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## Research Article

# Reproduction biology and feeding habits of the black mouth croaker, *Atrobucca nibe* (Jordan & Thompson, 1911), from Northwest of the Oman Sea

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**Abstract**

Reproduction biology and feeding habits of black mouth croaker, *Atrobucca nibe*, was investigated monthly from September 2013 to August 2014 in the Oman Sea. The specimens were collected by bottom trawl in the Northwest of Oman Sea. A total of 637 fish specimens examined, 284 males and 353 females were sexed. The average sex ratio was F: M= 1.24:1, showing dominance of females over the males. Spawning season of *A. nibe* was mostly observed in June and October but spawning might be occurred in all year long . The mean absolute fecundity was calculated 97008±55553 eggs, with a moderate linear relationship between absolute fecundity and total length (Fecundity= 10802TL-280712, $R^2$=0.7624). The mean length at first sexual maturity (Lm50 %) was 35 cm for females. *A. nibe* is an abstemious feeder according to the high vacuity index (VI=86.5±16.8 %). Skinny cheek lanternfish (65%), Japanese threadfin bream (13%) and deep-sea shrimps (11%) were the frequent food items of this species. Results showed that bony fishes were consumed by all size-classes, skinny cheek lanternfish (42.1%) and Japanese threadfin bream (79.4%) were more pronounced in size-class of 34-38 cm, and also crustacean were more frequent (29%) in 22-26 cm size classes.

**Keywords:** *Atrobucca nibe*, Reproduction, Feeding habits, Lanternfish, Oman Sea



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## Introduction

Scianidae family with 275 species and 70 genus is an important commercial fishes distributed all around world (Johnson *et al.*, 1998). The Black mouth croaker, *Atrobucca nibe*, the member of Scianidae family, found in coastal waters from 45 m down to a depth of >200 m (Sasaki , 2001), on seaweed beds and gravel (Yamada *et al.*, 1995). The Black mouth croaker is a small, moderately deep-bodied species, the lateral line scales reaching the tip of the caudal fin. The linings of the mouth, gill chamber and body cavity black (Fischer and Bianchi ,1984). In addition to the Oman Sea, *Atrobucca nibe* has been reported from western Indian Ocean, Mozambique, South Africa, India, China, Japan, and Philippine. It is also distributed in the northern areas of Australia to southern parts of Indonesia (Rao, 1974; Heemstra ,1986; Van der Elst and Borchert ,1993). The Black mouth croaker was new recorded commercial resources in the Northwest of Oman Sea and its high amount biomass was found amongst trial-commercial fishing of lanternfishes (Valinassab and Salarpouri, 2017). This species is one of the most important bycatch of lanternfishes mid-water trawler fleet, and total catch of black mouth croaker raised to 640 tons from Northwest of Oman Sea (Alizadeh and Owliaei, 2017). There are very few studies on this species , however Valinassab *et al*. (2011) have assessed some feeding habits of *A. nibe* from the Oman Sea, Rezvani and Ghavam (2017) studied on population genetic of *A. nibe* in the Oman Sea. Yamada *et al.* (1995) were declared *A. nibe* as endangered and vulnerable species from South Sea China and Yellow Sea. Fennessy (2000) estimated growth parameters of *A. nibe* from South Africa, Murty (1980) reproduction season and length-weight relationship from India, some evidence on overfishing and stock reduction of *A. nibe* from Hong Kong waters were reported (Kawasaki, 1987; Pitcher *et al.*, 1997). Very little is known about the Black mouth croaker, this is the first study conducted on the reproduction and feeding biology of Atrobucca nibe in the Northwest of Oman Sea.

## Materials and methods

The main fishing ground of *A. nibe* is in the Northwest of Jask area in the Oman Sea (Fig. 1). The samples were obtained in daylight period from the mid-water trawler onboard at monthly intervals. A total of 637 individuals of A. nibe were captured based on simple random sampling from September 2013 to August 2014. All specimens were freezed onboard and transferred to the Persian Gulf and Oman Sea Ecology Research Center laboratory. At least 50 specimens were taken per month; samples were sexed by observation of the gonads. Total length (TL, ±0.1cm) and total weight (TW, ±0.01g), gonad weight (GW) and stomach weight (SW) were measured for each specimen.



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**Figure 1: Map of the study area, location of the sampling sites of *Atrobucca nibe***

Sex of individual specimens was determined by observing the gonads after dissecting the specimens, the maturity stages of ovaries were assigned macroscopically according to the description of Qasim (1973) based on five stages (Table 1), The relative ovary weight or Gonadosomatic Index (GSI)=(Gonad weight/ total fresh weight of fish)×100 was calculated following Biswas (1993). The sex ratio analysis was carried out by monthly data sets of the total number of male and female fish. Chi-square ($X^2$) statistical was performed to test the difference between ratios in both sexes. The LM50% was estimated by using following formula King (2013) and least square method (Solver Tools in Microsoft Excel ver. 2013), P=L/[1+exp (- rm (L- Lm50))]

Where: rm is the slope of curve, Lm is the mean total length (cm) at sexual maturity, L is mean total length (cm) and P is probability of presence mature fish. Ovaries were removed and about 2 g samples of ovaries placed in 20 cc of Gilson's solution using method of Hunter *et al.* (1985).The samples were then passed through a 0.63 µ sieve, dried at ambient temperature and weighed 0.001 g. The absolute fecundity was obtained from AF=EW

$$AF = EW\left(\sum_1^3 SCCi \big/ SSWi\right)/\,3$$

Where: AF=absolute fecundity, or the total number of eggs per female; EW=weight of rinsed eggs; SSCi=subsample count i, where i=1 to 3; and SSWi=subsample weight i, where i=1 to 3, and the relative convergence from RF=AF/TW-GW where: AF=absolute fecundity, or the total number of eggs per female; TW=total weight; and GW=gonad weight (Bobko and Berkeley, 2004).

Stomach contents were examined under a binocular microscope and the



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food items, when possible, identified to the lowest taxa level according to appropriate taxonomic identification guides (Fischer and Bianchi, 1984; Randall, 1995; Asadi and Dehghani, 1996; Carpenter *et al.*, 1997). The number of prey items was recorded when the state of digestion was not advanced.

**Table 1: Month wise sex ratio of *A. nibe* from the Northwest of Oman Sea (2013-14).**

| Month | Female | Male | Mean Length ±SD (cm) | Length Range (cm) | X2 Value | F:M ratio |
|---|---|---|---|---|---|---|
| September | 26 | 24 | 29.3±6.2 | 20.3-44.0 | 0.08 | 1.08 |
| October | 38 | 18 | 26.9±3.2 | 20.6-36.1 | 7.14 | 2.11 |
| November | 18 | 38 | 23.5±2.2 | 18.5-29.5 | 7.14 | 0.47 |
| December | 15 | 41 | 25.1±5.2 | 18.5-42.0 | 12.07 | 0.37 |
| January | 40 | 16 | 28.7±1.9 | 24.0-34.0 | 10.29 | 2.50 |
| February | 23 | 37 | 28.0±6.6 | 18.0-45.0 | 3.27 | 0.62 |
| March | 54 | 16 | 34.9±5.4 | 19.0-47.5 | 20.63 | 3.38 |
| April | 16 | 3 | 37.7±3.2 | 32.5-42.5 | 8.89 | 5.33 |
| May | 28 | 28 | 25.5±4.4 | 18.0-35.0 | 0.00 | 1.00 |
| June | 27 | 19 | 37.0±3.7 | 31.5-45.2 | 1.39 | 1.42 |
| July | 36 | 20 | 28.0±3.3 | 23.0-38.0 | 4.57 | 1.80 |
| August | 32 | 24 | 30.3±3.8 | 23.5-41.0 | 1.14 | 1.33 |

Data analysis was done using some indices as follows (Hureau, 1970; Berg, 1979): (i) Frequency of occurrence: (%F)=100×(number of stomachs in which an especial food item was found/total number of stomach containing food); (ii) The numerical percentage of prey items: (%N)=100×(number of each prey item in all full stomachs/total number of observed food items in all stomachs in a sample); (iii) Vacuity index: (VI)=100×(number of empty stomachs/number of examined stomachs); The intensity of feeding as indicated by the VI is interpreted as: Edacious species $0 \leq VI < 20$, Relatively edacious species $20 \leq VI < 40$, Moderate feeder $40 \leq VI < 60$, Relatively abstemious $60 \leq VI < 80$, Abstemious $80 \leq VI < 100$ (Daan, 1973; Euzen, 1987).

Seasonal and length based differences in VI were tested pairwise using two-sample T-tests of proportion at $p$=0.05 (Euzen, 1987). Food Preference Index was calculated as FPj=(NSj/NS)×100, where; NSj=total number of individual prey of species j in all samples (stomach and intestine), Ns = Total number of samples containing food. If FPj<10 then species j is considered to be negligible in the diet. For FPj between 10 and 50, species j is considered a minor prey species and if FPj>50 then species j is a main diet item (Euzen, 1987). The Gastrosomatic


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Index (GaSI) for each month was calculated as: GaSI=100×(weight of stomach/weight of fish) (Desai, 1970).

## Results

From a total of 637 fish examined, 353 females and 284 males were sexed. Total length and total weight of collected specimens ranged between 18.0 and 45.2 cm (30.4±6.0 cm) and between 52.5 and 856.5 g (312.2±172.1 g), respectively. Lengthwise sex ratio of *A. nibe* (F: M) obtained during the study showed dominance of females over males in all the size classes up to 26 cm (Fig. 2).The average sex ratio between females and males observed during the period was 1.24:1, showing dominance of females over the males. Month- wise sex ratio of *A. nibe* showed the dominance of females over males in numbers during all months, except during November, December and February (Table 1). The GSI for both males and females showed dramatically fluctuation (Fig. 3), it seems that *A. nibe* has ability reproduce all year round, but ripe and spent ovaries were mostly observed in June (spring) and October (autumn) (Figs. 4). The mean absolute fecundity of A. nibe were calculated 97008±55553 eggs, with range of 16558 to 207879 eggs observed in 29 and 43.5 cm of total length, respectively. A moderate linear relationship (Fecundity=10802TL-280712, $R^2$=0.7624) was calculated between absolute fecundity and total length of A. nibe (Fig. 5). Length at first maturity (Lm50 %) of *A. nibe* was estimated 35 cm for females (Fig. 6).

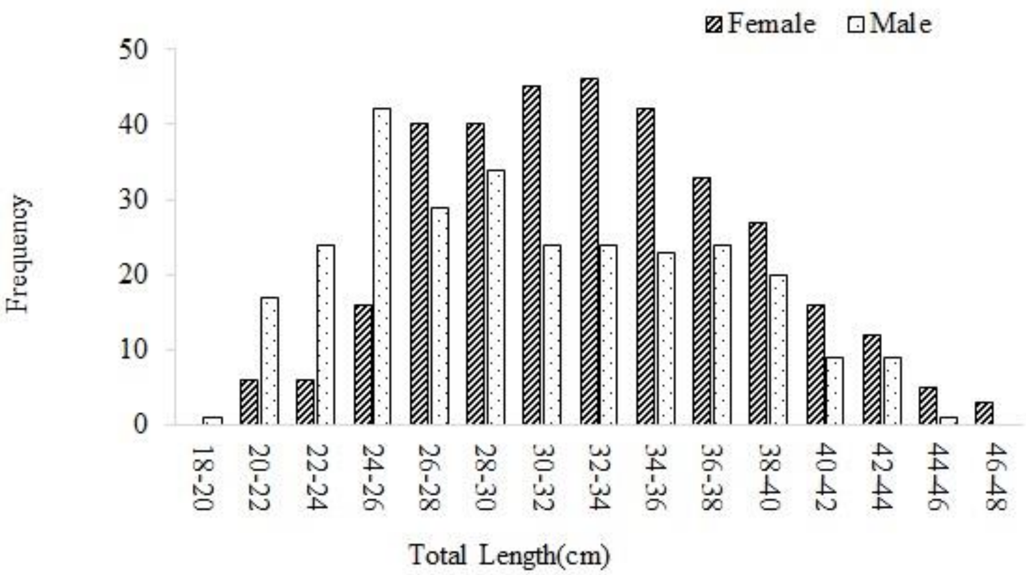


**Figure 2: Length- wise of *A. nibe* from the Northwest of Oman Sea (2013-14).**



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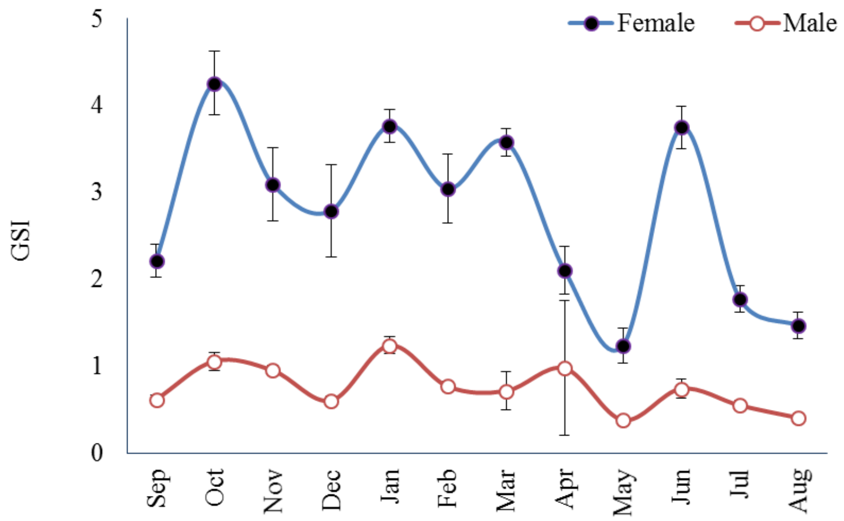


**Figure 3: The monthly mean Gonadosomatic Index (GSI)±SE of *A. nibe* from the Northwest of Oman Sea (2013-14).**

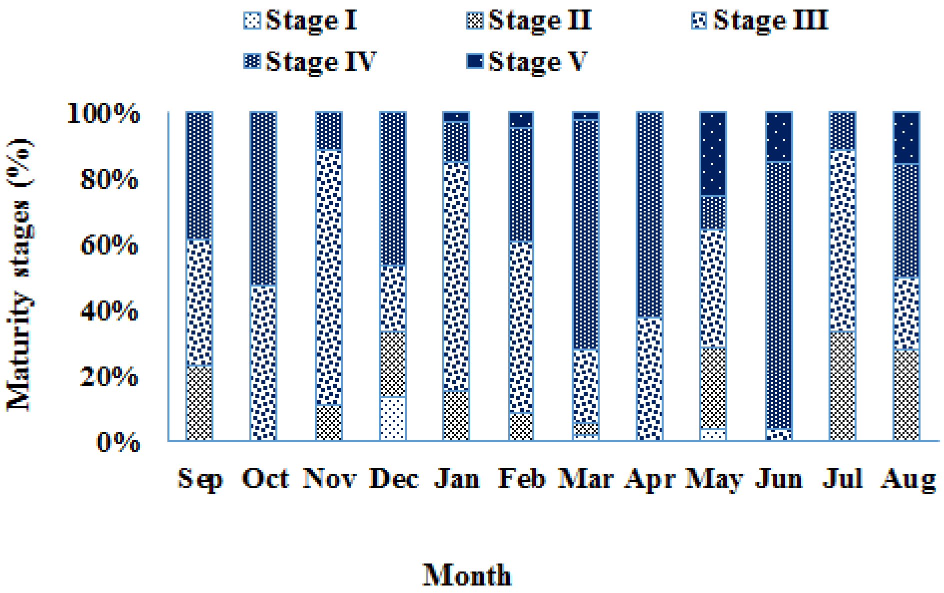


**Figure 4: Monthly variation in maturity stages of *A. nibe* from the Northwest of Oman Sea (2013-14).**

Of the 637 stomachs examined, 551 were empty (VI=86.5±16.8 %). Vacuity Index (VI) was high and varied from 42.1 to 100 %. This index significantly varied monthly over the study period ($X^2$=36.8, D.F.=11, $p$<0.05). The distribution of empty stomachs across month showed that the maximum and minimum of VI occurred during April and August 2014. The mean annual VI differed significantly among the size-classes ($X^2$=11.8, D.F.=12, $p$>0.05) with a minimum of 65.9% in 36-38 cm size-class (Table 2).



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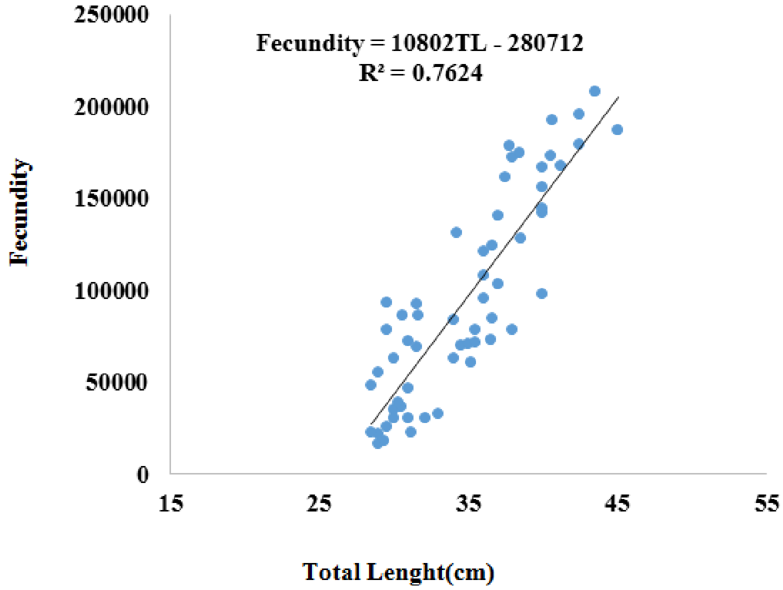


**Figure 5: Linear relationship between total length and absolute fecundity of *A. nibe* from the Northwest Oman Sea (2013-14).**

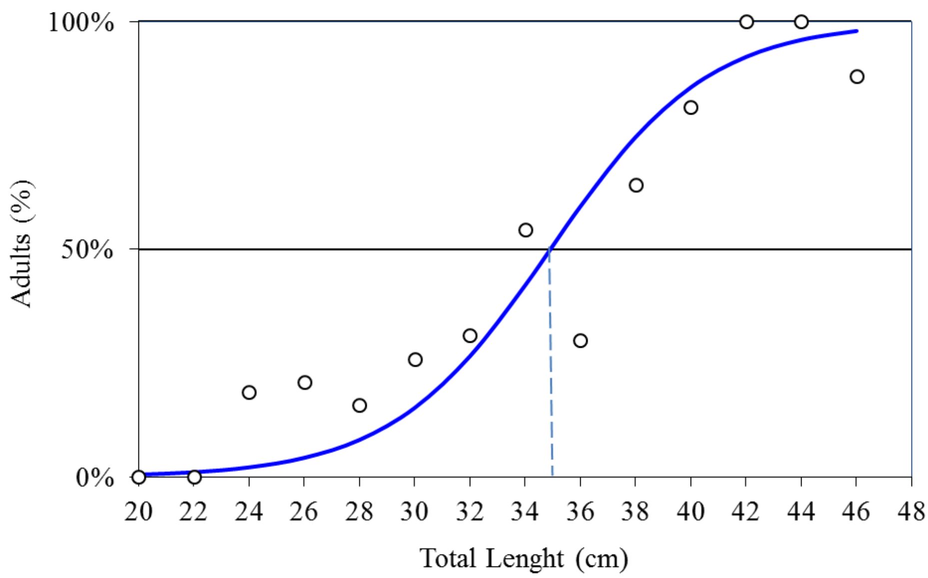


**Figure 6: Length at first maturity estimated of *A. nibe* (female) from the Oman Sea (2013-14).**

GaSI showed significant differences between the two sexes throughout the study period and its values were higher in females than those of males ($p$<0.05). The feeding intensity in females was much higher than males; the *A. nibe* GaSI in both sexes were fluctuated monthly and statistically significant within months ($p$<0.05), the highest and the lowest GaSI occurred in February and October to January, respectively (Figs. 7 and 8).

**Table 2: Month-wise and Length-wise distribution of *A. nibe* VI (%) from the Oman Sea (2013-14).**

| Month-wise | VI (%) | Length-wise | VI (%) |
|---|---|---|---|
| Sep | 68.6 | 18-20 | 91.7 |
| Oct | 77.2 | 20-22 | 100 |
| Nov | 98.2 | 22-24 | 84.5 |
| Dec | 94.6 | 24-26 | 82.5 |
| Jan | 98.2 | 26-28 | 94.6 |
| Feb | 98.3 | 28-30 | 94.2 |
| Mar | 87.1 | 30-32 | 92.9 |
| Apr | 42.1 | 32-34 | 87.7 |
| May | 92.9 | 34-36 | 87.2 |
| Jun | 80.4 | 36-38 | 65.9 |
| Jul | 80.4 | 38-40 | 80.4 |
| Aug | 100 | 40-42 | 81.7 |
| - | - | 42-44 | 100 |

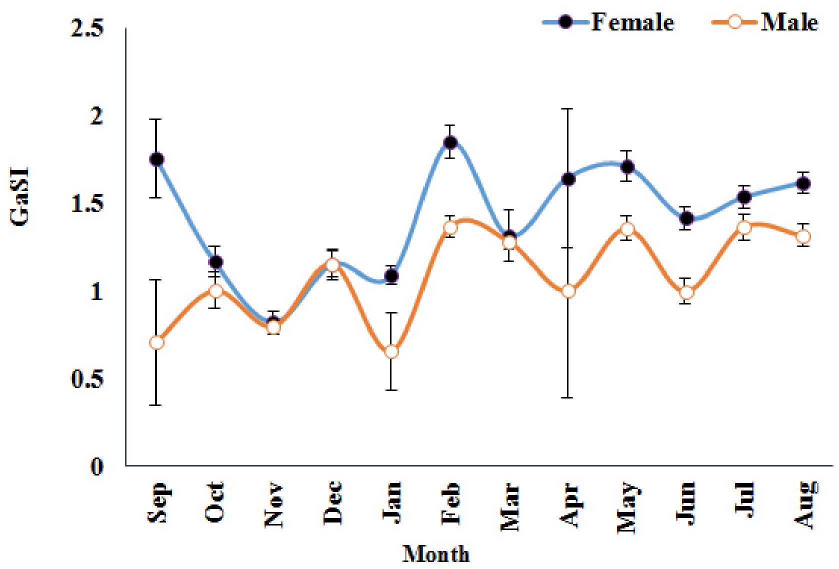


**Figure 7: The monthly mean Gastrosomatic Index (GaSI)±SE of females and males of *A.nibe* from the Oman Sea(2013-14).**

The stomach contents of Black mouth croaker consisted of nine different taxa belonging to two major food categories. Table 3 shows the frequency of occurrence and numerical composition of different prey groups and prey species found in stomachs. The overall diet was mainly composed of Teleostei (%88.2), but crustacean (%11.8) were also found in the stomach contents. Six



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different types of Teleostei and three different type of crustacean were identified in the stomach contents.

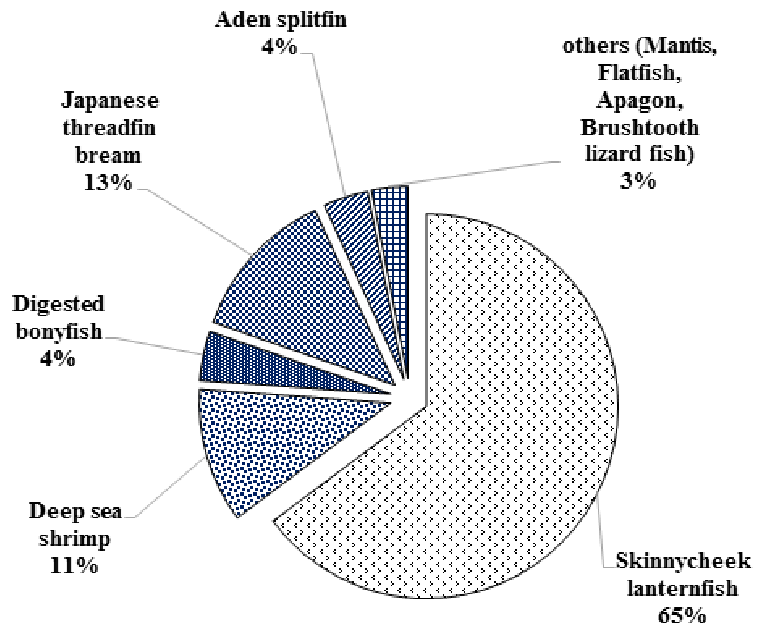


**Figure 8: Diet composition of *A. nibe* of the Oman Sea (2013-14).**

According to Table 3, among Teleostei, *Benthosema pterotum*, *Nemipterus japonicus*, and *Synagrops adeni* were the most important prey items and constituted the highest frequency and numerical percentage. Skinnycheek lanternfish was the main diet items, contains 65% of *A. nibe* total diet composition, Japanese threadfin bream (13%) and deep sea shrimps (11%) were the other food items, respectively.

Diet composition for size-classes of the five major food items is shown in Table 4. Feeding habit showed obvious change with the increase of body length. Skinnycheek lanternfish were the most important prey items in all size-classes except in larger size class (>38), feeding habits of *A. nibe* obviously shifted to bony fishes, as the length size class increasing. Crustacean items were present in all size-classes except for those larger than 22 cm and lesser than 38cm and the highest frequency and mean number of this items were recorded in medium individuals. Japanese threadfin bream were comparatively important food items for large size-classes and their frequency was higher in 34-38 cm size-class. For these major food items, statistical analysis revealed significant variations in frequency of occurrence among different size-classes ($p<0.05$).

**Table 3: Length-wise diet composition (%) of *A. nibe* from the Oman Sea (2013-14)**

| Length-wise (cm) | Skinnycheek lanternfish | crustacea (Shrimps and Mantis) | Japanese threadfin bream | Digested bonyfish | Other bonyfishes (Flatfish, Cardinalfish, Aden splitfin, Lizardfish) |
|---|---|---|---|---|---|
| 18-22 | 0.6 | - | - | 9.1 | - |
| 22-26 | 21.1 | 25.8 | - | 27.3 | - |
| 26-30 | 12.9 | 29.0 | - | - | 6.3 |
| 30-34 | 14.6 | 25.8 | 5.9 | 18.2 | 12.5 |
| 34-38 | 42.1 | 19.4 | 79.4 | 36.4 | 18.8 |
| 38-42 | 8.8 | - | 14.7 | 9.1 | 31.3 |
| >42 | - | - | - | - | 31.3 |

**Table 4: Prey items identified in the stomach contents of *A. nibe* from the Oman Sea. (%F=Frequency of occurrence; %N=Percentage of numerical abundance).**

| Major food groups and species | | %F | %N |
|---|---|---|---|
| **Scientific name** | **Common name** | | |
| **TELEOSTEI** | | | |
| *Benthosema pterotum* | Skinnycheek lanternfish | 46.4 | 65.0 |
| *Nemipterus japonicus* | Japanese threadfin bream | 6.2 | 12.9 |
| *Synagrops adeni* | Aden splitfin | 6.2 | 3.8 |
| *Saurida undosquamis* | *Brushtooth lizardfish* | 4.1 | 1.5 |
| *Ostorhinchus fasciatus* | Broad-banded cardinalfish | 1.0 | 0.4 |
| *Bothus myriaster* | Oval Flounder | 1.0 | 0.4 |
| Fish (Unidentified) | | 11.3 | 4.2 |
| **Total Teleostei** | | **76.3** | **88.2** |
| **CRUSTACEA** | | | |
| *Exhippolismata* sp. | *Hippolyte shrimp* | 16.5 | 8.4 |
| *Exopalaemon* sp. | Palaemonoid Shrimp | 6.2 | 3.0 |
| *Squilla manti* | Mantis shrimp | 1.0 | 0.4 |
| **Total Crustacea** | | **23.7** | **11.8** |

## Discussion

Length-wise and month-wise sex ratio (F: M) of *A. nibe*, were showed the dominance of females over males in overall. Murty (1980) reported the dominance of males over females (133 females, 224 males) except March and June for *A. nibe* and males were consistently larger in size. Sex ratio of *A. nibe* was reported 1:4 in Indian Veraval coast (Raje, 1988). Valinasab *et al*. (2011) reported that *A. nibe* had the highest sex ratio in November in the Oman Sea, and the reason was reproductive migration. Sex ratio of *Nibea maculata* (Blotched croaker) in Indian waters were calculated 1:1.16, indicating a significant difference



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(Jayasankar, 1989). Rao *et al.* (1992) argued that the sex ratios in the different species of Scianidae family are not the same, but they change monthly or seasonally. Sex ratio fluctuations throughout the year may indicate that male and female communities live separately from each other at specific periods, assuming factors influencing the separation or convergence of male and female populations should be examined. The length at first maturity (LM50%) of *A. nibe* was calculated at 35 cm; on the other hand, LC50 was calculated at 33 cm by Salarpouri *et al.* (2014). Murty (1980) calculated the length at first maturity of *A. nibe* calculated at 14.5 cm, while the range of studied individuals were 14 to 23 cm. The length at first maturity is important for fisheries and it should be designed special fishing gears because smaller fishes could escape from gears to prevent overfishing process. Results of the gonadal examination revealed that *A. nibe* has reproductive activity through the year. The peak of maturity index of *A. nibe* was found in June and October (Fig. 3), with several short gonadosomatic index peaks, all around the year. The ovarian histological studies indicated that *A. nibe* was a batch spawner, it may be possible to hatch throughout the year, but in June, it has the highest reproductive activity (Salarpouri *et al*., 2014). The range of water temperature, which affects the fish reproduction, was reported between 18°C in shallow waters, to 22°C in deep habitat of *A. nibe* in the Northwest of Oman Sea (Ebrahimi, 2013). Raje (1988) reported that *A. nibe* might be introduced to shallow waters for spawning, and then migrate to deep waters offshore. The mean absolute and relative fecundity of *A. nibe* was calculated 97008±55553 eggs, with a moderate linear relationship between absolute fecundity and total length (Fig. 5). The fecundity of Scianidae species were reported very different in India waters, fecundity of *Nibea maculate* was in range of 21584 to 475043 eggs (Jayasankar, 1989), 57674 to 344288 eggs of *Scucni glauca*, 78477 to 341178 eggs of *Johnius volgari* (Rao, 1985), 134405 to 466417 eggs of *Penahia macrophthalmus* (Jacob, 1948), and 275000 to 560040 eggs of *Nibe coiter* (Ranjan, 1968). The range of 81726 to 1483369 eggs were reported for *Otolithes ruber* in the Persian Gulf (Eskandari, 1998). Unlu and Balci (1993) argued the differences in fecundity rate, are due to genetic differences of subspecies and environmental factors such as food preparation, population density and temperature variations. Fecundity rate varies between species and depends on age, length, weight and environmental conditions (Biswas, 1993).

The vacuity index of all individuals was estimated 86.5% during the study period and since this value is more than 80 and less than 100 percent (80≤VI=86.5%<100), so, according to the classification of Euzen (1987) for VI values, this species is abstemious feeder (Euzen, 1987). Comparison of VI between males and females showed no significant difference over the entire year (Valinasab *et al.*, 2011; Sarkhanizadeh *et al.*, 2014). The high VI value observed in this study may be due to the fishing gear and/or to the feeding behavior of fish at the moment of capture (Verheijen and De Groot, 1979). The rapid change in depth during the lifting of the trawl net probably caused the contents of the stomach to come out of the fish's mouth due to pressure changes, and therefore most stomachs were recorded empty. Khadem-Sadr *et al.* (2011) have also mentioned high-pressure difference as one of the important factors that causes gastric contents to be outflow in *A. nibe*. Also, it could be stated that the capture of individuals may have been occurred before the ingestion of prey items and/or after the digestion process, so, many individuals would have had an empty stomach at the moment they were collected (Ghanbarzadeh *et al.*, 2020). On the other hand, the diurnal vertical migration of skinnycheek lanternfish as a main food item of *A. nibe*, maybe the next reason of inaccessibility of food and raising of vacuity index. During the spawning season after October, feeding intensity was relatively low from October to January, according to these results, there is a close relationship between feeding intensity and reproduction period of *A. nibe* and efforts to gain energy for the development of gonads and reproduction have led to an increase in its feeding intensity before gonadal maturation peak in July (Figs. 3 and 7). During spawning period, the gonads especially ovaries, grow substantially larger, generally filling the body cavity. In most fish species, it has been proved that the feeding intensity reduces during the reproductive activity when the specimens bear developed gonads (Ghanbarzadeh et al., 2021; Pati, 1980; Menon, 1984). According to the data obtained, bony fishes were consumed by all size-classes, but were more observed in large size-classes, skinnycheek lanternfish (42.1%) and Japanese threadfin bream (79.4%) were more pronounced in size-class of 34-38 cm, and other bony fishes were found in larger size classes. Crustacean were present in medium size-classes, and more frequent (29%) in 22-26 cm size classes. It seems that small and medium size classes of *A. nibe* at first feed on skinnycheek lantern fish, shifting feed on other bonyfishes in large size classes. Ontogenetic changes in feeding habits of a given species are a kind of adaptation to use available food, avoid intra and interspecific competition, and enable the catching of larger and more energetic preys (Amara *et al.*, 2001; Amezcua *et al.*, 2003). The present study shows that Teleostei was the most common prey group in the diet of *A. nibe*, Crustacean had minor importance. The most important consumed Teleostei was skinnycheek lanternfish, which is a carnivorous species with the main food item of fishes, and amongst them the skinnycheek lanternfishes are the main



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food with FP value of 65% and it is in agreement with findings of Valinassab *et al.* (2011) in the northern Oman Sea and Apparao (1989) in Indian waters. The feeding habit of *A. nibe* in the Indian waters show that the main food were identified as different fishes consist of *Opisthopterus* sp., *Uranoscopus* sp. , *Cynoglossus* sp., *Anchoviella* sp. , *Bregmaceros* sp., *Pseudosciaena* sp. , *Trichiurus* sp. and *Caranx* sp. and different crustaceans consist of *Acetes* sp. , *Penaeus* sp., *Metapenaeus* sp., *Solenocera* sp. and *Squilla* sp. (Apparao, 1989). Sarksnizade *et al.* (2014) were considered skinnycheek lanternfishes, are the main diet item for which the FP index (67.7%), minor diet groups were shrimps with FP=29.2% , and other groups, nempiterids, isopods, crabs, flatfishes and other bony fishes, were less than 10%, making negligible contributions to the diet of *A. nibe* in the Oman Sea. In general, it can be stated that the food items found in *A. nibe* diet in this study are similar to those reported by Sarkhanizade *et al.* (2014), but differ from those reported in Indian waters. The reason for the difference in the abundance of food items in the stomach is related to the abundance of food in the environment or the availability of food in that area (Nikolsky, 1963; Abdel-Aziz *et al.*, 1993), these differences can be explained by the presence of a diet in addition to its availability and choice as a food (Wootton, 1990) depends on seasonal fluctuations and on the physical and chemical factors of the water (Cavetiviere, 1987).

As an overall conclusion, the *A. nibe*, black mouth croaker, is a carnivorous and abstemious species. They select their food items according to amount of availability, with preference of fishes in their habitats. This species mainly spawns in October, but have reproductive activity all around the year. According the LM50% and recently fishing evidence, it seems that *A. nibe* is being faced fishing pressure in the Oman Sea. Information of this study is important for fisheries management and understanding the reproduction characteristics and trophic relationship of this species in relation to other species in the ecosystem.

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## References

**Abdel-Aziz, S.H., Khalila, N. and AbdelMagid, S.S., 1993.** Food and feeding habits of the common guitarfish, Rhinobatos rhinobatos in the Egyptian Mediterranean waters.

*Indian Journal of Geo-Marine Sciences*, 22(**4**), 287-290. DOI: 10.1071/mf9930507

**Alizadeh, E. and Owliaei, M., 2017.** Report of fisheries statistics of Hormozgan province, Iran. Bandar Abbas (in Persian). 100 P.

**Amara, R., Laffargue, P., Dewarumez, J.M., Maryniak, C., Lagarde`re, F. and Luczac, C., 2001.** Feeding ecology and growth of 0-group flatfish (sole, dab and plaice) on a nursery ground (Southern Bight of the North Sea). *Journal of Fish Biology*, 58, 788–803. DOI:10.1111/j.1095-8649.2001.tb00531.x

**Amezcua, F., Nash, R.D.M. and Veale, L., 2003.** Feeding habits of the Order Pleuronectiformes and its relation to the sediment type in the north Irish Sea. *Journal of the Marine Biological Association of the United Kingdom*, 83, 593–601. DOI:10.1017/s0025315403007525h

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

**Asadi, H. and Dehghani, R., 1996.** Fishes of the Persian Gulf and Oman Sea. Iranian Fisheries Research Organization Publication. Aieneh Press, Tehran. 226 P.

**Berg, J., 1979.** Discussion of methods of investigating the food of fishes, with reference to a preliminary study of the prey of *Gobiusculus flavescens* (Gobiidae). *Marine Biology*, 50(**3**), 263–273. DOI:10.1007/bf00394208

**Biswas, S.P., 1993.** Manual of methods in fish biology. South Asian Publishers. 157 P.

**Bobko, S.J. and Berkeley, S.A., 2004.** Maturity, ovarian cycle, fecundity, and age-specific parturition of black rockfish (*Sebastes melanops*). *Fishery Bulletin*, 102(**3**), 418–429.

**Carpenter, K.E., Krupp, F., Jones, D.A. and Zajonz, U., 1997.** Living marine resources of Kuwait, Eastern Saudi Arabia, Bahrain, Qatar, and the United Arab Emirates. Food and Agriculture Org. 293 P.

**Cavetiviere A., 1987.** The feeding regime of the majore demersal species of the Ivery Coast (and of Gulf of Guineu). Center of the Islands Santscruz de Tenerife Spain. 23-27, NO. 89/48: 125-143.

**Desai, V.R., 1970.** Studies on the fishery and biology of Tor tor (Hamilton) from river Narmada. *Journal of Inland Fisheries Society* of *India*, 2(**5**), 101–112.

**Daan, N., 1973.** A quantitative analysis of the food intake of North Sea cod, Gadus morhua. *Netherlands Journal of Sea Research*, 6(**4**), 479–517.DOI:10.1016/0077-7579(73)90002-1

**Ebrahimi, M., Jokar, K.K., Azini, M., and Sanjabi, M., 2013.** Hydrology and hydrobiology studies on the Oman Sea, Iranian Fisheries Research Institute. 130 P.

**Eskandari, G., 1998.** Reproduction biology and feeding habits of Otholites ruber in khoozestan province, iran. PhD thesis, Shahid Chamran University. 112 P.

**Euzen, O., 1987.** Food habits and diet composition of some fish of Kuwait. *Kuwait Bulltein of Marine Science*, 9(**9–10**), 65–85.

**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. DOI:10.1006/ecss.1999.0560

**Fischer, W. and 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.

**Ghanbarzadeh, M., Kamrani, E., Ranjbar, M.S., Salarpouri, A. and Walters, C., 2020.** Food and feeding habits of Indian halibut, Psettodes erumei from the North of the Persian Gulf and Oman Sea. *Iranian Journal of Ichthyology*, 7(**2**), 167-180. DOI: 10.22034/iji.v7i2

**Ghanbarzadeh, M., Kamrani, E., Ranjbar, M. S., Salarpouri, A., and Walters, C., 2021.** Reproductive biology of Indian halibut, Psettodes erumei from the northern Persian Gulf and Oman Sea (Teleoststei: Psettodidae). Iranian Journal of Ichthyology, 8(**1**), 1-13. DOI:10.22034/iji.v8i1.434

**Heemstra, P.C., 1986.** Family Sciaenidae. Smiths' sea fishes. Springer-Verlag. 539P.

**Hunter, J.R., Lo, N.C.H. and Leong, R.J.H., 1985.** Batch fecundity in multiple spawning fishes. NOAA Tech. Rep. NMFS 36, 67–77.

**Hureau, J.C., 1970.** Biologie comparée de quelques poissons antarctiques (Nototheniidae). Expéditions Polaires Françaises. 244 P.

**Jayasankar, P., 1989.** Some observations on the biology of the blotched croaker *Nibea maculata* (Schneider, 1801) from Mandapam. *Indian Journal of Fisheries*, 36(**4**), 299-305.

**Johnson, G., Gill, A., Paxton, J. and Eschmeyer, W., 1998.** Encyclopedia of fishes. Academic Press, San Diego, CA., 439 P.

**Kawasaki, T., 1987.** Fisheries problems in the Yellow and East China Seas. Environment and Policy Institute, East-West Center. East-West Environment and Policy Institute Working Paper, 88-2, 124.

**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: Second edition. In Fisheries Biology, Assessment and Management: Second Edition. DOI:10.1002/9781118688038.

**Menon, N.G., 1984.** On the biology of the flatmouthed catfish *Tachysurus platystomus* (Day) from Mandapam. *Indian Journal of Fisheries*, 31(**2**), 293-308.

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

**Nikolsky, G. V., 1963.** The Ecology of Fishes. London : Academic Press, 352 P.

**Pati, S., 1980.** Food and feeding habits of silver pomfrct *Pampus argenteus* (Euphrasen) from Bay of Bengal with a note on its significance in fishery. *Indian Journal of Fisheries*, 27(**1,2**), 244–225.

**Pitcher, T.J., Watson, R., Courtney, A. and Pauly, D., 1997.** Assessment of Hong Kong's inshore fishery resources. Fisheries Centre. University of British Columbia. 78 P.

**Qasim, S.Z., 1973.** An appraisal of the studies on maturation and spawning in marine teleosts from the Indian waters. *Indian Journal of Fisheries*, 20(**1**), 166–181. CMFRI/ICAR.

**Raje, S.G., 1988.** Occurrence of black mouth croaker, *Atrobucca nibe* (Jordon and Thompson) off Veraval coast. *Indian Journal of Fisheries*, 35(**4**), 302-303.

**Randall, J.E., 1995.** Coastal fishes of Oman. University of Hawaii Press. 439 P. DOI:10.2307/1447687

**Rao, T. A., Lal Mohan, R. S., Chakraborty, S. K., Murty, V. S., Nair, K.V., Vivekanandan, E. and Raje, S.G., 1992.** Stock assessment of sciaenid resources of India. *Indian Journal of Fisheries* (in Persian), 39(**1,2**), 85-103.

**Rao, T.A., 1974.** On the occurrence of the sciaenid fish *Atrobucca nibe* (Jordon & Thompson) off Visakhapatnam. *Journal of the Marine Biological Association of India*, 16(**1**), 310-311.

**Rao, T.A., 1985.** A note on the spawning habits and fecundity of Johnius vogleri (Blecker) from Veraval coast. *Journal of Marine Biological Association of India*. 27(**1,2**), 217-218.

**Rezvani, S. and Ghavam, P., 2017.** Population Genetic Studies of *Atrobucca nibe* (Jordan and Thompson, 1911) Using D-Loop Sequencing in the norththwest coasts of the Oman Sea. *Journal of Aquaculture Development* (in Persian), 11(**2**), 91–103.

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

**Sarkhanizadeh, A., Valinassab, T. and Fatemi, M.R., 2014.** Evaluation of some feeding indices of *Atrobucca nibe* in the Northern



[ DOR: 20.1001.1.15622916.2021.20.3.5.8 ]

Oman Sea. *Journal of Novel Applied Sciences* (in Persian), 3, 1268-1274.

**Sasaki, K., 2001.** Sciaenidae. In Carpenter KE, Niem VH, editors. FAO species identification guide for fishery purposes. The living marine resources of the Western Central Pacific. Vol. 5: Bony Fishes Part 3 (Menidae to Pomacentridae). FAO, Rome, Italy.

**Unlu, E. and Balci, K., 1993.** Observation on the reproduction of *Leuciscus cephalus orientalis* (Cyprinidae) in Savur stream (Turkey). *Cybium*, 17(**3**), 241-250.

**Valinassab, T., Salarpouri, A., Darvishi, M., Kaymaram, F., Ebrahimi, M. and Taghavi, A., 2011.** Status of Lanternfish Stocks and Exploitation in the Oman Sea. Iranian Fisheries Research Organization Publication (in Persian). 90 P.

**Valinassab, T. and Salarpouri, A., 2017.** Black Mouth Croaker a new target for commercial exploitation in offshore waters of the Oman Sea. *Journal of Marine Fishes* (in Persian). 1(**1**), 33–42.

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

**Verheijen, F.T., and De Groot, D.J., 1979.** Diurnal activity pattern of Plaice and Flounder (Pleuronectidae) in aquaria. *Netherlands Journal of Sea Research*, 3(**3**), 383-390.

**Wootton, R. 1990.** Ecology of teleost fishes. Chapman and HaHall. London. 404 P. DOI:10.1007/978-94-009-0829-1

**Yamada, U., Shirai, S. and Irie, T., 1995.** Names and illustrations of fishes from the East China Sea and the Yellow Sea: Japanese Chinese Korean. Overseas Fishery Cooperation Foundation. 288 P.