Hadhramout University Journal of Natural & Applied Sciences

Volume 15 | Issue 2 Article 11

2021

Reproductive Biology of Arabian Pandora, Pagellus Affinis (Boulenger, 1888) from Hadhramout Coast, Gulf of Aden

Mohammed Abdullah Al-Dohail
College of Environmental Sciences and Marine Biology, Hadhramout University

Sabri Mohammed Lagerb
** Factory of Fish Can; Science of Oceanographic and Marine Biology Authority- Mukalla*

Kamal Ahmed Baaoom
College of Science, Hadhramout University

Reproductive Biology of Arabian Pandora, *Pagellus* Affinis (Boulenger, 1888) from Hadhramout Coast, Gulf of Aden

Mohammed Abdullah Al-Dohail* Sabri Mohammed Lagerb**

Kamal Ahmed Baaoom***

Abstract

Two hundreds and fifty eight fish of *P. affinis* samples were randomly collected from Hadhramout coast, Gulf of Aden during period of March 2012 until April 2013. Generally, the best growth performance of *P. affinis* was occurred from May to September related to available nourishment, upwelled bottom nutrient. Length-weight relationship was 2.83 appeared the isometric growth during whole year. Sex ratio was revealed 1:1, males to females in whole year. The gonado somatic index values were above 3%, showing that spawning could be placed in June to September in a year at length 20.2 cm to 22.8 cm, with a peak of activity spawning in September. The highest percentage of absolute fecundity was 35% in June followed by 25% in both August and July, whereas the lowest percentage was 15% in September. Also, condition factor give the impression the sexual maturity from July to November at 19 cm to at 21.1 cm length.

Keyword: biological aspects, spawning behaviors, *Pagellus Affinis*.

Introduction:

Arabian Pandora *Pagellus affinis* (Boulenger,1888) is one of the most commercially important artisanal fish in Hadhramout coast which is one of the important demersal marine fish [4]; it is widely distributed in the Western Indian Ocean from Persian Gulf to the Gulf of Aden and northern coasts of Somalia [4]. [14] reported that catch of Arabian Pandora, *Pagellus affinis* in Oman has stopped for a year-long sampling in the Arabian Sea, revealing a high number of immature fish. Inhabits of the demersal fish species are various from sea bottom, especially sea grass beds and sand down to 500 m depth, but is more common between 40 and 100 m. Many sparids are omnivores in their feeding [9]. The artisanal fishermen use hand lines, gillnets and traps in order to capture of seabreams in the coastal coast while the industrial trawlers fish use in deeper coast (up to 150 m depth) in the Arabian Sea, Oman and Gulf of Aden. Among the sparids of Hadhramout coast, the Arabian Pandora *Pagellus affinis* is the
common commercially important species. The Arabian Pandora has a palatable flesh and is usually marketed fresh or frozen [1].

The length–weight relationship of fish could be affected by many factors such as food availability, feeding rate, sex, seasons, stage of maturity, and environmental conditions [24، 25]. It is determined by calculating the mathematical relationship between the two variables: the individual length and the weight of fish throughout the value of a and b. Also, the growth of fish is isometric when the b value is 3.0, indicating the slower increasing weight when b value is less than 3.0 or faster increasing weight when b value is more than 3.0 [26].

It is known that the fish fecundity considered the total number of ripe eggs before spawning in the fish female [3]. Fecundity could be assessed from mature ovaries collected during the spawning period of mature females. [29] mentioned that studying fecundity used to evaluate the population and productivity of fish. generally, there are increasing in fecundity with the increase of the ovary weight, total weight and total length of the fish. The relationship between fecundity and relative fecundity showed similar trend.

Many authors reported that fishing management are the following: known the reproductive parameters of fish such as the age, length at maturity, proportion of mature fishes in the population, fecundity and spawning frequency [16،20،27]. Besides, they mentioned that fish maturation dynamics are used to estimate the spawnners, egg, larval biomass, staging of gonads and estimates of reproductive parameters as they have been widely applied to manage capture fisheries, for instance, enforcement of minimum catch at size restrictions, closed fishing seasons during peak of breeding periods.

* Department of Marine Biology, Research Team, Faculty of Environmental Sciences and Marine Biology, Hadhramout University.

** Factory of Fish Can; Science of Oceanographic and Marine Biology Authority- Mukalla.

***Department of Biology, Faculty of Sciences, Hadhramout University, Mukalla, Yemen. Received on 6/12/2016 and Accepted for Publication on 8/10/2018

There are many studies in the Gulf of Aden and Arabian Sea. The studies in the Gulf of Aden were achieved on the most essential biological parameters for the dominant demersal fish such as biometrics, growth and mortality [7]; whoever in Arabian Sea the studies were achieved on the most essential biological parameters for *P. affinis* such as biometrics and growth [4].

Arabian Pandora *Pagellus affinis* is one of the most important fishes in Hadhramout coasts for people because of its very cheaper price in the market. Information regarding the biology of the *P. affinis* is not available from Hadhramout coast; therefore the present study was thus conducted to highlight the importance of the length and weight distribution, sex ratio, length-weight relationship, relative condition factor, gonado somatic index, absolute and relative fecundity, eggs number and frequency number of fish of *P. affinis* from Hadhramout coast in order to sustainable exploitation and management strategies too.

Material and Methods:

Area of Study:

The study area of present study is located on longitude and latitude at Broom N14^{o} 22' ; E49^{o} 00'and °Mukalla N14^{o} 48' ; E50^{o} 00' where Arabian Pandora, *Pagellus affinis* were caught from Hadhramout coast which connected to Gulf of Aden are shown in Plate 1.

Plate 1: The study area where Arabian Pandora, *Pagellus affinis* were caught from Hadhramout coast

Collocation of Samples:

Two hundreds and seventy three fish of Arabian Pandora, *P. affinis* (plate 2) specimens were collected during the present study; 128 of them were males, 124 of females and 6 of immature. The samples were randomly collected every week during period of March 2012 until April 2013 from fishermen who used traditional tools from Hadhramout coast, Gulf of Aden. The fishermen who catch the *P. affinis* used different fishing tools such as small long line, bottom gill net and traps. Attracted baits are usually sardine, crustaceans and cuttlefish. Also, some samples were collected from central fish landed in Mukalla city. The collected samples were immediately sent to Lab of Marine biology, Faculty of Environmental Sciences and Marine biology. The biological measurements were done for each sample: total length, total weight, gonad weight and sex.

Plate 2: Arabian Pandora, *Pagellus affinis* from the Hadhramout coast, the Gulf of Aden

Morphological Parameters

It is known that there are many morphological parameters as follows:

A) Total Length

Total length of fish were measured passes over straight-line from first point of
snout until the end point in the longer part of tail fin.

B) Total Weigh

Total weight is taken by digital electronic balance until 0.5 gm.

C) Gonads Weight

Gonads weight is taken by digital electronic balance until 0.01 gm.

Maturity Index

The monthly gonado-somatic index (GSI) was calculated for females and males by using the following formula (8); (10):

$GSI = (GW/ TW) \times 100$

Where, GW is the gonad weight (g) and TW is the total body weight (g).

The relative condition factor (K) was calculated for each month

$K = 100 (TW / TL^3)$

Where, TW is the total body weight (g) and TL is the total length (cm).

Fecundity of Fish:

Fecundity was determined from mature ovaries which collected during the spawning period of mature females. The ovaries were kept in formalin 5% for few days. Three samples of each ovarian lobe were taken and weighed ±0.005 g. Then these samples of ovaries were kept in modified Gilson"s fluid of Simpson for 2 weeks in order to easy separation of eggs. Each sample was placed in a cell counting chamber which divided into 75 squares, each square measuring 1 cm × 1 cm. The numbers of mature ova in squares were counted using a binocular microscope and were recorded. The absolute fecundity and relative fecundity were calculated using the following formulae:

$F = (C/SW) \times GW$

Where F is the absolute fecundity, C the number of mature eggs in the sample, SW is the weight of the sample and GW is the weight of the ovary.

$RF= (F/TW)\times 1000$

Where RF is the relative fecundity per g total body weight, F is the absolute fecundity, and TW is the total weight of the fish (g).

Statistical Analysis:

All statistical analysis was performed using the SPSS software packages, version 18. The ratio of sex, gonado somatic index and condition factor were analyzed and tested for differences between group means for significance ($P<0.05$) using the correlation, regression and T-test technique. Also, morphological parameters: fish weight, fish length and length-weight relationship, absolute and relative fecundity, eggs number and frequency number of fish were analyzed using Microsoft Excel 2010.

Results:

Weight of Fish:

Data for mean fish weight of *P. affinis* which were caught during May 2012 to April 2013 from Hadhramout coast, Gulf of Aden are shown in Figure 1. The highest mean weight of 172.20 g was observed in May 2012 and the lowest mean weight was 91.69 g in March 2013.

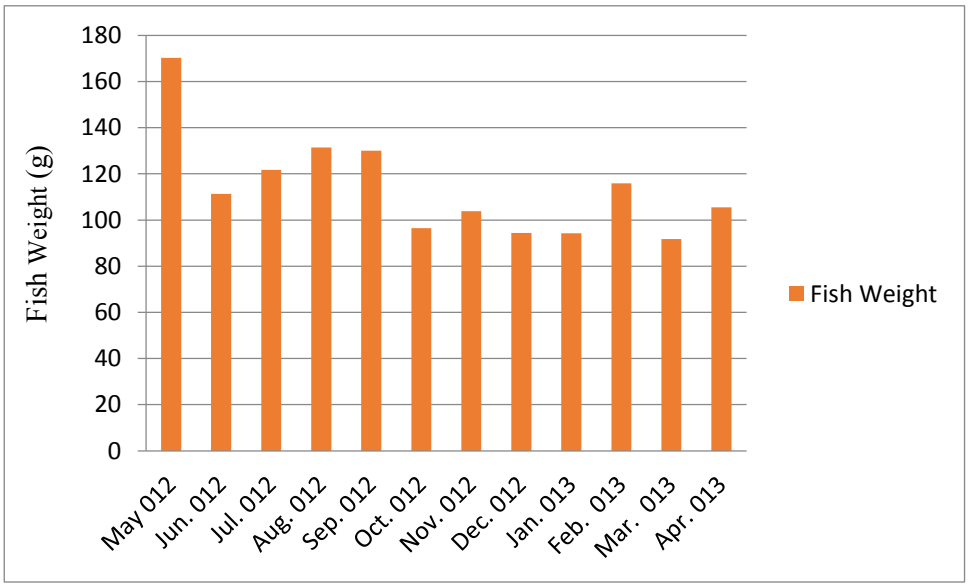

Figure1: Mean weight of P. affinis which used during study

Length of Fish:
Data for mean fish length of *P. affinis* were shown in Figure 2. The highest mean length of 23.31 cm was observed in May 2012 and the lowest mean length was 18.71 cm in March 2013.

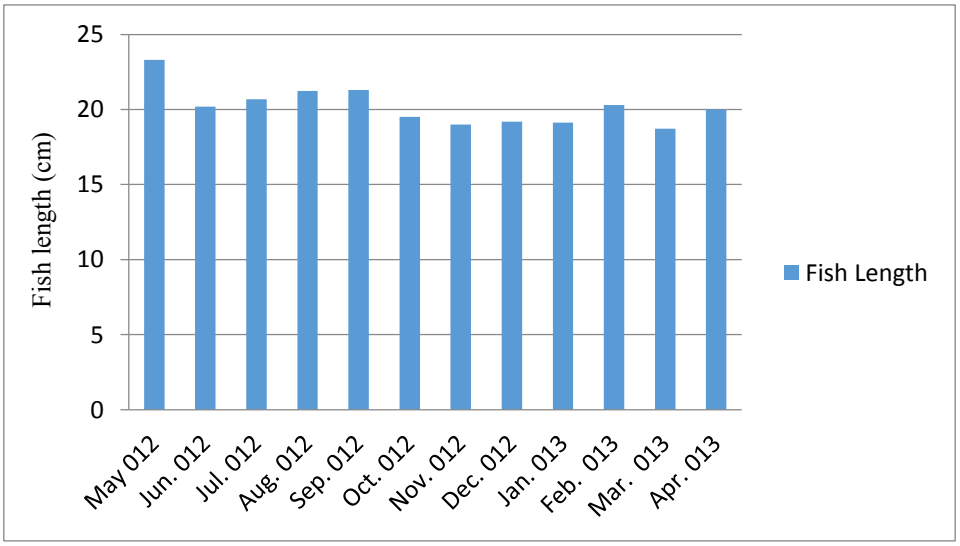

Figure 2: Mean length of *P. affinis* which used during study

Length-Weight Relationship:
Data for the length-weight relationship of *P. affinis* caught throughout May 2012 to April 2013 are shown in Figure 3. The results of present study showed that the b value was 2.84 and correlation coefficient R^2 was 0.96 during 12 months period.

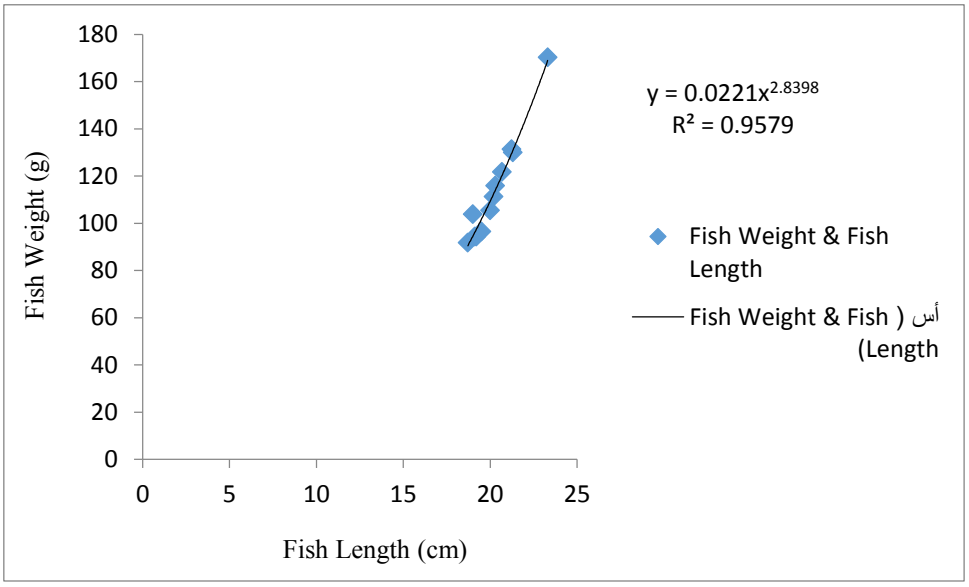

Figure 3: Length-weight relationships of *P. affinis* which used during study

Sex Ratio:

The results of present study showed that there were no correlation significant differences (*P>0.05*), regarding the monthly ratio of male to female of Arabian Pandora. Although the ratio of sex different from month to month, the mean ratio of sex in whole year is 1:1, males to females as summarized in Table 1. Also, Pearson correlation was 0.575.

Besides, T-test showed that no significant differences (*P>0.05*) regarding the ratio of sex monthly of both males and females. But, levene's test showed that there is homogenous between samples of males and females (Table 1).

Table 1: The ratio of males to females of *P. affinis*

Months	Male	Female	Ratio M to F
May 012	15	05	3:1
Jun. 012	25	33	1:1.3
Jul. 012	12	14	1:1.2
Aug. 012	32	15	2.1:1
Sep. 012	16	05	3.2:1
Oct. 012	11	06	1.8:1
Nov. 012	02	12	1:6
Dec. 012	01	04	1:4
Jan. 013	01	08	1:8
Feb. 013	04	04	1:1
Mar. 013	02	07	1:3.5
Apr. 013	07	11	1:1.6
Total	128	124	1:1

Gonado Somatic Index of Both Sexes:
The results showed that increasing length of 1 cm leads to increase gonado somatic index (GSI) about 0.542 regarding either to males or females of *P. affinis*, as summarized in Table 2. There was no a significant difference (*P>0.05*) regarding the gonado somatic index with length when regression was used. The highest value of gonado somatic index was 3.38 at 21.3cm of fish length in September followed by 3.24 at 20.2 cm of fish length in June and 3.57 at 20.68 cm of fish length in July as presented in Table 2.

Table 2: The gonado somatic index of both sexes of P. affinis

Months	Fish Length	Gonado Somatic Index
May 012	23.31	1.703
Jun. 012	20.20	3.236
Jul. 012	20.68	2.883
Aug. 012	21.24	2.815
Sep. 012	21.30	3.384
Oct. 012	19.50	1.274
Nov. 012	19.00	0.452
Dec. 012	19.20	0.278
Jan. 013	19.12	0.328
Feb. 013	20.29	0.431
Mar. 013	18.71	0.359
Apr. 013	20.00	2.360

Condition Factor of Both Sexes:
The results showed that increasing length of 1 cm leads to increase condition factor about 0.011 regarding either to males or females of Arabian Pandora, as summarized in Table 3. There was none a significant differences (*P>0.05*) regarding the condition factor of Arabian Pandora. The highest value was found in November and the lowest was appeared in October of *P. affinis* are shown in Table 3. It was 1.513 in November and 1.301 in October.

Table 3: The condition factor of both sexes of *P. affinis*

Months	Fish Length (cm)	Condition Factor
May 012	23.31	1.343
Jun. 012	20.20	1.350
Jul. 012	20.68	1.376
Aug. 012	21.24	1.371
Sep. 012	21.3	1.345
Oct. 012	19.50	1.301
Nov. 012	19.00	1.513
Dec. 012	19.2	1.332
Jan. 013	19.12	1.349
Feb. 013	20.29	1.387
Mar. 013	18.71	1.399
Apr. 013	20.00	1.318

Absolute Fecundity:
The results showed that, the highest percentage of absolute fecundity of *P. affinis* was 35% in June followed by 25% in both August and July, whereas the lowest percentage was 15% in September as presented in Figure 4.

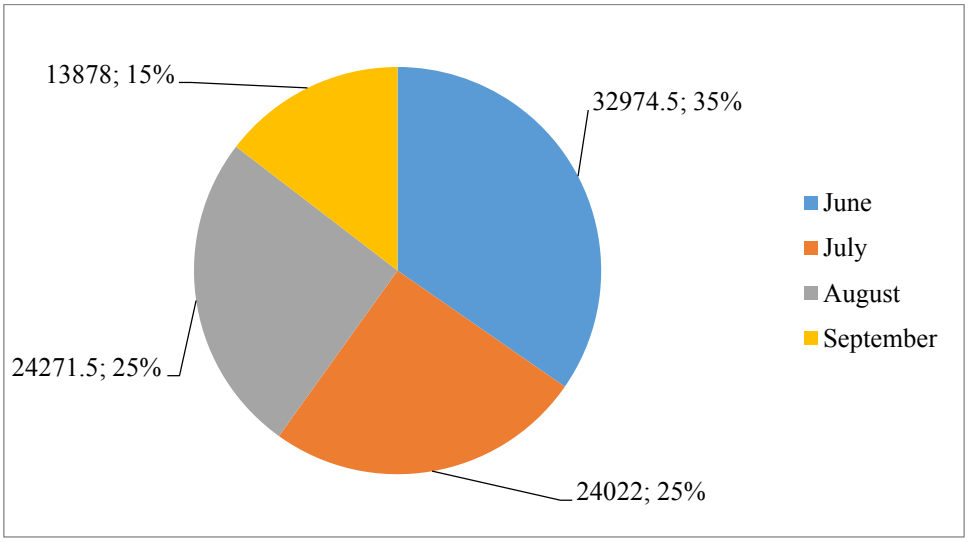

Figure 4: The absolute fecundity of *P. affinis*

Relative Fecundity:
The results showed that, the highest percentage of relative fecundity of *P. affinis* was 41% in June followed by 21% in August and 20% in September, whereas the lowest percentage was 18% in July as displayed in Figure 5.

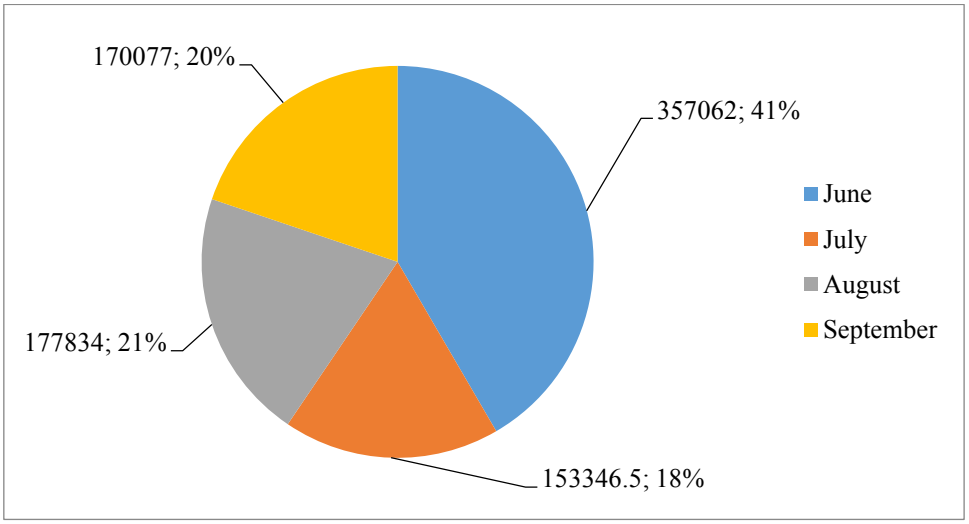

Figure 5: The relative fecundity for total weight of *P. affinis* which were caught in maturative months

Eggs Number:
The results showed that, the highest percentage of eggs number of *P. affinis* was 30% in July followed by 26% in September and 25% in June, whereas the lowest percentage was 19% in August as presented in Figure 6.

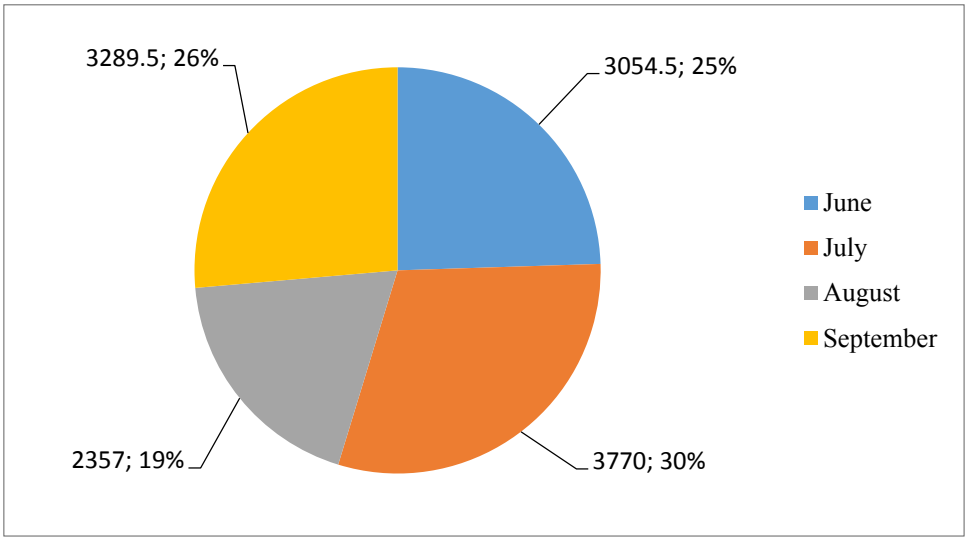

Figure 6: The eggs number of *P. affinis* which were caught in maturative months

Frequency of Fish Lengths:
The results showed that the monthly frequency of *P. affinis* were the highest frequency number (37 individuals) at range between 15 – 20.9 cm in length of fish in June compared to 22 individuals which arranged between 21.0- 26.9 cm in the same month, whereas the highest frequency number (33 individuals) at range between 21.0- 26.9 cm in length of fish in August compared to 14 individuals which arranged between 15 – 20.9 cm in the same month are shown in Figure 7.

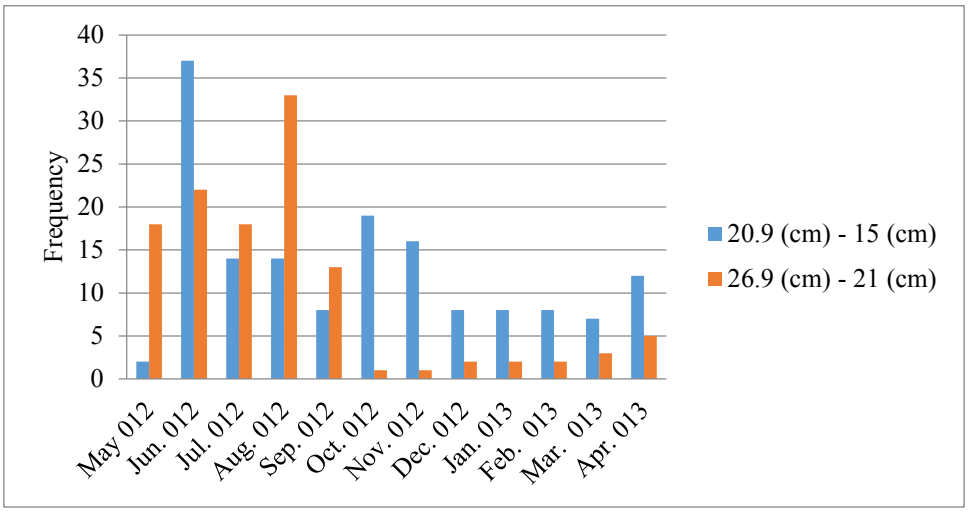

Figure7: The frequency of *P. affinis* lengths which used during study

Discussion:
The present study was conducted to know the biological aspects of Arabian Pandora *P. affinis*: the length and weight distribution, sex ratio, length-weight relationship, relative condition factor, gonado somatic index, absolute and relative fecundity, eggs number and frequency number of *P. affinis* from Hadhramout coast, Gulf of Aden.

The present study showed that the highest mean weight and length of *P. affinis* were observed in May followed by September, August and July (Figure 1 and 2). These explanations probably indicate that the growth performance of *P. affinis* are related to available nourishment, found more in these months than other months throughout year because of upwelling phenomenon,

upwelled bottom nutrient from May to September as supported by [22] who reported that upwelling areas, obtaining nutrient of zooplankton and phytoplankton, have enriched fish production; as mentioned by [21] who declared that the appropriating nutrition and spawning environment of fish, having better in the offshore region by upwelling phenomenon. Besides, the higher growth of *Strangomera bentincki* (Clupeidae) and *Engraulis ringens* (Engraulidae) were achieved with upwelled bottom nutrient [6]; high productivity of Clupeidae and Engraulidae were related to upwelling areas [2]. Other factors such as feeding rate, developing gonads and spawning period could be reasoned or perhaps other reasons could not be known yet due to rear information on the variation of weight and length connected to *P. affinis*.

For length-weight relationship of *P. affinis*, the b value was 2.84 (close to 3 value), showing mostly the isometric growth during whole year. The correlation coefficient R^2 was 0.96, increasing in length of fish indicate to increase in weight of fish during whole year are shown in Figure 3. These observations probably indicate that the isometric growth of *P. affinis* are linked by finding nourishment throughout the year as supported by [24] and [25] who reported that the length–weight relationship of fish could be affected by many factors such as food availability, feeding rate, sex, seasons, stage of maturity, and environmental conditions. Also, supported by (26) who declared that when the b value is 3, the growth of fish is isometric, whereas it indicates the slower increasing weight when b value is less than 3.0 or faster increasing weight when b value is more than 3.

It is known that the ratio of sex is an important parameter of population structure. For example, if the sex ratio have differed from ratio of 1:1 between males and females, this result would be indicated the effecting capture [12], patterning migration [23], rating mortality [17], differing season [11،19], changing structure in population of fish between inshore and offshore locations [13] and spawning season [5]. The results of the present study showed that although the ratio of sex different from month to month, the mean ratio of sex in whole year is 1:1, males to females (Table1). The statistical analysis appeared that there were no correlation significant differences ($P>0.05$), and also t-test showed that no significant differences regarding the ratio of sex monthly of both males and females. These explanations probably indicate that, in spite of differences from month to month, there is homogenous and link between number of males and females, relating to characters of *P. affinis* and also is no effecting capture. This suggestion supported by levene's test showed that there is homogenous between samples of males and females regarding the monthly ratio of male to female of Arabian Pandora *P. affinis,* as supported by [1] who stated that in *P. affinis,* the ratio of male to female is homogenous (1:1) in Oman coast, Arabian Sea. In contrast, the present results are differed from the ratio of 1 male to 0.88 female, in Oman coast of Arabian Sea, reported by [18]. This difference in sex ratio with the present study could be connected to the difference in geographic area and weather as well as effecting capture.

It is known that gonado somatic index (GSI) is measured the relative weight of the gonad regarding the fish length. Also, GSI determined the egg production which related to the percentage of body weight of fish or length of fish. The results showed that increasing length of fish by 1 cm leads to increase GSI about 0.542 regarding with both sexes of *P. affinis* (Table 2). There was no a significant difference ($P>0.05$) regarding the gonado somatic index with fish length when regression test was used. The highest value of gonado somatic index in both sexes were 3.384 at 21.3 cm length appeared in September followed by June, July and October (Table 2). These observations indicates that important the increasing length of fish effecting on gonado somatic index and GSI values were above 3%, showing that spawning could be placed in June, July to September in a year at length 20.2 cm to 22.8 cm of fish. These suggestions supported by [1] who described that in *P. affinis*, the high increasing in the mean monthly gonado somatic index displayed obviously prolonged spawning season from June to October, with a peak activity in August and September in the Arabian Sea. Also, supported by [28] who pronounced that when the value of GSI is more than 3.7%, the spawning will happen very soon in pandora *Pagellus erythrinus.*

For the fish condition factor which shows a measure of various ecological and biological factors: degree of fitness, developing gonad and feeding situation [15]. The high value of condition factor means that the fish achieved a better condition. The fish condition factor affected due to: stress, sex, feeds, water quality and season [15]. The results showed that

increasing length of fish by 1 cm leads to increase the condition factor about 0.011 regarding either males or females of Arabian Pandora, *P. affinis*. There was none a significant differences (*P>0.05*) regarding the condition factor of *P. affinis*. In both sexes of *P. affinis*, the highest value was 1.52 at 19 cm length in November (Table 3). These explanations indicates that important the increasing length of fish relating the condition factor, showing the sexual maturity in both sexes of *P. affinis* at 19 cm length in November. These suggestions supported by [1] who described that the sexual maturity in *P. affinis,* in Oman Arabian Sea, assessed in both sexes of 22.8 cm in length. Also (18) reported that the sexual maturity of *P. affinis,* in Oman Arabian Sea, evaluated in both sexes at 21.9 cm in length. The little bit differences in values from the present study could be related to variation of geographical area and available of nourishments and other environmental factors.

It is known that the fish fecundity considered the total number of ripe eggs before spawning in the fish female [3،29] mentioned that studying fecundity used to evaluate the population and productivity of fish. The results showed that, the percentage of absolute fecundity of *P. affinis* was 35% in June followed by 25% in both August, July and 15% in September (Figure 4). The percentage of relative fecundity of *P. affinis* was 41% in June followed by 21% in August, 20% in September and 18% in July (Figure 5). Besides, the percentage of eggs number of *P. affinis* was 30% in July followed by 26% in September, 25% in June and 19% in August (Figure 6). These observations indicate that spawning period of *P. affinis* placed in June, July, August and September, linking the available nourishment because of upwelling phenomena at those months in Hadhramout coast, Gulf of Aden as supported by [22] who reported that upwelling areas, containing the nourishment, are suitable for benefit fish production; also mentioned by [21] who declared that upwelling phenomenon making offshore region the rich with nourishment and suitable spawning environment for fish. Besides, [1] supported our findings, who reported that in *P. affinis* the spawning season take place from June to October in Oman coast, Arabian Sea. Other factors such as feeding rate, developing gonads and spawning period could be reasoned or perhaps other reasons could not be known yet owing to rear information on fecundity related to *P. affinis* in Arabian Sea and Gulf of Aden.

For frequency of fish lengths, The results showed that the monthly frequency of *P. affinis* were the highest frequency number (37 individuals) at range between 15 – 20.9 cm in length of fish in June compared to 22 individuals which arranged between 21.0- 26.9 cm in the same month, whereas the highest frequency number (33 individuals) at range between 21.0- 26.9 cm in length of fish in August compared to 14 individuals which arranged between 15 – 20.9 cm in the same month (Figure 7). These explanations indicate that the frequency number of small size fish is more than the big size fish in June, whereas frequency number of small size fish is less than the big size fish in August, connecting to available of nourishment where the upwelling phenomenon start slowly from June until September, with the peak in August.

In the present study, we can conclude that in general the growth performances of *P. affinis* are observed from May to September and shown the isometric growth during whole year. Also, there is homogenous and link between number of males and females (ratio of sex in whole year is 1:1, males to females). Besides, it is possible to conclude in general, from GSI values and condition factor values, the sexual maturity, mature stages and spawning period of *P. affinis* placed in June to November. In addition, we can recommend that: firstly, fishing of *P. affinis* in Hadhramout coast should be stopped during spawning season from first of June to end of September. Secondly, the *P. affinis* size larger than 18 cm should be avoiding fishing through the year. Finally, artificial breeding, releasing larvae to natural water bodies and artificial culture of *P. affinis* should be taken in account in order to support the population and decline the pressure of natural stocks.

Acknowledgements:

The authors would like to thank the research team of marine biology. This study was funded by Hadhramout University under programme of M.Sc. study in department of marine biology of Faculty of Environmental Sciences and Marine Biology.

References:

1- Al-Kiyumi, F. (2013). Biology and Fisheries Assessment of the Arabian PandoraPagellus affinis (Boulenger, 1887) in the Arabian Sra, Sultanate of Oman. PhD thesis, University of Tasmania.

2- Arcos, D. (1987). Seasonal and short time scale variability in copepod abundance and species composition in an upwelling area off Concepción coast, Chile. . New York: PhD thesis. State University of New York, Stony Brook.

3- Bagenal, T. B., & Braun, B. (1978). Egg and early life history.In Bagenal,. In T. B. (ed) (Ed.), Methods of the assessment of fishp roduction in fresh waters. (T. B. (ed) ed., pp. 16 5- 201). Oxford.

4- Bauchot, M.-L., & Smith , M. M. (1984). Sparidae. FAO species identification sheets for fishery purposes. Western Indian Ocean (Fishing Area 51). (W. Fischer and G. Bianchi (eds.) ed., Vol. 4). Rome.: FAO.

5- Cao L, e. a. (2009). The evolution, complex structures and function of septin proteins. . Cell Mol Life Sci 66(20), 3309-23.

6- Cubillos, L., Arcos, D. F., Buncarey, D. A., & Canales, M. T. (2001). Seasonal growth of small pelagic fish off Talcahuano, Chile (37°S, 73°W): A onsequence of their reproductive strategy to seasonal upwelling? Aquat. Living Resour. 14, 115-124.

7- Edward, R., Ghaddaf, A. .., & Shaher, S. (1986). Demersal Fish Population of Yemeni Coastal Water Mar. Sci. Resources Res . Centre Aden UNESCO Project 703/PDY/40.

8- June, F.C. (1953). Spawning of yellowfin tuna in Hawaiian waters. 54.

9- Figueiredo, M., Morato, T., Barreiros, J. P., Afonso, T., & Santos, R. (2005). Feeding ecology of the white seabream, Diplodus sargus cadenati, and the ballan wrasse, Labrus bergylta, in the Azores. . Fish. Res. 75(1-3),, 107-119.

10- Yuen, H.S.Y. (1955). Maturity and fecundity of big-eye tuna in the Pacific. [Journal] // US Fish and Wildlife Service, Special Scientific Report.

11- Hoey, J. (1991). Sex ratio data for western North Atlantic swordfish. ICCAT Coll. Vol. Sci. Pap. 34(2), 429–436.

12- Hood, P., & Johnson, A. K. (1999). Age, growth, mortality, and reproduction of Vermilion snapper (Rhomboplites aurorubens) from the eastern Gulf of Mexico. Fish. Bull.(97), 828– 841.

13- Hyndes, G., & Longeragan, N. R. (1992). Influence of sectioning otoliths on marginal increment trends and age and growth estimates for the flathead, Platycephalus soeculator. Fish. Bull. 90, 276–284.

14- Iwatsuki, Y., Russell, B., Pollard, D., Mann, B. Q., Carpenter, K. E., Buxton, C. D., et al. (2014). Pagellus affinis. The IUCN Red List of Threatened Species. Version 2014.3. Retrieved March 27, 2015., from www.iucnredlist.org

15- Khallaf, E., Galal, M., & Athuman, M. (2003). The biology of Oreochromis niloticus in a polluted canal. Ecotoxicology.12, 405-416

16- Kjesbu, O., Solemdal, P., Bratlan, P., & Fonn, M. (1996). Variation in annual egg production in individual captive Atlantic cod (Gadus morhua). Can. J. Fish. Aquat. Sci. 53, 610–620.

17- Mazzoni, R., & Caramaschi, E. P. (1997). Spawning season, ovarian development and fecundity of Hypostomus affinis (Osteichthyes, Loricariidae). Rev. Brasil. Biol. 57(3), 455–462.

18- McIIwain, J., Hermosa, G. V., Claereboudt, M., Al-Oufi, H. S., & Al-Awi, M. (2006). Spawning and reproductive patterns of six exploited finfish species from the Arabian Sea, Sultanate of Oman. J. Appl. Ichthyol. 22(2),, 167–176.

19- Mejuto, J., Garcı´a, B., & Quintans, M. (1991). Areliminary analysis of the sex-ratio of the swordfish (Xiphias gladius) in the North Atlantic by size class using space-time strata. ICCAT Coll. Vol. Sci. Pap. 35(2), 473–481.

20- Rickman, S., Dulvy, N. K., Jennings, S., & Reynolds, J. D. (2000). Recruitment variation related to fecundity in marine fishes. Can. J. Fish. Aquat. Sci. 57, 116–124.

21- Rykaczewski, R., & Checkley Jr., D. M. (2008). Influence of ocean winds on the pelagic ecosystem in upwelling regions. Proceedings of the National Academy of Sciences 105 (6),, 1965–1970.

22- Ryther, J. (1969). Photosynthesis and fish production in the sea. . Science 166, 72–76.

23- Sadovy, Y., & Shapiro, D. Y. (1987). Criteria for the diagnosis of hermaphroditism in fishes. Copeia 1, 136–156.

24- Santos, M., Gaspar, M. B., Vasconcelos, P., & Monteiro, C. C. (2002). Short communication: Weight-length relationships for 50 selected fish species of the Algarve coast (southern Portugal). Fish. Res. 59(1),, 289–295.

25- Seisay, M. (2001). Population ecology of dab (Limanda limanda L.) in the eastern Irish Sea, North Wales. . Unpublished PhD Thesis. School of Ocean Science. University of Wales, Bangor,227p.

26- Sharma, K. R., & Bhat, R. A. (2015). Length-weight relationship, condition factor of rainbow trout (Oncorhynchus mykiss) from Kashmir watersScholars. Research Library Annals of Biological Research 6 (8)(http://scholarsresearchlibrary.com/archive.html), 25-29.

27- Trippel, E., Kjesbu, O. S., & Solemdal, P. (1997). Effects of adults age and size structure on reproductive output in marine fishes. In R. T. Chambers (Ed.), Early Life History and Recruitment in Fish Populations. (pp. 31–62.). London: Chapman & Hall.

28- Valdes, F., Gupta, R., Rose, J. A., & Singh, H. P. (2004). The Indo-US Library of Coudé Feed Stellar Spectra. The Astrophysical Journal Supplement Series., 152(2), 251-259.

29- Wootton, R. (1990). Ecology of teleost fishes. London: Chapman & Hall, .

الخواص البيولوجية وسلوك التكاثر لسمكة البندورة العربية Pagellus Affinis في ساحل حضرموت –خليج عدن

محمد عبدالله الدحيل صبري محمد لجرب

كمال أحمد باعوم

الملخص

هذه الدراسة أنجزت لتقدير الجوانب البيولوجية وسلوك التكاثر مثل: قياس الطول والوزن ، ونسبة الجنسين، علاقة طول بالوزن، نسبة معامل الحالة، مؤشرات الغدد التناسلية ، الخصوبة المطلقة والنسبية، عدد البيض وعدد تكرار أطوال الأسماك بالنسبة لسمكة البندورا العربية جنس Pagellus affinis من مياه حضرموت –خليج عدن. جمعت مائتان وثلاثة وسبعون عينة من الأسماك البندورا العربية عشوائيا خلال الفترة من مارس 2012 حتى أبريل 2013. اظهرت النتائج عموماً ان أفضل أداء نمو لأسماك البندورا العربية كان من مايو إلى سبتمبر وذلك لتوفر المغذيات بسبب انبثاق المياه من أسفل إلى أعلى. وقد ظهرت علاقة الطول بالوزن أن النمو متساو خلال عام كامل. وكذلك نسبة الجنس الذكور للإناث كانت 1:1 خلال السنة. وكانت القيم لمؤشرات الغدد التناسلية أكثر من 3٪، والتي تبين أن وضع البيض يمكن أن يكون في الفترة من يونيو إلى سبتمبر عند طول الأسماك من 20.2 سم إلى 22.8 سم، و ذروة النشاط لوضع البيض في سبتمبر. أيضا معامل الحالة تعطي انطباعاً عن النضج الجنسي لهذا النوع من الأسماك في الفترة من يوليو إلى نوفمبر عند أطوال 19 سم إلى 21.1 في سم على مدار العام.

الكلمات ذات الدلالة: الجوانب البيولوجية، سلوك التكاثر، البندورة العربية