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Length-weight Relationship and Fecundity of *Parastromateus niger* from Gwadar Port Balochistan Province, Pakistan

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ABSTRACT

Background: *Parastromateus niger,* is one of the important fish species from economic point of view in Gwadar, Balochistan-Pakistan. This study was carried out to determine the growth and fecundity of *Parastromateus niger*.

Methods: Growth of *P. niger* was determined by applying Le Cren formula while mean fecundity and relative fecundity of this fish was calculated by using equation of Yelden and Avsar.

Result: Relationship between fish weight and ovary weight was found as 0.384 and 0.898 respectively in 1st and 2nd year of research. Annual mean fecundity of *P. niger* was calculated as 43165.4 eggs with relative fecundity of 73.7 in 2017-18 and annual mean fecundity in 2018-19 was 39759.5 eggs with 50.2 relative fecundity. Value of R^2 in first year of research between fecundity and ovary weight was 0.751, for mean fecundity and relative fecundity was 0.545, in term of fecundity and total length of fish was 0.60 and for fish total weight and fecundity was 0.596. Value of R^2 between fecundity and weight of ovary was 0.951, with mean fecundity and relative fecundity as 0.968, between fish fecundity and total length was 0.578 and in case of fecundity and total body weight was found 0.809 in second year of research period.

Key words: Fish, Fecundity, Growth, Gwadar, Length, *P. niger.*

INTRODUCTION

Gwadar, a very important port city of Balochistan province located on the southwestern sea coast of Pakistan with a population of roughly 50,000, is found at the top of Arabian Sea and at the mouth of the Persian Gulf (FAO, 2002). Fish has importance from economic point of view (Pathak *et al.* 2019), as for several economically developing nations, fish is the first or second largest export product (FAO, 2002). Being a healthy choice over several animal proteins, sea feed is on an increasing demand around the world. (FAO, 2002; Gowsalya *et al.* 2020), transported among various countries and therefore the freshness or quality of these products are of vital importance, because it reflects dominantly over its value (FAO, 2002).

Parastromateus niger, is one of the important fish species from the economic point of view (Salim *et al.* 2020; Islam *et al.* 2021), with systematic position of this species as among the perciform (Bloch, 1795). These fishes are exported to various countries of world like China, Sri Lanka, Thailand, Malaysia and Japan, which is an important factor to boost the economic growth of Gwadar. This fish is utilized for eating and medicinal purpose and huge number of Gwadar residents are involved in export of this fish species, thus employing it as a source of income (F. D, 2010).

In order to analyze the changing trend in fish populations and level of fish exploitation, studies on their age, growth and population dynamics are important (Liu, 2008). An essential factor for determining growth and biology of a fish in any sort of environment, is the length-weight relationship (Hubert, 1999; Qadri *et al.* 2017). Fish growing process is totally related to number of fishes specific to that area. The attributes of water, food provision and competition between fish species are used to find out the growth rate and increase in size. In the presence of all environmental factors and food supply, the fish will continue to grow, however, the growth of fish will reduce with the limitation of various crucial growth requirements (Hubert, 1999).

Apart from length-weight relationship, fecundity is also a crucial factor in revealing growth of fish. The term fecundity refers to the fish's egg laying ability specifically in a spawning season (Lagler, 1956). In order to identify the biology of fish, its production and availability for human food and also for management of fisheries sector, fecundity is of extreme importance. Depending upon the species, fecundity is affected by the presence of food (Nandikeswari and Anandan, 2013; Prasad *et al.* 2005; Marquez *et al.* 2003;

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Tracey *et al.* 2007). To get idea about the production of eggs, fecundity is practical as it is related to size of female fish (Chondar, 1977). The reproductive capacity or fecundity, indicates increase of fish stocks (Marquez *et al.* 2003), additionally exact evaluation of fecundity helps to recognize the potential's recovery of fish population (Lagler, 1956).

Research study is largely lacking on the part of this specific fish species (*Parastromateus niger*) from the coast of Balochistan. Present research study was designed to determine the growth and fecundity of *Parastromateus niger* from Gwadar Port Balochistan, Pakistan.

MATERIALS AND METHODS

Sample collection

Parastromateus niger samples were collected every month from August 2017 to July 2019, from the landing station of Gwadar, Balochistan. A total of 600 fish samples were utilized in current research, with a collection of 25 fishes per month from August 2017 to July 2019. Samples were stored in sealed ice boxes and brought to Zoology lab of Sardar Bahadur Khan Women's University for further study.

Growth (Length-weight)

Measurements of sample's length and width were made in centimeters (cm) and body weight was measured in grams (g) respectively. A digital balance (Model No.805A with sensitivity 0.01 gram) was used to calculate samples weight. For measuring fish growth, Length-weight relationship (LWR) is a useful parameter. Data pertaining to length and weight was recorded in length and weight logs, obtained by inspecting male and female samples, accordingly.

Analysis

Le Cren equation was adopted to calculate Length-Weight Relationship:

$$W = a\ Lb$$

W is total weight in gram (g), L represents total length of fish in centimeter (cm) and *a* and *b* are constants, *a* shows body form and *b* show type of growth. For determination of fecundity, only female fish samples were considered (Murua *et al.* 2003).

Dissection

The fish was dissected to remove ovary while length and weight were measured before dissection. Weight of ovary was measured by digital weighing machine (Model No.805A with sensitivity 0.01gram), moreover two lobes of ovary were separated and divided into three equal parts, anterior, posterior and middle. Afterwards, 0.1 g from each portion was taken and soaked in 25% buffer solution (consisting 75 ml distilled water and 25 ml formalin) for 24 hours. Eggs were kept in Petri dish and counted under stereo light microscope (Nikon, YS-100). The sample from the three sub-samples were exploited to find the fecundity by gravimetric method (Yelden and Avsar, 2000).

$$\text{Fecundity} = \frac{\text{No of egg in sub-sample} \times \text{Gonad weight}}{\text{Weight of sub-samples}}$$

$$\text{R. fecundity} = \frac{\text{Mean fecundity}}{\text{Weight of fish}}$$

Furthermore, the relative fecundity was calculated by dividing the mean fecundity of the fish to its total weight (g). Similar method was used by Murua *et al.* 2003, Mustafa *et al.* 1983, Dewan and Doha, 1979, Shafi *et al.* 2012 and Doha and Hye, 1970.

RESULTS AND DISCUSSION

Growth

Determination of Length-weight equation was based independently on sexes. Values of exponent (*b*) calculated for *P. niger* was from 2.82 to 2.92 in 2017-18 (Table1), while the range of (*b*) value observed in 2018-2019 was from 2.50 to 2.70. The coefficient (*b*) of female (2.70) was higher than male (2.65) during second year. Value (*b*<3) shows that fish is lighter in weight and pattern of growth is negative allometry. The regression coefficient R^2 in 2018-19 was 0.889 in males, 0.912 in females and 0.898 in combine population (Table 1). The highest (*b*) value was 2.92 obtained in females during first year of research period and lowest value was seen in combine population of *P. niger* (2.50) in second year of research. The (*b*) values were less than 3.0 (*b*<3), showing negative allomertic growth (A-) for both sexes. Length-weight relation of fish gives indication about patterns of fish growth. Fig 1 illustrates the logarithmic relationship between weight and length of males, females and combine population of *P. niger* with regression values. The regression coefficient between log length and log weight in the year 2017-18 was 0.974 in males, 0.974 in females and 0.975 in combine population (Table 1). Weight and length relationship among combine population of *P. niger* was represented by R^2=0.974 in 2017-18. The value of R^2 between length and weight in the year 2018-19 was 0.898. Fish weight was directly proportional to its length and hence showing a linear regression equation (Fig 1).

Correlation of fish weight and ovary weight

Fish weight and ovary weight relationship expressed as R^2 was 0.384 in 2017-18. Moreover, ovary weight was not related with total weight of fish, therefore, non-linear relationship was observed. The R^2 value (0.384) indicates negative correlation. The relation between weight of fish and ovary was R^2=0.864 in 2018-19, indicating a strong positive relation.

Fecundity

The mean ovary weight of *P. niger* was higher in July 2017-18, which indicates a weight gain in ovary from July onwards. The number of eggs per gram of ovary was comparatively greater in July than in other months, whereas, the number of eggs per kg fish (relative fecundity) was higher in July. Fish weight of *P. niger* ranged from 410.3 to 954.8g and ovary weight of fish was between 1.43 g to 25 g, moreover, 43165 was the mean number of eggs in ovary. Mean annual relative fecundity of *P. niger* was 73 eggs/g and ranged from

5 eggs/g to 172 eggs/g. Highest and lowest values of relative fecundity were obtained in 2017-18 (Table 2).

In 2018-19, the mean ovary weight of *P. niger* was maximum in August. The mean annual fecundity in second year of study was recorded as 39759 eggs, which is lower than first year of study. Number of eggs per kg of fish weight was highest in July (158). The fecundity was highest (153175 eggs) in August (Table 2).

Fecundity and total length correlation

The correlation R^2 between total length and fecundity was 0.602 and 0.578 in first and second year of study which indicates that the total length and fecundity were positively associated to each other (Fig 2 and 3). Fecundity of *P. niger* was directly related to fish length.

Correlation of fecundity and fish weight

A value of R^2 0.596 and 0.809 was calculated for the year 2017-18 and 2018-19 showing a linear relationship among fecundity and fish weight. Fecundity of *P. niger* was highly related with total weight of the fish. A highly significant linear regression equation was obtained. The R^2 values 0.596 and 0.809 were significant, indicating a moderate and strong positive correlation (Fig 2 and 3).

Correlation of fecundity and ovary weight

Correlation among ovary weight and fecundity of fish was determined as R^2=0.751 and 0.951 in 1st and 2nd year of research, displaying a strong positive correlation (Fig 2 and 3). Fecundity was directly proportional to weight of female fish ovary.

Correlation of fecundity and relative fecundity

The R^2 value between fecundity and relative fecundity was 0.545 and 0.968 during 2017-18 and 2018-19 of study showing moderate and strong positive association between relative and mean fecundity of *P. niger* (Fig 2 and 3).

Table 1: Descriptive statistic and estimated parameters of length-weight relationships (LWRs) of *Parastromateus niger* male (M), female (F) and combined sexes (C) during 2017-18 and 2018-19.

Sex	n 2017-18/2018-19	Length range (cm)	Weight range (g)	*A*	*B*	r^2
M	161/144	24.2-41.8/25-43.5	410.3-734/543.7-1280.3	0.0038/0.0032	2.82/2.65	0.924/0.889
F	139/156	24.4-55/23.3-43.9	320.3-954/500.2-1282.9	0.0022/0.0040	2.92/2.70	0.894/0.912
C	300/300	24.2-55/23.3-43	410.3-954.8/500.2-1282.8	0.0062/0.0045	2.88/2.50	0.974/0.898

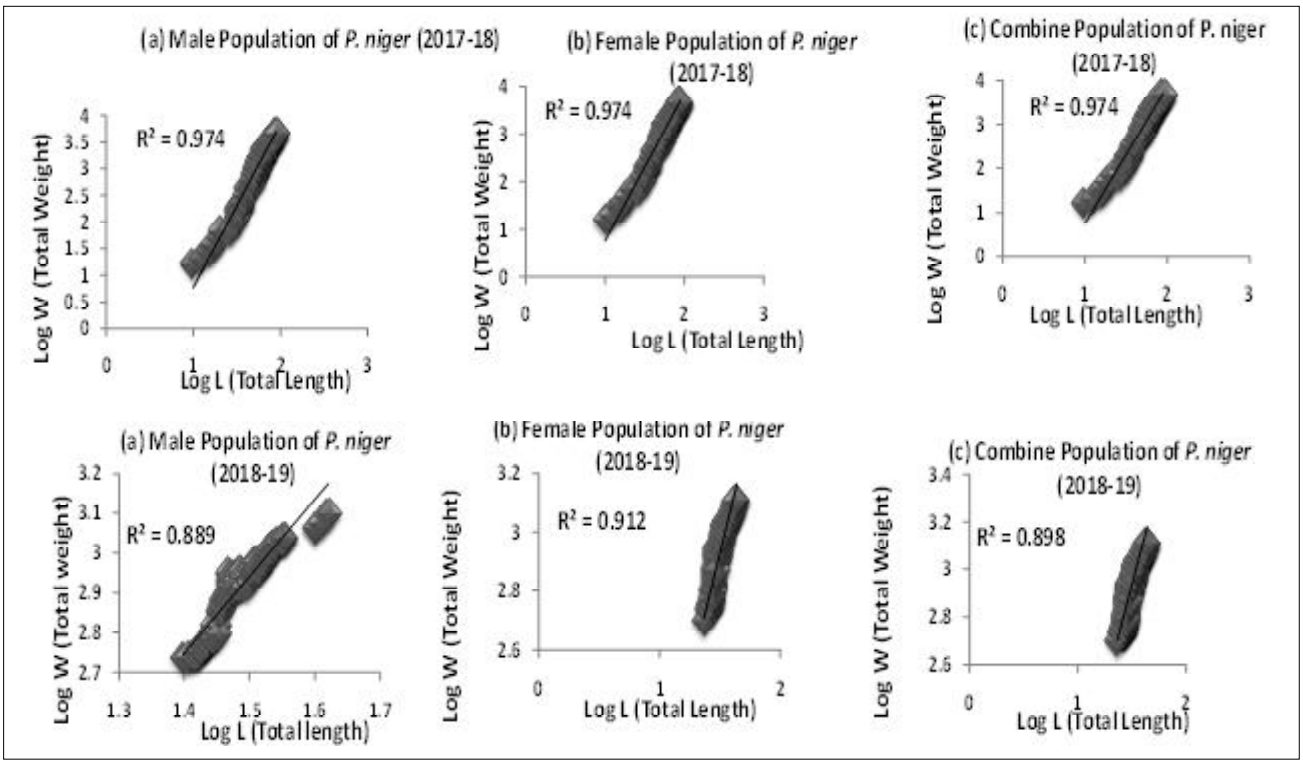

Fig 1: Co-efficient of logarithmic of length-weight relation of (a) male, (b) female and (c) combine population of *P. niger* in 2017-2018 and 2018-19.

Present findings support the finding of Yadollahvand and Rahnama (2014), who studied *P. niger* growth and age from Oman Sea. Their research was conducted on 94 fish samples and the value of coefficient (*b*) was 2.386, which is consistent with our results. Regression analysis between length and weight was R^2=0.982. Range of length in Yadollahvand and Rahnama research was 21 cm to 56 cm, which is in accordance with our findings. The value (*b*) for

Table: 2 Month wise fecundity, relative fecundity, total length, weight and ovary weight of *Parastromateus niger* during 2017-18 and 2018-19.

Month	Mean fecundity	Relative fecundity 2017-18/2018-19	Total length (cm)	Fish weight (g)	Ovary weight (g)
Jan	0/0	0/0	25.41/29.56	325.34/557.42	1.43/2.09
Feb	2150.03/259.53	5.31/0.64	27.77/30.55	404.03/400.03	2.91/3.11
Mar	80626.3/1763.8	154.94/3.2	42.91/31.29	472.68/554.67	25.35/4.49
Apr	13747.4/461.94	27.33/0.8	31.89/34.19	510.28/580.48	4.88/4.02
May	48774.3/32274.2	69.42/49.95	34.01/34.8	694.55/649.57	10.93/6.86
Jun	92978.8/81236.8	116.42/117.75	36.83/33.45	804.17/697.7	14.16/13.23
Jul	142822/124239	172.28/158.84	37.52/36.07	836.26/788.04	17.19/14.95
Aug	108666/153176	128.09/155.56	38.38/41.48	856.1/996.63	16.4/19.08
Sep	23224/54350	37.97/69.1	34.63/28.11	624.2/789.12	6.9/12.05
Oct	4540.93/22160.8	172.36/34.036	34.43/30.94	26.11/655.37	2.21/6.8
Nov	454.46/6811.31	0.93/11.65	30.2/26.68	483.14/581.32	1.02/4.35
Dec	0/380.61	0/0.82	27.56/28.55	400.88/481.19	0.75/2.66
Mean	43165.4/39759.5	73.75/50.2	33.46/32.14	536.48/644.29	8.68/7.81
St.d	50565.77/53141.59	70.78/61.52	5.12/4.11	242.14/159.16	8.04/5.6

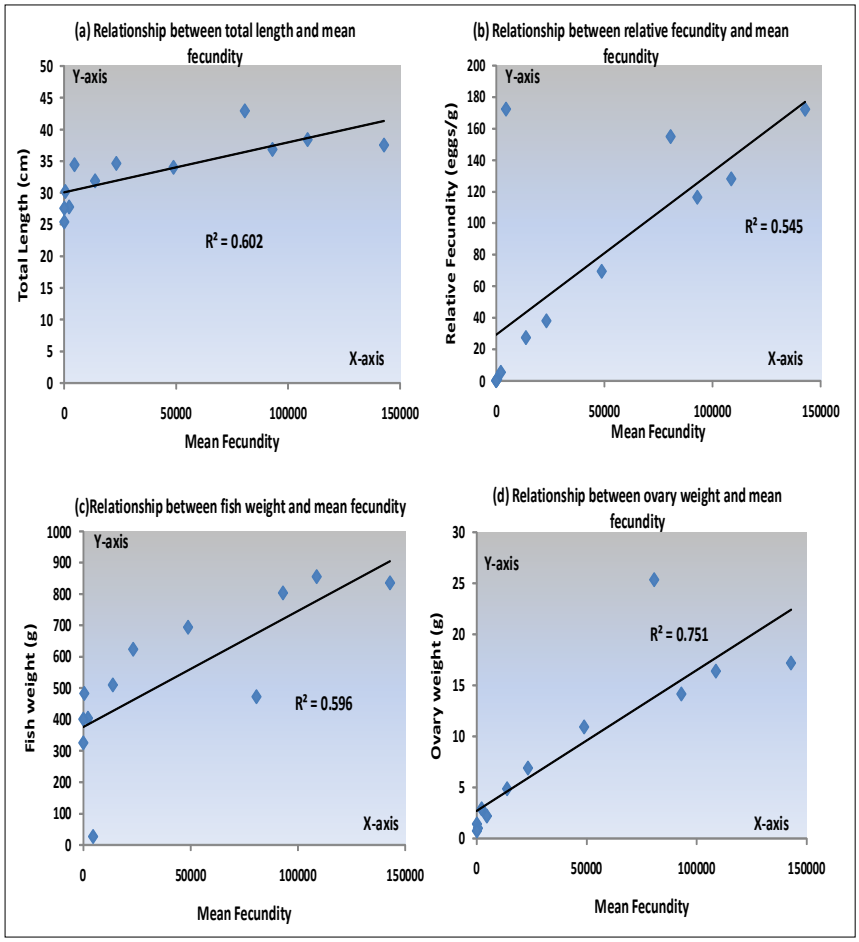

Fig 2: Relationship of (a) fish length, (b) relative fecundity, (c) weight and (d) ovary weight with mean fecundity of *P. niger* in 2017-18.

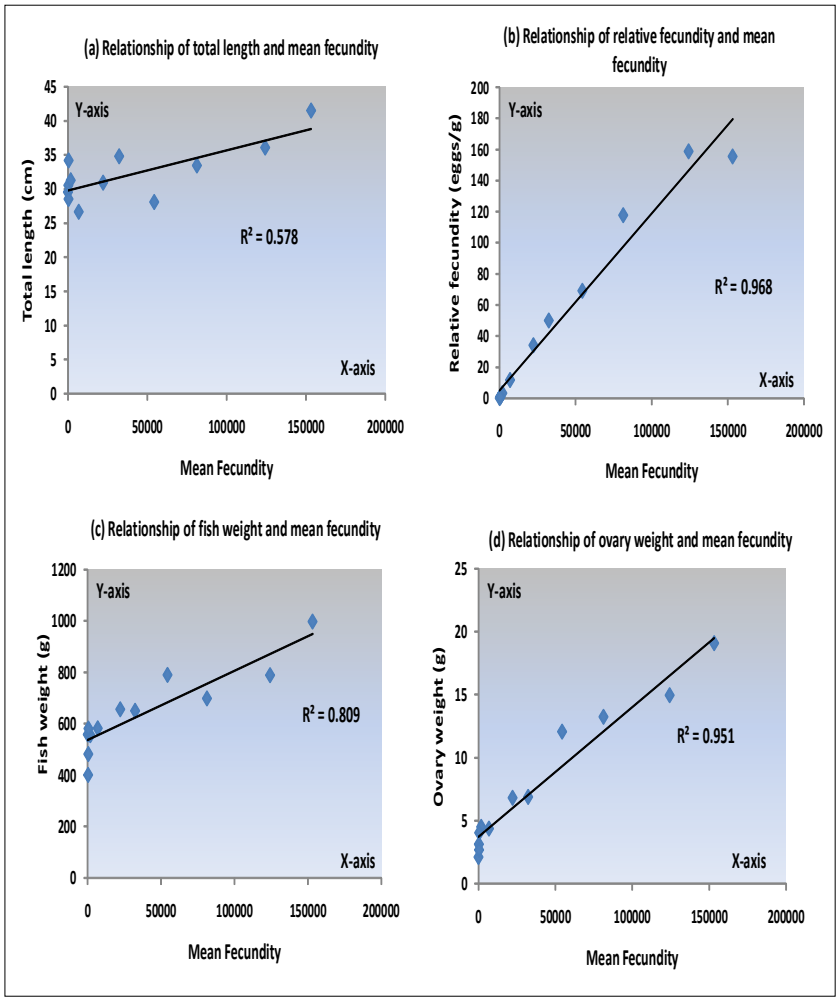

Fig 3: Relationship of (a) fish length, (b) relative fecundity, (c) weight and (d) ovary weight with mean fecundity of *P. niger* in 2018-19.

length and weight calculated in our study was less than 3, which indicates negative allometric growth. Hoque *et al.* (2018), measured the length weight relation of *P. niger* with total length of 36.5 to 43 cm, which was quite close to our results and they observed that total weight was between 850 to 1500 g. Fish weight was positively related with fish fecundity, which is similar to current research.

Relative fecundity of *P. niger* in our research work was from 0 to 172 eggs/g. Ovary weight and relative fecundity of fish was high in July. Fecundity relationships with fish length (0.602), total weight (0.596) and weight of ovary (0.751) were linear, indicating normal to strong relation. In many reports, similar association of fecundity with total length, weight and ovary weight was observed. High fecundity in *P. niger* was reported by earlier researcher from India in 2002, compared to our research (39759.5-43165.4). Simpson (1951), reported the fecundity (84030) of *P. niger*, from Southern Bight North Sea, which differ from our results, due to various reasons including type of species, size of fish, age of fish and environmental conditions like presence of fish food, salinity and temperature of water. Normal fecundity of *P. niger* was reported in present work, indicating various reasons that might be responsible for that level of fecundity *i.e.*, genetic makeup of fish or unavailability of feed for fish species that disturb the growth of fish and also cause imbalance development of gonads. Hoque *et al.* (2018), studied the fecundity of *P. niger* from Bangladesh, that was between 112170 to 1116228 eggs. Annual mean fecundity was recorded as 512585 eggs. These results do not support our findings, as they observed that there was positive relationship between fecundity and total body weight of fish.

CONCLUSION

Value of (*b*) in *Parastromateus niger* was less than (3), which indicates that fish grows negative allometrically because there are many parameters which are responsible for changing the condition factors of a fish. These parameters include acquiring data, division of obtained data into various groups, type of sex, stages of fish maturity and condition of fish stomach. Values of condition factors also change due

to variation in ecological conditions. Observation in this research represents the coefficient of correlation for length-weight relationship being higher, which shows that these two parameters are directly related with each other in studied fish. Fecundity of studied fish in first year of research work was higher in the month of July, while in second year of research, the fecundity was found highest in August. Fecundity of this fish was positively correlated with fish weight, ovary weight, fish length and relative fecundity.

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Conflict of interest

All the authors declare no conflict of interest in this research study.

REFERENCES

Bloch, M.E. (1795). Naturgeschichte der auslandischen Fische. Berlin. pp. 397-429.

Chondar, S.L. (1977). Fecundity and its role in racial studies of Gudusiachapra (Pisces: Clupeidae). The Proceedings of the Indian Academy of Sciences. 86: 245-254.

Dewan, S. and Doha, S. (1979). Spawning and fecundity of certain pond fishes (*viz. Chela phula*, *Esomus danrica*, *Amblypharyngodon mola*, *Aplocheilus panchax*, *Ambassis nama*, *Glossogobius giuris* and *Colisa lalius*). Bangladesh Journal of Agriculture. 4(1):1-8.

Doha, S. and Hye, M.A. (1970). Fecundity of Padma River hilsa, Hilsa ilisha (Hamilton). Pakistan Journal of Science. 22(3): 4.

Fisheries Department. (2010). Departmental Report of Gwadar district fishes.

Food and Agriculture Organization of the United Nations, Fisheries Department. (2002). The State of World Fisheries and Aquaculture (FAO, Rome).

Gowsalya, T., Kanaga, V., and Faizullah, M. M. (2020). Analysis of fish production status and marketing structure in aliyar reservoir, Tamil Nadu. Indian Journal of Animal Research. 54(9): 1159-1164.

Hoque, N., Das, N., Sharif, A.S.M. and Das, J. (2018). Maturation patterns of black pomfret (*Parastromateus niger*) from coastal waters of the Bay of Bengal, Bangladesh. Journal of Noakhali Science and Technology University. 2: 1-9.

Hubert, W.A. (1999). Standards for assessment of age and growth data for channel catfish. Journal of Freshwater Ecology. 14(3): 313-326.

Islam, M.A., Akhter, F., Islam, M.M. and Zahangir, M.M. (2021). Comprehensive study on the reproductive biology of black pomfret (*Parastromateus niger*) in the Bay of Bengal, Bangladesh. Regional Studies in Marine Science. 41: 101556.

Lagler, K.F. (1956). Freshwater Fishery Biology. Second Ed. W.M.C. Brown Company, Dubuque, lowa, pp. 421.

Liu, R.Y. (2008). Checklist of marine biota of China Seas. Science Press, Beijing, pp 1267.

Marquez, G.J.L., Mendoza, P.B., Ugarte, S.I.H. and Arroyo, G.M. (2003). Reproductive aspects of *Oreochromis niloticus* (Perciformes: Cichlidae) at Coatetelco lake, Morelos, Mexico. Revista de Biologia Tropical. 51(1): 221-228.

Murua, H., Kraus, G., Saborido-Rey, F., Witthames, P.R., Thorsen A. and Junquera, S. (2003). Procedures to estimate fecundity of marine fish species in relation to their reproductive strategy. Journal of Northwest Atlantic Fishery Science. 33: 33-54.

Mustafa, G., Islam, K.R., Ali, S. and Ashraful Alam, A.K.M. (1983). Some aspects of the biology of *Puntius sarana* (Hamilton): Food and feeding habits in relation to fish size and fecundity. Bangladesh Journal of Zoology. 10(2): 92-100.

Nandikeswari, R. and Anandan, V. (2013). Analysis on gonadosomatic index and fecundity of Terapon puta from Nallavadu coast Pondicherry. International Journal of Scientific and Research Publications. 3(2):1-4.

Pathak, A.K., Sarkar, U.K., Dayal, R. and Singh, S.P. (2019). UPFBase-A freshwater fish diversity database of Uttar Pradesh, India. Indian Journal of Animal Sciences. 89(3): 347-354.

Prasad, R.R., Jaiswar, A.K., Reddy, S.B., Chakraborty, S.K., Palaniswamy, R. and Parida, P. (2005). Growth, mortality and yield per recruit of *Polynemus heptadactylus* (Cuvier) (Teleostei: Polynemidae) from Mumbai waters, India. Fisheries Research. 76(1): 155-161.

Qadri, S., Shah, T.H., Balkhi, M.H., Bhat, B.A., Bhat, F.A., Najar, A.M., *et al.,* (2017). Morphometrics and length-weight relationship of Schizothorax curvifrons Heckel 1838 in River Jhelum, Kashmir, India. Indian Journal of Animal Research. 51(3): 453-458.

Salim, G., Atieqah, N., Handayani, K. R., Indarjo, A. and Ransangan, J. (2020). Growth, mortality and exploitation rate of *Pampus argenteus*, *Parastromateus niger* and *Scomberomorus commerson* in Sebatik Waters, Indonesia. Biodiversitas Journal of Biological Diversity. 21(11). doi.org/10.13057/biodiv/d211142.

Shafi, M., Quddus, M.M.A. and Islam, N. (2012). Maturation and spawning of Hilsa iisha (Hamilton-Buchanan) of the river Meghna. Dacca University Studies. 26(2): 63-71.

Simpson, A.C (1951). The fecundity of the Plaice. Fish. Invest. Lond. pp. 27.

Tracey, S.R., Lyle, J.M. and Haddon, M. (2007). Reproductive biology and per-recruit analyses of striped trumpeter (*Latris lineata*) from Tasmania, Australia: implications for management. Fisheries Research. 84(3): 358-367.

Yadollahvand, R. and Rahnama, B. (2014). The age determination of black pomfret (*Parastromateus niger*), based on otolith cross sections in Iranian coast of Oman Sea. Journal of Aquaculture Research and Development. 5(5): 1.

Yeldan, H. and Avsar, D.A. (2000). Preliminary study on the reproduction of the rabbit fish *Siganus rivulatus* (Forsskal. 1775) in the North eastern Mediterranean. Turkish Journal of Zoology. 2: 173-182.