Some Biological Aspects of Sea Bream (Acanthopagrus Latus) In Shatt Al-Arab River, Iraq

Layla A. Aufy [1], Shaymaa A.J. Al-Jumaiee [2]

Abstract: Acanthopagrus latus caught from Shatt Al-Arab river, then its growth pattern, age, length-weight relationship, condition factor, as well as reproduction were investigated. Samples were monthly collected from September 2020 to August 2021 by gill nets. Total length and wet weight were recorded, and fish were sexed by extracted gonads out of the body cavity and examined and weighted, and using scales to determine the age of the species. The total lengths of species ranging from 10.7 to 23.7 cm. The length-weight relationships of males and females together were estimated as W=0.016 L3.007 and exhibited isometric growth (b=3.007). Mean relative condition factor (Kn) was 1.09 and 1.34 for males and females respectively. The maximum age was four years according to the reading of scales. The growth equation (von Bertalanffy) represented as: [Lt = 50.4(1-e-0.25(t+0.277)] using back calculated length. The growth performance index (Φ) was 2.56. The ratio of sex was 1:1.13 male to female. The peak of Gonadosomatic index (GSI) for both sexes was in March. The spawning period from March to May. The results generally showed that this species was slow growing relatively and had along live, which should be taken into account for sustainable management and exploitation to prevent excessive utilization in the studying area.

Key Words: Acanthopagrus latus, growth, reproduction, age, shatt al-arab river.

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Introduction

Sea breams, species of the Sparidae family, found in both temperate coastal water and tropical waters (Randall et al., 1997). The sea breams (Sparidae), which consist of roughly 36 genera and 130 species, are found within shallow temperate as well as tropical seas of the Atlantic, Indian, and Pacific oceans (Eschmeyer & Fong 2011). A broadly widespread fish with significant economic and ecological importance in the Indo-West Pacific is the yellowfin seabream (Acanthopagrus latus) (Xia et al., 2008).

This fish, a protandrous hermaphrodite like many other sparidae, typically spans a large biogeographic spectrum but is particularly common in shallow warm coastal waters, frequently reaching estuaries and mouths of river (Li and Ou, 2000; Xia et al., 2008). Fish growth patterns in both applied and fundamental management, are useful for estimating fish weight from its length measures (Hossain et al., 2009), calculating the biomass and productivity of the population of fishes (Hossain et al., 2016), and providing data about the stock's health (Hossen et al., 2020). Among the previous studies on this species in the Shatt al-Arab and Khor al-Zubayr is the study of Al-Hassan (1990) studied the genetic and phenotypic changes among the species in the Shatt Al-Arab. Al-Dubakel & Abdullah (2006) noted that there was a positive correlation between otolith's weight with both the weight and the total body length of three studied species, including A.latus in Khor Al-Zubayr, and Abdulsamad (2010) studied the age and growth of this species in the Shatt al-Arab river . The aim of the current study is to ascertain some biological parameter such as the age, growth pattern, condition factor, length-weight relationship, and reproduction of A.latus within the Shatt Al-Arab River from September 2020 to August 2021.

Materials and Methods

Gill nets with length of 200 to500 m and mesh size of 25x25 mm were used to collect 273 individual every month from September 2020 to August 2021 from Shatt Al-Arab river (Abu Al-Khasib location) south of the Abu Al-Khasib area (30° 46' 37" N, 47° 77' 11" E) (Figure 1).

Crushed ice was used to reserve samples and transport them to the laboratory, where they underwent immediate analysis. The length and weight of each fish were measured to the nearest 0.1 cm and 0.01 gm, respectively. Five to ten scales between the lateral line and the base of the dorsal fin from each fish were collected and placed in labeled envelopes. In between two glass slides, scales were placed after being washed with warm water. Using a micro-projector (20X magnification) to estimate age, determine the radius of the scale and the expanse between each annulus.

The length-weight relationship's regression equation is estimated using exponential regression :W= a Lb, where; W = total weight (gm), L = total length (cm), a = regression's intercept, and b = regression coefficient (slope) (Froese 2006). The Student's t-test was used to determine whether allometric coefficient "b" deviated regarding the predicted of isometric

growth value (b = 3). The formula Kn = W-/W (Le Cren, 1951) has been used to obtain the relative condition factor (Kn) in terms of sex as well as months; where W- = observed weight, and W= estimated weight.

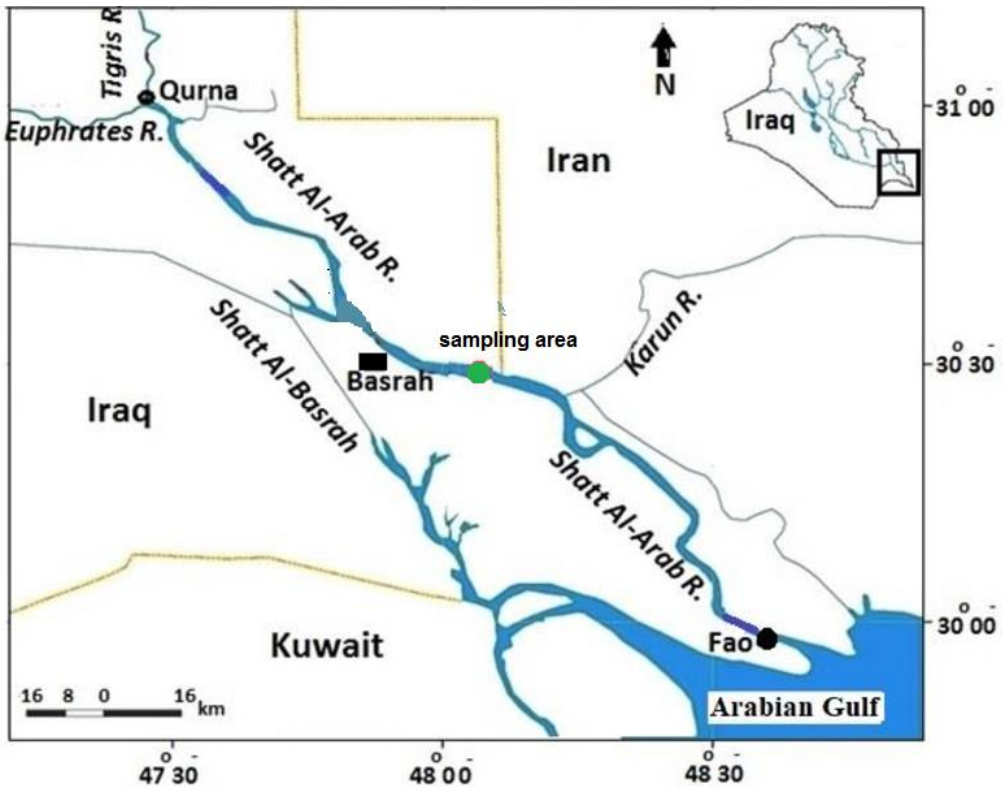

Figure 1. Map showing the Location of studying area.

The scale was read using a Projectina microscope [Form: 4014 BK-2] at 10x magnification. The radius of every annulus in addition to the scale's edge was measured from the enlarged image. The formula □L=a + bS□ (Bagenal and Tesch, 1978) as (a) represents intercept [correction factor] while (b) represents regression line, was used to determine the relationship between the length of fish at the time of capture (L) and scale radius (S). Following equation is employed to calculate total length at age: □Ln= a + Sn /S (L-a)□; as (Ln) represents length of fish at the age (n) and (a) is the correction factor, while annulus' radius was represented by (Sn); also (S) = radius of the scale, and (L) represented the length of fish at a moment it was captured.

The equation of von Bertalanffy was used to examine hypothetical growth in length: Lt = L∞ (1 – e -K (t - t0)), where (Lt) = the length of fish at age (t) ; (L∞) = the asymptotic length of fish , (K) = the coefficient growth, and (t0) represents hypothetical age at which the fish had zero length (Ricker, 1975).

The following formula was using to estimate the index of growth performance (Φ) = log10 K + 2 log10L∞ (Pauly and Munro, 1984).

The gonads were then taken out of the body cavity, weighed, and inspected macroscopically to determine their sex. Only fish with clearly distinguishable male and female gonads had their monthly male to female specimen ratios calculated. The chi-square (X2) method was used to determine the sex ratio (Sokal and Rohlf, 1995). Using monthly changes of the gonado-somatic index (GSI) to determine the spawning period of the species. GSI= Gonad weight / Body weight) * 100 (King,2013).

Results

Length-weight relationship

The relationship between total length and body weight regarding A.latus is calculated on the entire sample, with total lengths ranging from 10.7 to 23.7 cm and weights ranging from 24.21 to 214.9gm, as there was no statistically significant differences between sexes in regressions (t= 0.335, P>0.05). Figure(2) demonstrates how body weight increased exponentially with overall length: W=0.016 L3.007 (r2= 0.955). The t-test revealed that the relationship's regression coefficient (b) was very close to 3, demonstrating isometric growth.

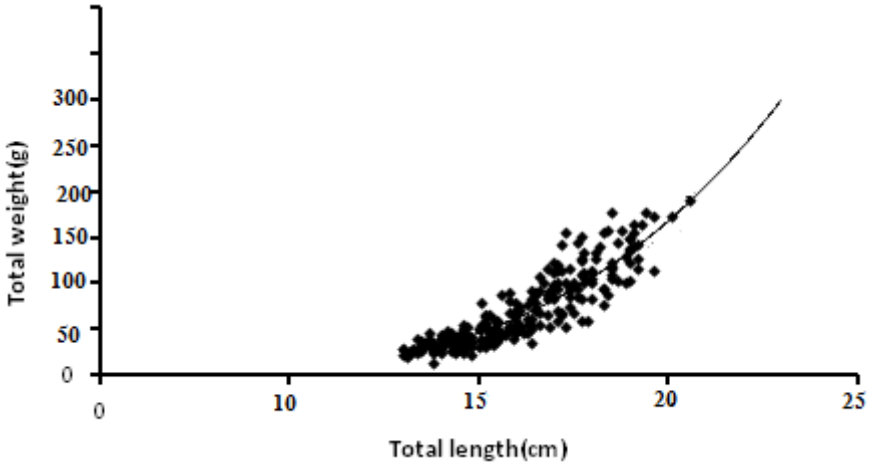

Figure 2. The length-weight relationships of A.Latus

Relative condition factor

Similar tendencies were seen in both sexes in the monthly change of the relative condition factor (Kn) between A. latus (Figure 3). Kn for males ranged from 0.91 in August to 1.09 in April, whereas it was 0.89 in August to 1.34 in April for females.

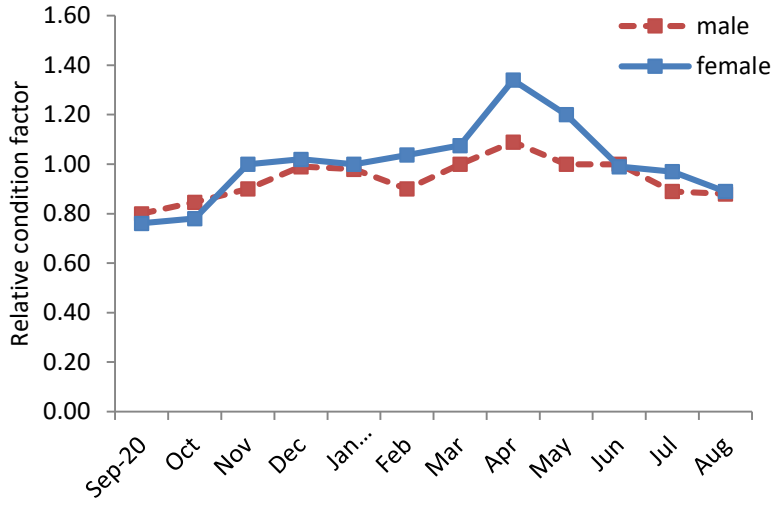

Figure 3. Relative condition factor (Kn) of A.latus

Age and Growth

Scales provided an estimated age range of 1 to 4 years, with the majority of samples being one year old. The equation for the relationship between the fish's total length (L) and the scale radius (S) was L = 1.941 + 0.87S. Increased coefficient correlation (r2 =0.902) showed the relationship's linear agreement. Based on a back lengths calculation from various age fish, the average length of A.latus for every annulus is displayed in (Table I).

The first year of life showed occurrence of rapid development in length, which was subsequent to an interval of slower growth rate among left life years. The annual increment percentage was fluctuated from 50.6% in the first life's year to 10.9% in the fourth life's year (Table I). Age/length data for A. latus were adjusted using the von Bertalanffy growth model, which is represented like the following: {Lt = 50.4 (1 - e-0.25 (t + 0.277))}. The growth performance index of A. latus is estimated to be 2.56.

Table 1. A.latus's average observing and back-calculated total lengths.

Age	Number of fish	Length at age (cm)			
		1	2	3	4
1	32	12.7			
2	45	13.1	16.3		
3	11	14.7	16	19.3	
4	5	14.8	17.9	19.5	22.3
Mean length (cm)		12.8	16.9	22.1	25.3
Annual increment (cm)		13.2	4.5	3.2	2.7
% Growth increment		15.6	7.2	5.3	2.9

Reproduction

GSI for both males and females of A.latus reached its peak in March, with the principal spawning season lasting until June. The Gonado-somatic index start reaches its maximum value in March, when it reached 8.9 for males and 9.3 for females, indicating that the maturity of gonads starting from October, and their weight increases until it reaches its maximum during the March, then it decreases. The values of the GSI decreased with the period of spawning from April until June, the lowest value of GSI recorded in August was 0.32 and 0.45 for males and females respectively (Figure 4).

The gonads of A. latus did not have any macroscopically identifiable ovaries during the summer (July to September) or include rather large volumes of both immature ovarian. Due to the process of sex change, there were a greater number of fish ovotestes in August that had great amounts of both immature testis and ovary. The number of females significantly raised their contributions during the winter. The general sex ratio (M : F) was 1:1.13 and did not deviate substantially from 1:1.

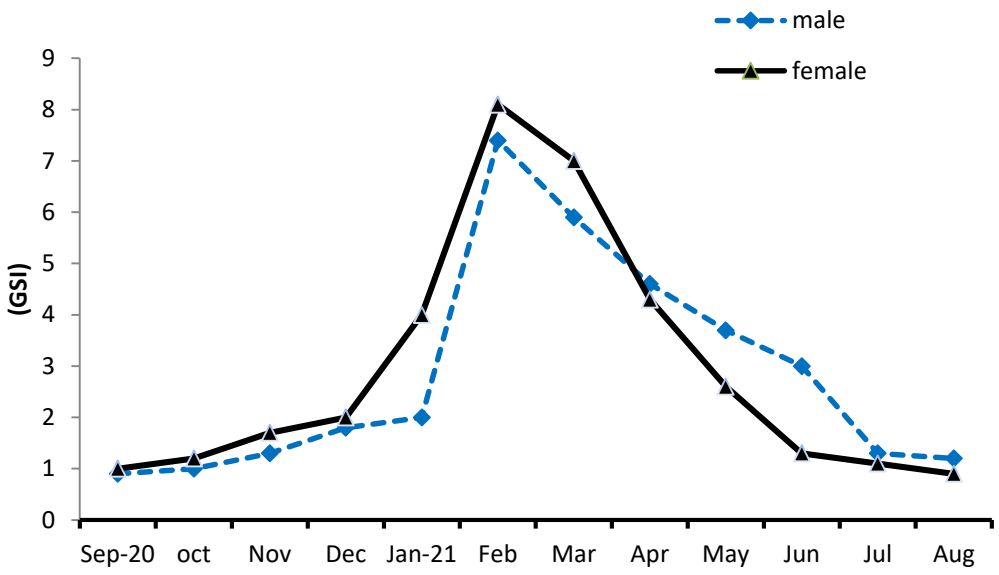

Figure 4. GSI for males and females of A.latus

Discussion

Studying the biology of sea bream A. latus is crucial for figuring out the nature of fish populations and if these communities are made up of one or many groups (Ghasemi and Shadi, 2018). Interestingly, the majority of local studies dealt with the presence and growth of A. latus in Iraqi waters, whether marine, Shatt al-Arab, Shatt al-Basra as well as the southern marshes due to their great ability to be present in various sizes and stages of different maturity in more than one different Iraqi environment, local studies focused on the presence and growth of A. latus in Iraqi waters (Mohamed,et al., 2010). The lengths of A. latus individuals in the current study ranging from 10.7 to 23.7 cm and were compared with various

authors in other geographic localities such as 11.6 -29.7 cm in the River of Shatt al-Arab, (Abdulsamad ,2010) and 10.2 – 38.0 in Al-Razzaza Lake (Mansour, 2004) These differences could be due to environmental conditions, nutrition, density of population, fishing stress, and may be use of various fishing gear (Mohamed and Abood, 2020).

That study examined the relationships of length and weight of species obtained from the Shatt Al-Arab river. Determining length-weight relationship has an important role in fisheries evaluations and can reveal a lot of information about the demographic composition of the stock, (Dauod et al., 2010; Taheri Mirghaed et al., 2020). The results of the present study showed that body weight rose exponentially with overall length. The relationship's regression coefficient (b) was 3.007, showed isometric growth for A. latus and the matching significant correlation value also indicated a significantly linear length-weight relationship. In agreement with these results, in Al-Razzaza Lake, (Mansour, 2004) (b) was 2.98 and (Abdulsamad, 2010) (b) was 3.045 in Shatt al-Arab River, revealed isometric growth and there was a strong length-weight relationship. In contrast with this study, Vahabnezhad,et al.,2017 indicate allometric growth (b) was 2.57 for the same species in the Persian Gulf. The reason for these differences can be attributed to seasonal fluctuations, changes in environmental indicators such as temperature and salinity, physiological condition of the fish at the time of sample collection, gender, nutritional conditions and reproductive stages of the fish (Sourinejad et al., 2014, Cuadrado,2019).

The relative condition factor showed similar pattern among males and females. The range of relative condition factor regarding males range from 0.91 in August –1.09 in April, while for females varied range was 0.89 –1.34 within August - April. In Awan et al., (2017) study, in Narreri lagoon in Pakistan, the condition factor of A. latus was found to be 0.46 indicating poor condition. On the other hand, Nikkhah Khajeataei and Kamrani, (2014) found that condition factor was 2.132 in the Persian Gulf waters. In addition, condition factor has declined from January toward March and then raised from April toward the end of autumn.

In the study of Abdulsamad (2010), it was noticed that there is an inflexion in the relative condition factor (Kn) at the length range of 20.1-22.0 and 22.1-24.0 cm in males and females, respectively, and such an inflexion is an appropriate indicator of the length at which sexual maturity begins. Also, the high value of (Kn) indicates that the rate of weight gain is greater than the rate of increase in length (Al- Hassan, 1990), and one of the reasons for this may be due to the effect of the weight of the gonads on body weight, especially if this coincides with the maturation of the gonads during the prespawning stage (Abdulsamad, 2010).

In general, many factors affecting the changes in the condition index such as conditions and environmental factors and its fluctuations, the physiological conditions of the fish during sample collection, age and sex, fullness of stomach, the reproduction stage of fishes and the nutritional conditions of the fish (King, 2013).

The basis of longitudinal structure is very important for determining fisheries management solutions in the field of stock assessment (DeMartini et al., 2000). For this

reason, the age or length of maturity of the population is a factor that is very important in the evaluation of the population status during fishing. The present study revealed a range of ages from 1 to 4 years. It was shown that the quick growth incidence among length of A. latus was discovered during the first year of life, and then there was a time when the growth rate was slowed throughout the rest of life. In agreement with the present results, Abdulsamad (2010) found the same age results in Shatt al-Arab River. On the other hand Mansour,2004 and Dauod et al.,2010 reported fish individuals up to 8 years old in Al-Razzaza Lake for the studying species. The growth parameter in compare with other study that recorded $L\infty$=37cm in Shatt al-Arab River (Abdulsamad, 2010), $L\infty$ =50.4 cm in Bushehr province south of Persian Gulf (Vahabnezhad,et al.,2017), $L\infty$=55cm at the Abu Dhabi waters (Grandcourt et al., 2004), and $L\infty$=57.8cm in the Gulf of Aden, southern Persian Gulf (Edwards et al., 1985). The growth performance index (Φ) of A.latus in our study (2.56) was in similar with Vahabnezhad,et al.,(2017) study that recorded (Φ)= 2.76 in Bushehr province south of Persian Gulf. Like other Sparidea species, A. latus, appears to be a relatively long-lived fish. The variation in environmental factors, such as water temperature, diversity, the availability of food, and overexploitation of natural resources, may be responsible for the differences in growth characteristics among populations of the same species in different geographic locations (Wootton,2011).

The total sex ratio (males: females) of A. latus population was determined to be 1:1.13 in the current study, which is in agreement with . The male-to-female sex ratio in Al-Razzaza lake was 1:1.18 (Mansour,2004), in the Bushehr province south of Persian Gulf it was 1:1.03 (Vahabnezhad,et al.,2017) and in the Narreri Lagoon Badin, Pakistan it was 1:1.44 (Panhwar,2017). Variation of sex ratio of fish population affected by several factor such as life stage, the spawning season and ground, migration and fishing area. (Nikolsky,1963, Bartulovic, et al.,2004).

The peak in the (GSI) for both males and females A.latus was shown in March, with the main spawning period enduring to June. These results were in agreement with Mansour(2004)who indicated the spawning period of these species took place from March to May in Al-Razzaza lake. Vahabnezhad et al. (2017) stated that the highest Gonado-somatic index was shown in February, and it's annual cycle also showed that A.latus spawning season (in Persian Gulf) lasted from February toward May. That also was in line with Hoseini and Savari (2004) in Persian Gulf . Conversely, Abou-Seedo et al., (2003) reviewed evidence suggesting that despite mature fish occurred within December, and the numbers were very little to be taken into account. This was done by the examination of Gonado-somatic index of this species. In Kuwaiti waters, the majority of the individuals start to spawn in January, (Abou-Seedo et al., 2003), on the other hand, noted the end of spawning within April rather than March. However, depending on their locales, A.latus' spawning season within the northern hemisphere differed significantly. Hence, it was found that A.latus possessed an extended spawning season in the Shatt Al-Arab River, according to information about how the stages of maturation change with season and the existence of mature fish.

Conclusion:

Based on current findings, it is concluded that for A.latus, there was a significantly linear length-weight relationship. The incidence of quick growth regarding length of A. latus was present in life's first year. The peak of (GSI) in both males and females of A.latus was revealed in March.

Recommendations:

1. Control fishing and prevent catching of immature and adult during the spawning period to aoid harmful to fish stock.
2. Study the possibility of cultivation this species.
3. Studying on other biological feature on this species such as feeding and ecological feature.

References

1. Abdulsamad S.(2010). Some Observations about Age and Growth of Shanag Acanthopagrus latusm (Houttuyn) in Shatt Al-Arab River. JOURNAL OF THI-QAR SCIENCE, 2(2).
2. Abou-Seedo, F. S.,Dadzie, S.,and Al-Kanaan, K. A.(2003). Sexuality, sex change and maturation patterns in the yellowfin seabream, Acanthopagrus latus (Teleostei: Sparidae)(Houttuyn, 1782). Journal of Applied Ichthyology, 19(2), 65-73.
3. Al-Dubakel ,A.Y; Abdullah ,J.N.(2006). Relationship of body size with somebody structures of three young marine fish species collected from Khor Al-Zubair, Iraq. Anales de Biología 28: 95-99.
4. Al-Hassan, L.A.J. (1990). Genetic and morphological variation in Acanthopagrus latus (Sparidae) in Iraq. Asian Fish. Sci. 2:269-273.
5. Awan, K. P., Qamar, N., Farooq, N., and Panhwar, S. K. (2017). Sex ratio, length weight relationships and condition of eight fish species collected from Narreri Lagoon, Badin, Sindh. Pakistan. J. Aquac. Mar. Biol, 5(4), 1-4.
6. Bagenal TB, Tesch FW. (1978) Age and Growth. In: Bagenal TB, editor. Methods for assessment of fish production in freshwater. Blackwell, Oxford, England.
7. Bartulovic V, Glamuzina B, Conides A, Dulcic J, Lucic D, Njire J, Kozul V.(2004). Age, growth, mortality and sex ratio of sand smelt, Atherina boyeri, Risso, 1810 (Pisces: Atherinidae) in the estuary of the Mala Neretva River (Middle-Eastern Adriatic, Croatia). J. Appl. Ichthyol.20:427-430.
8. Cuadrado JT, Lim DS, Alcontin RMS,Calang JL, Jumawan JC. (2019). Species Composition and length-weight relationship of twelve fish species in the two lakes ofEsperanza, Agusan del Sur, Philippines. Fish Taxa.4(1):1-8.
9. Dauod, H. A. M., Al-Aamery, R. A., Ali, A. I., Chabuk, F. M., & Abbas, K. M. (2010). Observations on the Age and Growth of Shank (Acanthopagrus latus (Houttuyn, 1782)) from Al-Razzazah Lake. Ibn AL-Haitham Journal For Pure and Applied Science, 23(1), 50-61.
10. DeMartini, E. E., Uchiyama, J. H., and Williams, H. A. (2000). Sexual maturity, sex ratio, and sizecomposition of swordfish, Xiphias gladius, caught by the Hawaii-based pelagic longlinefishery. Fishery Bulletin, 98(3), 489-489.
11. Edwards, R.R.C., Bakhader, A. and Shaher, S., (1985). Growth, mortality, age composition and fishery yields of fish from the Gulf of Aden. J.Fish Biol., 27, 13-21.
12. Eschmeyer, W.N. and Fong, J.D. (2011). Pisces. In: Zhang, Z.-Q. (Ed.). Animal biodiversity: An outline of higher level classification and survey of taxonomic richness. Zootaxa 3148: 26-38.
13. Froese, R. (2006). Cube law, condition factor and weight length relationship: history meta-analysis and recommendations. J. Appl. Ichthyol., 22: 241-253.

14. Ghasemi, A., and Shadi, A. (2018). Population Structure of Acanthopagrus latus from the Northern Persian Gulf and Gulf of Oman Based on Microsatellite Markers. Turkish Journal of Fisheries and Aquatic Sciences, 18(8), 983-990.
15. Grandcourt, E.M., Al Abdessalaam, T.Z., Francis, F.and Al Shamsi, A.T.,(2004). Biology and stock assessment of the Sparids, Acanthopagrus bifasciatus and Argyrops spinifer (Forsskål, 1775), in the Southern Arabian Gulf. Fisheries Research, 69, 7-20.
16. Hoseini, H. and Savari, A.,(2004). Some aspects of reproductive biology of A. latus in Boushehr water (Persian Gulf). Journal of Iranian Fisheries Science, 3(1), 45-52 .
17. Hossain, M.Y. Naser, S.M.A.; Bahkali, A.H.; Yahya, K.; Hossen, M.A.; Elgorban, A. M.; Islam, M.M. and Rahman, M.M.(2016). Life History Traits of the Flying Barb Esomus danricus (Hamilton, 1822) (Cyprinidae) in the Ganges River, Northwestern Bangladesh. Pak. J.Zool., 48(2): 399-408.
18. Hossain, M.Y.; Ohtomi, J.; Ahmed, Z.F.; Ibrahim, A.H.M. and Jasmine, S.(2009). Length-weight and morphometric relationships of the tank goby Glossogobius giuris (Hamilton, 1822) (Perciformes: Gobiidae) in the Ganges of the northwestern Bangladesh. Asian Fish. Sci., 22(3): 961-969.
19. Hossen, M.A.; Hossain, M.Y.; Khatun, D.; Pramanik, M.N.U.; Parvin, M.F.; Jasmin, J.; Sharmin, S.; Rahman, O.; Mawa, Z.; Rahman, M.A. and Hasan, M.R. (2020). Morphometric and meristic traits of three ambassid fish species (Chanda nama, Parambassis lala and Parambassis ranga). Indian J. Mar. Sci., 49 (03): 398-405
20. King, M. (2013). Fisheries biology, assessment and management. John Wiley & Sons.
21. Le Cren ED.(1951). The length-weight relationship and seasonal cycle in gonad weight and condition in the perch (Perca fluviatilis). J.Anim. Ecol. 20:201-219.
22. Li, J. Ou, Y.J. (2000). Studies on the reproduc-tive biology of the pond-cultured Sparus latus Houttuyn, in the coast of Shenzhen bay. Journal of Zhejiang Ocean University (Natural Science), 19: 139-143.
23. Mansour, R.H. (2004). Some biological characteristics of silver sheim (Shank) Acanthopagrus latus (Houttuyn, 1782) in Razzaza lake. M. Sc. Thesis, Technical College of Al-M ussayib. (In Arabic).
24. Mohamed ARM, Abood AN.(2020). Population dynamics of three mullets species (Mugilidae) from the Shatt Al- Arab River, Iraq. Journal of Agriculture and Veterinary Science.13(9):22-31.
25. Mohamed, A. R. M., Jasim, B. M., and Asmail, A. K. (2010). Comparative Morphometric And Merstic Study On Yellow Fin Seabream, Acanthopagrus Latus In Iraqi Waters. Basrah Journal of Agricultural Sciences, 23.
26. Nikkhah Khajeataei, Sand Kamrani, E. (2014). Growth pattern, condition factor and length at first maturity of Yellowfin Seabream Acanthopagrus latus in the Persian Gulf. Utilization and Cultivation of Aquatics, 3(2), 1-14.
27. Nikolsky,G.V.(1969). Theory of population denuding as the biological back ground for rational exploitation and management of the fishery resources. Oliver & Boyd :323pp.

28. Panhwar,S.K. Qamar,N. Farooq,N.and AwanK.P.(2017). Sex ratio, length weight relationships and condition of eight fish species collected from Narreri Lagoon, Badin, Sindh, Pakistan. Journal of Aquaculture & Marine Biology, 5 (4),12-14.
29. Pauly, D. and Munro, J.,(1984). Once more on the comparison of growth in fish and invertebrates, Fishbyte. 2,21.
30. Randall, J.E., Allen, G.R. and Steene, R.C.,(1997). Fishes of the Great Barrier Reef and Coral Sea. University of Hawaii Press, Honolulu, Hawaii, 507P.
31. Ricker,W.E.(1975). Computation and interpretation of biological statistics of fish populations.Bull.Fish.Res.Board Can.,(191) :382pp.
32. Sokal, R.R. and Rohlf, F.J.,(1995). Biometry The Principles and Practice of Statistics in Biological Research, third ed., W.H. Freeman and Co., New York, 887P.
33. Sourinejad, I., Ataei N. K., Kamrani, and Shojaei G. (2014). Growth pattern, condition index and length of the first sexual maturity of the yellowfin Acanthopagrus latus in the Persian Gulf. Journal of Aquaculture, 3(2), 1-14
34. Taheri Mirghaed, A., Ghodrati Shojaei, M., Weigt, M., Ebrahimzadeh, S. M., Jahangard, A., Abbasi, M., and Abdolahian, M. (2020). Length–weight and length–length relationships of six fish species from the Persian Gulf. Aquaculture Sciences, 8(1), 102-111.
35. Vahabnezhad A.1; Taghavimotlagh S.A.1; Ghodrati Shojaei M.. (2017). Growth pattern and reproductive biology of Acanthopagrus latus from the Persian Gulf. Journal of Survey in Fisheries Sciences. 4(1) 18-28.
36. Wootton RJ.(2011). Growth: environmental effects. In: Farrell AP, editor. Encyclopedia of fish physiology: from genome to environment. Elsevier Science Publishing Co. Inc, United States.
37. Xia, J.H., Huang, J.H., Gong, J.B., Jiang, S.G.(2008). Significant population genetic structure of yellowfin Seabream Acanthopagrus latus in China. Journal of Fish Biology, 73: 1979-1992.