &Amio 1951
	2.77	50.9	0.23	-1.08	20	South Korea	Matsui & Amio 1951
	2.76	57.3	0.18	-1.09	20	Taiwan	Matsui & Amio 1951
	2.60	58.5	0.12		22	Taiwan	Lin 1956
	2.70	58.7	0.15	-1.04	20	Taiwan	Matsui & Amio 1951
	2.56	50.2	0.20	-0.70	20	Iran	This study

average of 25 cm for *A. nibe* in central Pacific Ocean waters. The range total length of *A. nibe* was 18.7 to 28.2cm in the Veraval coast of India (Raje 1988). The *A. nibe* individuals were caught in the fishing season (June-July) in Kakinada India, and ranged from 11 to 40cm in total length (Apparao et al. 1992). Lengthwise sex ratio of *A. nibe* (F: M) showed a dominance of females over males in all the size classes up to 26 cm (Salarpouri et al. 2021). *Atrobucca nibe* females grow faster than males, and were larger in size (Terwaves 1977; Raje 1988). In over 80% of fish species, the females, including those known as big old fecund females, grow bigger than the males (Pauly 2019), a situation also recorded for the sciaenids *Otolithes ruber* and *A. nibe* (Fennessy 2000; Eskandari et al. 2012). The *a* and *b* coefficients of the length-weight relationships were estimated at 0.0089 and 3.0256, respectively. Despite the many variations of fish forms, generally, the *b* values of fishes are closer to 3 (King 2013). As an overall comparison, the estimated *b*-value in this study is in agreement with the values of *b*=3.213 (Murty 1980), *b*=3.128 (Khadem Sadr et al. 2011), and *b*=2.925 for *A. alcocki* (Memon et al. 2016) reported from the same area. The value of *b*=3.0256 showed that the model of isometric growth was used for the calculation of the condition factor ($c.f=W.100/TL^{3.0256}$). Length-weight relationships have a very important role in population dynamics and fisheries stock assessment studies (Gulland & Rosenberg 1992). The accuracy of length-weight relationships is affected by several factors e.g. length ranges, sex, sample size, condition of fishes caught in

different seasons, and fishing methods (Haimovici & Canziani 2000).

In this study, the largest fish, measured 47.5cm, falls within the 95% of 50cm recorded as asymptotic length. The growth performance of *Atrobucca* sp. from different sources comparison is given in Table 2. The growth performance index (Ø) values are usually similar within related taxa and have narrow normal distributions. Generally, Ø is a species-specific parameter, but the gross dissimilarity of Ø in the same species or related species indicates the unreliability in the accuracy of estimated growth parameters (Moreau et al. 1986). Gayanilo et al. (2003) stated that Ø can be used only for comparing growth performances between fishes with similar shapes.

Moreau et al. (1986) suggest that the coefficient of variation of Ø for several stocks of the same species should not exceed 5%. The coefficient of variation (CV) of 3.75% of *A. nibe* is low and next to the other studies (Table 2). On the other hand, Ragonese & Bianchini (1998) suggested that growth performance differences can likely reflect slight environmental differences such as food availability, temperature, etc. but partially result from the different techniques used.

The M/K ratio of a fish should fall between 1.0–2.5 (Beverton & Holt 2012). The fishes with a faster growth rate have a M/K ratio of not more than 1.5. In the case of *A. nibe* the M/K ratio was found to be 2.3 which shows that it grows at a lower rate.

Three cohorts were distinguished annually with a mean length of 24.16, 34.41 and 41.48cm. In this study, double recruitment peaks per year were obtained, confirmed by Pauly (1984) assertion that the double recruitment pulses per year are a general feature of tropical fish species. The potential of recruitment throughout the year is common in tropical species (Sparre & Venema 1998). The *A. nibe* species fishing grounds in the Oman Sea ranged from 200 to 350m in depth and complied with continental slope (Salarpouri et al. 2014). The *A. nibe* is a demersal fish with a *K*-selected strategy, high longevity of 14 years, low-speed growth performance (K=0.20 yr^{-1}), low natural mortality (M=0.46 yr^{-1}), lives in low environmental fluctuations habitat, seriously depend on lanternfish schools (65%) in terms of food, and limited cohorts and recruitment (Table 1), made this species in a fragile condition. The *A. nibe*, with a maximum age of 14 years, is a relatively long-life fish like other Sciaenids. This is confirmed by the low natural mortality and superimposed growth curve from von Bertalanffy growth equation. The estimated age of 16.5 years for *A. alcocki* was reported from Pakistani waters (Memon et al. 2016). Generally, longevity is more closely related to mortality than K, $L\infty$ or ambient temperature (Sparre & Venema 1998).

The total mortality (Z) was estimated at 0.54 per year and natural mortality at 0.46 per year, resulting in a low value for fishing mortality (F) and, consequently, a low value for exploitation rate (E=0.14 yr^{-1}). The estimated natural mortality agrees with *A. alcocki* (M=0.49 yr^{-1}) reported from Pakistani waters (Memon et al. 2016). The rate of total, natural, and fishing mortality may not stay at a constant level and may vary from time to time (Sparre & Venema 1998; Gayanilo et al. 2003). The calculated mortality rates may be affected by small variations in growth parameters (Tserpes & Tsimendis 2001). The optimal exploitation ratio (E) for fish with low population identification is approximately 0.5, indicating whether the catch is uncontrolled (Gulland 1971). The exploitation rate for *A. nibe* was calculated as 0.14 per year, which is lesser than 0.5, which shows that the stock of *A. nibe* in the Oman Sea was not under pressure. In this study, the L_{C50} was recorded 33cm, was lesser than of L_{M50} =35cm (Salarpouri et al. 2021), it seems that the gear mesh size was not suitable for *A. nibe* fishery, and this species faced fishing pressure in the Oman Sea.

The *A. nibe* is an important bycatch in Myctophids' fishery trawlers, which was introduced as a new fish resource for exploitation in the northwest of the Oman Sea by Valinassab & Salarpouri (2017). The *A. nibe* stock has not been assessed scientifically yet, it is recommended an agenda for fishery assessment and management of this newly introduced stock for further commercial exploitation in the Oman Sea with emphasis on joint assessment and management

between Iran and the Sultanate of Oman.

ACKNOWLEDGMENTS

This research was funded and registered with the code 4-75-12-91123 by the Iranian Fisheries Science Research Institute. The authors are grateful to Mr. Mohebbi Director, and other staff of Hormozgan Fisheries Administration, have special thanks to the Captain and personnel of R/V Ferdwos-1, and other trawlers fleet operating for lanternfish fishing in the Oman Sea, for all help regarding the sampling.

REFERENCES

Apparao, T. 1989. Food and feeding habits of *Pennahia macrophthalmus* Bleeker at Visakhapatnam. Journal of Marine Biology Association. India 27: 61-66.

Bhattacharya, C.G.1967.A simple method of resolution of a distribution into gaussian components. Biometrics 23: 115-35.

Ebrahimi, M., Khodadadi Jokar, K. & Azini, M., 2012. Study on Physicochemical properties of the Iranian waters in the Oman Sea. 100 p.

Eagderi, S.; Fricke, R.; Esmaeili, H.R. & Jalili, P. 2019. Annotated checklist of the fishes of the Persian Gulf: Diversity and conservation status. Iranian Journal of Ichthyology 6: 1-171.

Eskandari, G.; Savari, A.; Kochanian, P. & Taghavi Motlagh, A. 2012. Age, growth and length at first maturity of *Otolithes ruber* in the Northwestern part of the Persian Gulf, based on age estimation using otolith. Iranian Journal of Fisheries Sciences 11(1): 13-27.

Fennessy, S.T. 2000. Aspects of the Biology of Four Species of Sciaenidae from the East Coast of South Africa. Estuarine, Coastal and Shelf Science 50(2): 259-269.

Fischer, W. & Bianchi, G. 1984. FAO species identification sheets for fishery purposes: Western Indian Ocean (Fishing Area 51). v. 1: Introductory material. Bony fishes, families: Acanthuridae to Clupeidae.-v. 2: Bony fishes, families: Congiopodidae to Lophotidae.-v. 3: families: Lutjanidae to Scaridae.-v. 4: families: Scatophagidae to Trichiuridae.-v. 5: Bony fishes, families: Triglidae to Zeidae. Chimaeras. Sharks. Lobsters. Shrimps and prawns. Sea turtles. v. 6: Alphabetical index of scientific names and vernacular names.

Gayanilo, F.C.Jr.; Sparre, P. & Pauly, D. 2003. FAO-ICLARM Stock assessment tools (FiSAT) user's guide, FAO Computerized Information Series (Fisheries), No. 8, Rome, FAO, 266p.

Gulland, J.A. & Rosenberg, A.A. 1992. A review of length-based approaches to assessing fish stocks: Food and Agriculture Org.

Gulland, J.A. 1971. The Fish Resources of the Oceans West Byfleet. Survey News (Books), Ltd. FAO, 255p.

Haimovici, M. & Canziani, G.V. 2000. Length-weight relationship of marine fishes from Southern Brazil. Naga. The ICLARM Quarterly 23(1): 19-23.

Hales Jr, L.S. & Reitz, E.J. 1992. Historical changes in age and growth of Atlantic croaker, *Micropogonias undulatus* (Perciformes: Sciaenidae). Journal of Archaeological Science 19(1): 73-99.

Heemstra, P. 1986. Family No. 199: Sciaenidae. Kob. Smiths' sea fishes. Springer-Verlag, Berlin, Heidelberg, New York, London, Paris, Tokyo, pp: 616-619.

Johnson, G.; Gill, A.; Paxton, J. & Eschmeyer, W. 1998. *Encyclopedia of Fishes*. Academic Press, San Diego, CA. 439p.

Kamali, E.; Dehghani, R.; Behzadi, S. & Ejlali, K. 2006. A study on some species of biological javelin grunter (*Pomadasys kaakan*), tigertooth croker (*Otolithes ruber*) and spotted croaker (*Protonibea dicanthus*) in Hormozgan waters, Final report in Persian. Iranian Fisheries Research Organisation, 91p.

Kawasaki, T. 1987. Fisheries problems in the Yellow and East China Seas: Environment and Policy Institute, East-West Center.

Khadem-Sadr, S. 2011. A survey on feeding habit of big-eye croaker in the Oman Sea. The Scientific-Extension Journal of Rehabilitated Natural

Resources 2: 14-26.

King, M. 2013. Fisheries biology assessment and management fishing. Second Edition. Blackwell publishing Ltd, 396p.

Le Cren, 1951.The length-weight relationship and seasonal cycle in gonad weight and condition in the Perch (*Perca fluviatilis*). Journal of Animal Ecology 20: 201-219

Lin, F.H. 1956. Studies on black croaker (*Argysomus nibe,* Jordan & Thompson, 1911) in the northern trawling ground of Taiwan. Rep. Inst. Fish. Biol. Ministry of Econ. Affairs and National Taiwan University 1(1): 62-64.

Matsui, I. & Amio, M. 1951. On the age composition and the circuli of the black croaker *Nibea nibe* (Jordan & Thompson, 1911). Bulletin of the Japanese Society for the Science of Fish 16(12): 168-173.

Matsui, I. & Takai, T. 1951. Ecological studies on the valuable fish in the East China Sea and Yellow Sea. II. Ecological studies on the black croaker, *Nibea nibe* (Jordan & Thompson). Bulletin of the Japanese Society for the Science of Fish 16(12): 125-143.

Memon, K.H.; Liu, Q.; Kalhoro, M.A.; Nazir, K.; Waryani, B. & Chang M. 2016. Estimation of Growth and Mortality Parameters of Croaker *Atrobucca alcocki* in Pakistani Waters. Journal of Agricultural Science and Technology 18(3): 669-679.

Moreau, J.; Bambino, C. & Pauly, D. 1986. A comparison of four indices of overall growth performance based on 100 tilapia populations (Family Cichlidae). In: Maclean, J.L.; Dizon, L.B. & Hosillos, L.V. (Eds.). The First Asian Fisheries Forum. Asian Fisheries Society, Manila, Philippines, pp: 201-206.

Murty, V.S. 1980. Observations on some aspects of biology of the black croaker *Atrobucca nibe* (Jordan & Thompson, 1911) from Kakinada. Indian Journal of Fisheries 27(1&2): 66-75.

Pauly, D. & Caddy, J.F. 1985. Modification of bhattacharya's method for the analysis of mixtures of normal distributions. FAO Fisheries and Aquaculture - CIRCULARS, 781: 16.

Pauly, D. & Munro, J.L., 1984. Once more on the comparison of growth in fish and Invertebrates. ICLARM Fishbyte 2(1): 21.

Pauly, D. 1980. On the interrelationships between natural mortality, growth parameters, and mean environmental temperature in 175 fish stocks. ICES Journal of Marine Science 39(2): 175-192.

Pauly, D. 1983. Some simple methods for the assessment of tropical fish stocks: Food and Agriculture Org.

Pauly, D. 1984. Fish population dynamics in tropical waters: a manual for use with programmable calculators. ICLARM, 143:1-325.

Pauly, D. 1989. Biology and management of tropical marine fisheries. Resource Management and Optimization 6: 253-271.

Pauly, D. 2019. Female Fish Grow Bigger - Let's Deal with It. Trends in Ecology & Evolution 34(3): 181-182.

Pauly, D.; David, N. & Pauly, D. 1981. ELEFAN I. Length-based Methods in Fisheries Research 1.

Pitcher, T.J.; Watson, R.; Courtney, A. & Pauly, D. 1998. Assessment of Hong Kong's inshore fishery resources. Fisheries Centre Research Reports 6(1): 1-168.

Queste, B.Y.; Vic, C.; Heywood, K.J. & Piontkovski, S.A. 2018. Physical con-trols on oxygen distribution and denitrification potential in the North West Arabian Sea. Geophysical Research Letters 45: 4143-4152.

Ragonese, S. & Bianchini, M.L. 1998. Growth, mortality and yield-per-recruit of the poor cod, *Trisopterus minutus capelanus*, from the Strait of Silcily. Naga, the ICLARM quarterly. Fishbyte Section. January-March 1998: 61-69.

Raje, S.G. 1988. Occurrence of blackmouth croaker, *Atrobucca nibe* (Jordon & Thompson, 1911) off Veraval coast. Indian Journal of Fisheries 35(4): 302-303.

Rezvani Gilkolaei, S. & Ghavam Mostafavi, P. 2017. Population Genetic Studies of *Atrobucca Nibe* (Jordan & Thompson, 1911) Using D-Loop

Sequencing in the Norththwest Coasts of the Oman Sea. Journal of Aquaculture Development 11(2): 91-103.

Salarpouri, A. 2020. Report of Myctophids fisheries in Iran. Persian Gulf and Oman Sea Ecological Research Institute. 10 p.

Salarpouri, A.; Valinassab, T.; Behzadi, S.; Kaymaram, F.; Darvishi, M. & Dehghani, R., 2021. Reproduction biology and feeding habits of the Blackmouth croaker, *Atrobucca nibe* (Jordan & Thompson, 1911), from Northwest of the Oman Sea. Iranian Journal of Fisheries Science 20(3): 901-917.

Salarpouri, A.; Valinassab, T.; Kamali, E.; Behzadi, S.; Rezvani, S.; Memarzadeh, M. & Karami, N. 2014. A survey on Blackmouth croaker, *Atrobucca nibe*, resources in the Northwest Oman Sea. Final Report of research project. Iranian Fisheries Research Organization Publication (in Persian). 148 p.

Sasaki, K. 2001. Sciaenidae. Croakers (drums). FAO species identification guide for fishery purposes. The living marine resources of the Western Central Pacific 5: 2791-3380.

Sparre, P. & Venema, S.C. 1998. Introduction to tropical fish stock assessment, Part 1. Manual. FAO Fisheries Technical Paper, No.306.1, Rev. 2. Rome, FAO. 407 p.

Sturges H.A. 1926. The choice of a class interval. Journal of the American Statistical Association 21(153): 65-66.

Tserpes, G. & Tsimendis, N. 2001. Age, Growth and Mortality of *Serranus cabrilla* (Linnaeus, 1785) on the Cretan Shelf. Fisheries Research 51: 27-34.

Valinasab, T. 2005. Biomass distribution and pattern of myctophids in the Oman Sea. Iranian Journal of Fisheries Science 4(2): 101-110

Valinassab, T. & Salarpouri, A. 2017. Blackmouth Croaker a new target for commercial exploitation in offshore waters of the Oman Sea. Journal of Marine Fishes 1(1): 33-42.

Valinassab, T.; Daryanabard, R.; Dehghani, R. & Pierce, G. 2006. Abundance of demersal fish resources in the Persian Gulf and Oman Sea. Journal of the Marine Biological Association of the United Kingdom 86(6): 1455-1462.

Valinassab, T.; Salarpouri, A.; Darvishi, M.; Kaymaram, F.; Ebrahimi, M. & Taghavi-Motlagh, A. 2011. Status of Lanternfish Stocks and Exploitation in the Oman Sea.

Van der Elst, R. & Borchert, P. 1993. A guide to the common sea fishes of southern Africa. Struik Publishers, Cape Town. 398 p.

Yamada, U. & Tokimura, M., 1994. Blackmouth croaker (in Japanese). Fisheries Resource Conservation Association 184-193.

Yamada, U.; Shirai S. & Irie, T. 1995. Names and illustrations of fishes from the East China Sea and the Yellow Sea: Japanese Chinese Korean. Overseas Fishery Cooperation Foundation.

Zanganeh, E. 2020. Report of fisheries statistics of Hormozgan Province, Iran (year 2019). Hormozgan Province Fisheries Department. 88 p.

Iran. J. Ichthyol. (2022) 9(1): 43-53
P-ISSN: 2383-1561; E-ISSN: 2383-0964

doi: 10.22034/iji.v9i1.880
http://www.ijichthyol.org

مقاله کامل

پارامترهای رشد و مرگ و میر ذخیره تازه بهره‌برداری شده شبه شوریده دهان سیاه *Atrobucca nibe* (Jordan & Thompson, 1911) در آب‌های دریای عمان

علی سالارپوری[1*]، سیامک بهزادی[1]، تورج ولی نسب[2]، فرهاد کی‌مرام[2]، آرزو وهاب نژاد[2]، محمد مؤمنی[1]

[1]پژوهشکده اکولوژی خلیج‌فارس و دریای عمان، موسسه تحقیقات علوم شیلاتی کشور، سازمان تحقیقات آموزش و ترویج کشاورزی، بندرعباس، ایران.
[2]موسسه تحقیقات علوم شیلاتی کشور، سازمان تحقیقات آموزش و ترویج کشاورزی، تهران، ایران.

چکیده: برخی از پارامترهای پویایی جمعیت شبه شوریده دهان سیاه (*Atrobucca nibe*) در آب‌های شمال غرب دریای عمان به‌صورت ماهانه از شهریور ۱۳۹۴ تا مرداد ۱۳۹۵ مورد بررسی قرار گرفتند. درمجموع فراوانی طولی ۱۶۸۵ با استفاده از روش ترال میان آبی مورد نمونه‌برداری قرار گرفتند. میانگین و انحراف معیار طول کل ۲۸/۷±۵,۹ و دامنه طولی نیز از ۱۸ تا ۴۷/۵ سانتی متر بدست آمد. فراوان ترین طبقه طولی ۲۶-۲۴ سانتی متر بود. رابطه طول- وزن برای این ماهی $W=0.00895L^{3.0256}$ بدست آمد که بیانگر رشد ایزومتریک بود. پارامترهای رشد طول بی نهایت($L\infty$) و ضریب رشد(K) این ماهی به‌ترتیب ۵۰ سانتی‌متر و ۰/۲۰ در سال تخمین زده شدند. پارامترهای طول در زمان صفر (t0)، طول بیشینه(T_{max}) و ضریب فی پرایم مونرو(Ø) برای این گونه به‌ترتیب ۰/۷۰- سال، ۱۴ سال و ۲/۶۹ به‌دست آمدند. شبه شوریده دهان سیاه دارای دو مرحله بازگشت است که اوج اصلی آن ۲۳/۱۴ درصد می‌باشد. برای این ماهی در طول سال سه کوهورت با میانگین طول ۲۴/۱۶، ۳۴/۴۱ و ۴۱/۴۸ سانتی‌متر به‌دست آمدند. نرخ مرگ و میر کل، صیادی و طبیعی به‌ترتیب ۰/۵۴، ۰/۴۶ و ۰/۰۸ در سال محاسبه شدند. بر اساس ضریب بهره‌برداری محاسبه شده (۰/۱۴) می‌توان نتیجه گرفت که شبه شوریده دهان سیاه در دوره تحقیق تحت فشار صیادی قرار ندارد. طول صید (L50) برای شبه شوریده دهان سیاه ۳۳ سانتی‌متر به‌دست آمد، که کمتر از طول بلوغ گزارش شده (۳۳سانتی‌متر) برای همین گونه در دریای عمان است، به‌نظر می‌رسد که چشمه‌های تور ادوات صید ترال برای صید شبه شوریده دهان سیاه مناسب نمی‌باشند.

کلمات کلیدی: *Atrobucca nibe*، پارامترهای رشد، نرخ مرگ و میر، نرخ بهره‌برداری، دریای عمان.