



**FECUNDITY OF THE CRITICALLY THREATENED CYPRINID FISH PUNTIUS  
VITTATUS CAUGHT FROM THE RIVER TAMBAPARANI, TIRUNELVELI  
DISTRICT**

**J. Michael Antony Prabhu Arachi\***

Assistant Professor in Zoology Annamalai University, Chidambaram – 608001.



\*Corresponding Author: J. Michael Antony Prabhu Arachi

Assistant Professor in Zoology Annamalai University, Chidambaram – 608001.

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### ABSTRACT

It was observed from the present reprobological studies that *P.vittatus* was biannual monsoon breeder and iteroparous species. It was observed that during the spawning month (November) the absolute fecundity of *P.vittatus* ranged 85-88 eggs in a 0.0135g ovary for a fish of 1.6mm ovary length. The maximum number of eggs per gram body weight (Relative fecundity) of *P.vittatus* was 152, and per gram ovary weight was 138. The males of *P.vittatus* matured at a smaller size of 2.5cm SL than the females 3.1– 3.5 cm SL. The highest absolute fecundity (AF) of a female fish was 88 eggs, and the mean absolute fecundity in the spawning month (November and January) was 72 eggs. The maximum average relative fecundity was 138 eggs in November. The fecundity of *P.vittatus* increased with the increase in body length, body weight, ovary length and ovary weight. The analyses of all these reproductive traits of *P.vittatus* pin-point the exact spawning season of the fish and also its reproductive capacity so as to enable one to employ this species in fish farming practice.

**KEYWORDS:** Fecundity, *Puntius vittatus*, Absolute fecundity, Relative fecundity.

### INTRODUCTION

Fecundity, gonadosomatic index (GSI) and lengths at sexual maturity are essential biological aspects to understand the reproductive dynamics of specific fish species as these attributes provide the knowledge of their maturity and spawning activity (Murua *et al.*, 2003; Rasheed and Mustaqim, 2010). Fecundity refers to the total number of oocytes possibly laid by an individual brood fish in its breeding period (Hossain *et al.*, 2012). The reproductive cycle of different species has developed in response to the fish's natural range and habitat. The reproductive cycle and spawning season of a fish could be ascertained by analyzing a number of reproductive and body indices such as gonadosomatic index (GSI), condition factor (K), fecundity, oocyte size frequency distribution, and sex ratio. The spawning season indicates the actual ovulation and is of short duration in teleost fish (Arevalo *et al.*, 2023). An ecologically sustainable use of fisheries resources requires a thorough knowledge of the reproductive biology of the species concerned.

Fecundity is another indicator of the reproductive potential of a fish. The estimation of fecundity and its relationship with the body measurements give an idea about the clutch size of the fish species (Arachi and

Sumaiya, 2025). Typically, increased fish size is associated with increased fecundity (Hasan *et al.*, 2020), and presumably, smaller eggs increase the potential for high clutch size (FAO,2022). The highest fecundity indicates the spawning peak of the fish. Hence, in the present study, seasonal changes in various reproductive parameters such as gonadosomatic index (GSI), gonadal histology, fecundity, mean egg size (MES), and sex ratio were analyzed to determine the spawning potential and fecundity of *P. vittatus* about the seasonal changes.

### MATERIALS AND METHODS

#### Field Sampling and Physical conditions

Field sampling was carried out from June 2023 to November 2024. Specimens of *Puntius vittatus* were collected fortnightly by random sampling method using a hand net of 4mm mesh size from a perennial pond fed by Tambiraparani River at Tirunelveli (Tamil Nadu) 8.44°N and 77.44°E. Each sample consisted of about 300 specimens and was utilized to record data on total length, standard length, body weight, stages of sexual maturity, liver weight, and length and weight of the gonads. The measurement of length was recorded to the nearest millimeter, and weight to the accuracy of 0.01g. Sex (male or female or immature) was determined either by external appearance or internal anatomy of the gonads.

### Fecundity

The fecundity of *P.vittatus* was estimated from all the ovaries of mature fish, during the breeding months. **Absolute fecundity (AF)** is defined as the total number of mature eggs in a female prior to spawning (Treasurer 1990). Approximately 10mg of each ripe ovary was weighed to the nearest 0.01 g and the ova were dispersed on a microslide under the binocular microscope, and were counted to determine fecundity (Sidik *et al.*, 2020). Absolute fecundity (AF) (no.of eggs/fish) = (nG) / g

where n is the number of eggs in the sub-sample, G is the weight of the ovary and g is the weight of the sub-sample. The absolute fecundity (AF) of *P.vittatus* was studied in relation to the total length, standard length, body weight of fish, ovary length and ovary weight.

The relative fecundity (RF) was calculated as the number of eggs per gram wet weight (e.p.g) of the mature fish (Treasurer, 1990) by dividing the number of eggs per fish by its total body weight (Efizon *et al.*, 2021).

**Relative fecundity (RF)** (no.of eggs/g live fish) = Total number of eggs / live weight of the fish

The relationships between the fecundity and other meristic parameters of *P.vittatus* were obtained by plotting the respective values in a scatter diagram and fitting a regression equation as given below (Tamsil and Hasnidar, 2024),

$$Y = a + bX$$

where, Y is dependent variable, i.e., fecundity, X is independent variable, i.e., fish length, fish weight, ovary length and ovary weight, a and b are the constants. The relationship were also expressed in logarithmic form as given below.

$$\text{Log } Y = \text{log } a + b \text{ log } X.$$

The correlation coefficient (y) was calculated for each relationship.

### Oocyte measurement

Average oocyte diameter was determined for each growth stage with an ocular micrometer. In serial ovarian sections from five females representing each stage, three

measurements of diameter were made for each oocyte with a visible germinal vesicle to provide mean diameter for each growth stage.

$$\text{Mean ova diameter (mm)} = (\text{long axis length} + \text{short axis length}) / 2$$

Monthly means of oocyte diameters were determined by light microscopy at a power of 40X for small follicles or 10X for larger follicles. A total of 50-80 oocyte measurements were made from five females each month and averaged for monthly diameter values. The size progression of intraovarian oocytes of *P.vittatus* was followed from June 2023 to November 2024. The spawning periodicity was determined by ova diameter studies.

### Data analysis

The relationships between the two sets of variables were analysed by plotting the respective values in a scatter diagram and calculating a regression equation (Tamsil and Hasnidar, 2024),

$$Y = a + b x$$

where, Y is a dependent variable, i.e., fecundity, x is an independent variable, i.e., fish length, fish weight, ovary length and ovary weight, a and b are the constants;

or in the logarithmic form,

$$\text{Log } Y = \text{log } a + b \text{ log } X.$$

The correlation coefficient (y) was calculated using Stat view 5.0 for each relationship. Data were also subjected to student's t test and one way / two way analysis of variance (ANOVA) (Zar, 1984).

## RESULTS

### Fecundity

During the spawning month (November) the absolute fecundity of *P.vittatus* ranged 85-88 eggs in a 0.0135g ovary for a fish of 1.6mm ovary length. The maximum number of eggs per gram body weight (Relative fecundity) of *P.vittatus* was 152, and per gram ovary weight was 138. The annual fluctuations in the absolute fecundity and the relative fecundity are shown in Fig 1.

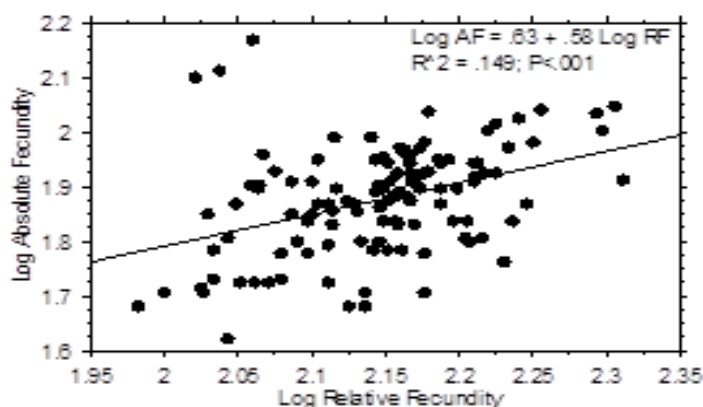
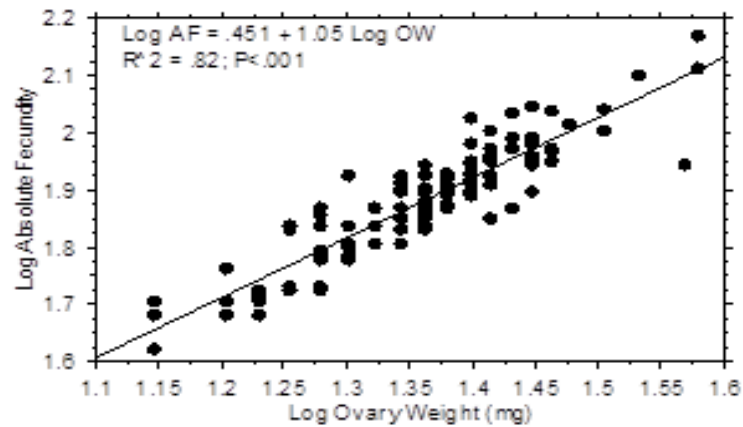


Fig. 1: *P. Vittatus*: Log – log relationship between absolute fecundity (no.of eggs/fish) and relative fecundity.

### Fecundity and total length

Fig 2 shows the log-log relationship between total length and the absolute fecundity of *P.vittatus*. The number of

ova in the specimens varied from 1.69 for a fish of 0.45cm total length to 2.18 in one measuring 0.62cm total length.



**Fig. 2: *P. vittatus*: Log – log relationship between absolute fecundity (no.of eggs/fish) and ovary weight (mg).**

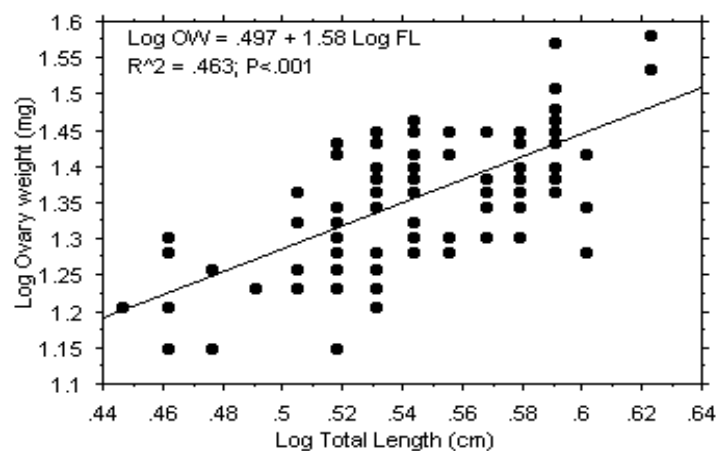
While the minimum log absolute fecundity was 1.7 eggs for smaller fish of 0.45cm TL, the largest specimen of 0.62cm TL had a log absolute fecundity of 2.18. The fecundity increased progressively with fish length in such a way that the largest fish in the sample had nearly 50 times as many ova as per the smallest one. A linear relationship was obtained between fecundity and total

length in *P.vittatus*. The regression equation for this relationship is

$$\text{Log AF} = 0.883 + 1.825 \text{ Log TL} \quad (r) = 0.677 (p < 0.001)$$

### Fecundity and Standard length

The fecundity values of *P.vittatus* were plotted against the respective SL of fish in a scatter diagram (Fig 3).



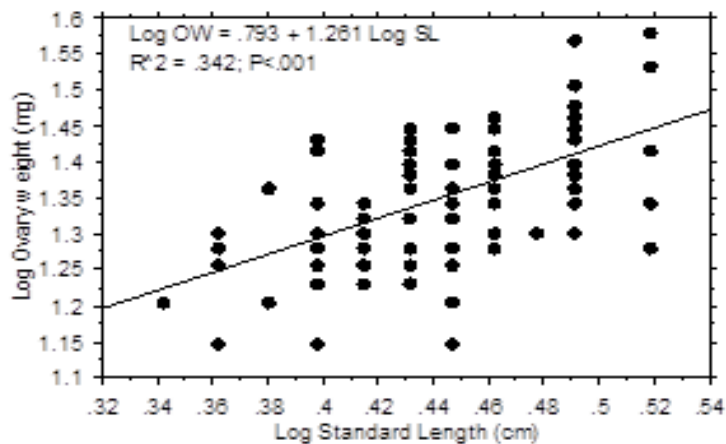
**Fig. 3. *P.vittatus*: Log – log relationship between ovary weight (mg) and total length (cm).**

The fitted regression (log-log plot) between fecundity and standard length (SL) could be expressed as

$$\text{Log AF} = 1.192 + 1.529 \text{ Log SL} \quad (r) = 0.612 (p < 0.001)$$

### Fecundity and fish weight

The number of eggs produced per gram of fish weight was 138 with an overall range of 55-280; within the weight group, the mean egg production per gram fish weight not varied and showed a constant pattern. The log-log relationship between absolute fecundity and weight of fish is depicted in Fig 4.

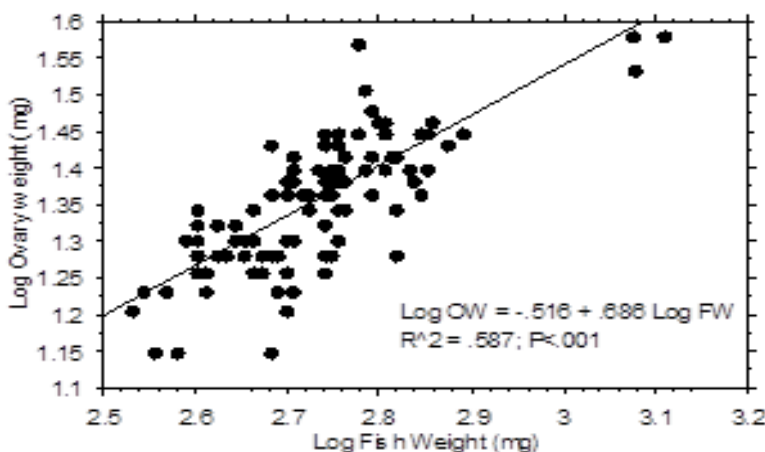


**Fig. 4: *P. vittatus*: Log – log relationship between ovary weight (mg) and standard length (cm).**

The fitted regression (log-log plot) between the fecundity and total body weight could be expressed as  
 Log AF = -.311 + .801 Log FW (r) = 0.772(p < 0.001)

**Fecundity and Ovary length**

The fecundity in females of *P. vittatus* increased with length of ovaries. The data on the length of ovary and fecundity of *P.vittatus* are plotted in Fig 5.



**Fig. 5: *P.vittatus*: Log – log relationship between ovary weight (mg) and fish weight(g).**

The fitted regression (log-log plot) between fecundity and the length of the ovary could be expressed as  
 Log AF = 1.564 + 1.552 Log OL (r) = 0.882(p < 0.001)

**Fecundity and ovary weight**

The egg production in *P.vittatus* ranged from 66 in an ovary of 0.012mg weight to 286 in an ovary of 0.0135mg weight. The number of ova per gram weight of ovary varied from 63 to 148, with an average of 138 eggs. The relationship between is fecundity and ovary weight is presented in Fig. 6.

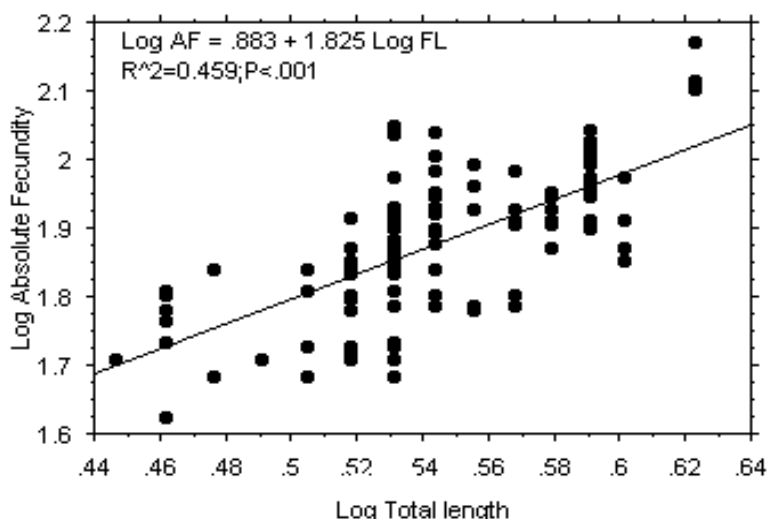


Fig. 6: *P.vittatus*: Log – log relationship between absolute fecundity and total length.

The fitted regression (log-log plot) relationship between the fecundity and the weight of the ovary could be expressed as

$$\text{Log AF} = 0.451 + 1.05 \text{ Log OW} \quad (r) = 0.997 (p < 0.001)$$

## DISCUSSION

### Fecundity

Absolute fecundity (AF) is found to be related to fish or gonad length and weight in *P.vittatus* as suggested by Ain *et al.*, (2021). Tamsil and Hasnidar (2024) suggested that the fecundity of a fish increased in proportion to the square of its length. Hasan *et al.*, (2020) pointed out that the fecundity of plaice was related to the cube of its length. Ardelia *et al.*, (2023) showed that there was a direct proportional increase in fecundity with size, weight, and age in American shad.

The close relationship between absolute fecundity and fish length was observed in *P. vittatus* as supported by the works of Ain *et al.*, (2021), Arevalo *et al.*, (2023), Efizon *et al.*, (2021), Hasan *et al.*, (2020), Hanida *et al.*, (2021) and Sidik *et al.*, (2020). A positive correlation was observed between total length of females of *P.vittatus*. The same trend was reported by Hasnidar, *et al.* (2021), *Pterygoplichthys pardalis*, Hasnidar *et al.*, (2022), *Anabas testudineus*. Indira *et al.*, (2013), *Hemichromis bimaculatus*, Hasan *et al.*, (2020), (*Clupisoma garua*), Arachi (2023), *Aplocheilus lineatus*, and Arachi and Sumaiya (2025). *Aplocheilus lineatus* and their fecundity. Arachi (2023) suggested that previously spawned fish had a greater fecundity than fish of the same age and size that had been spawning for the first time. In the mosquitofish *Gambusia affinis*, the maximum average monthly fecundity was reached when the length of the mother was at its greatest (Sukarman, 2022).

The fecundity was related more to the weight of the ovary in *Labeo calbasu* (Singh and Sing, 2001). There was an increase in number of ova produced with increase in the weight of ovary in *P.vittatus* as in *Puntius*

*sophore*, (Mehedihasan *et al.*, 2020), Similar relationship between weight of the ovary and fecundity had been previously reported by Ain *et al.*, (2021), Arevalo *et al.*, (2023), Efizon *et al.*, (2021), Hasan *et al.*, (2020), Hanida *et al.*, (2021) and Sidik *et al.*, (2020). The linear relationship between fecundity length, and weight of fish and ovary was observed in *P.vittatus*. as reported by several workers.

In *P.vittatus* also there was an increase in the number of ova produced with the increase in body weight. However, the fecundity and fish length relationship was closer than the fish weight and fecundity relationship in *P.vittatus*. The same trend was observed by Nursyahran *et al.*, (2021) in *Oreochromis niloticus*. The fecundity of *P.vittatus* increased with the increase in length of the ovary, as seen in many other freshwater fishes including *Labeo gonius* (Joshi and Khanna, 1980), and *Macropodus cupanus* (Zin *et al.*, 2011). The relationship between the ovary length and fecundity showed that ova production increased with the length of the ovary in experimental fish *P.vittatus*, as were observed in *Puntius bimaculatus* and *P. titteya* (Jan and Jan, 2017), *Puntius titteya* (Tripathi *et al.*, 2010).

The weight of ovary and fecundity in *P.vittatus* had a linear relationship. The coefficient of correlation was perfect and statistically significant, as reported for *Labeo gonius* (Joshi and Khanna, 1980). The linear relationship of fecundity with total length standard length, body weight, ovary length and ovary weight indicated that in *P.vittatus* the number of eggs in the ovaries increased in proportion to these variables. In females the highest gonad weight represented the peak of ripe gamete storage (Hasnidar, *et al.* (2021), *Pterygoplichthys pardalis*, Hasnidar *et al.*, (2022), *Anabas testudineus*. Indira *et al.*, (2013), *Hemichromis bimaculatus*, Hasan *et al.*, (2020), (*Clupisoma garua*), Arachi (2023), *Aplocheilus lineatus*, Arachi (2023). *Aplocheilus lineatus*, and Arachi and Sumaiya (2025) *Aplocheilus lineatus*. But the present investigation showed a

corresponding increase in the number of eggs with the increase in the weight of ovary in *P.vittatus*, as in *Aplocheilus lineatus* (Arachi, 2023), *Mystus vittatus* (Tripathi *et al.*, 2010), *Puntius filamentosus* (Victor *et al.*, 2004) *Esox lucius* (Treasurer, 1990) and, in other Cyprinids like *Barbus humilis*, *B. trispilopeura* and *Xenontedon cancila*(Mridul, 2018).

Gonadal maturity and somatic growth were linked since the analysis of the body length-gonadal length relationships revealed that increase in female gonad length was proportional to fish length (Efizon *et al.*, 2021; Hanida *et al.*, 2021). Accepting the premise that fecundity was a reflection of female reproductive effort (Tamsil and Hasnidar, 2024), and that attaining gonadal maturity was unfavourable to somatic growth and maintenance (Arevalo *et al.*, 2023), high fecundity, higher GSI values and smaller size at first reproduction indicated a high reproductive effort in *P.vittatus*. Thus the reproductive strategy in *P.vittatus* was geared to take advantage of environmental and other factors which offered the greatest opportunities for survival and development of the new generation.

## CONCLUSION

It was observed from the present reprobological studies that *P.vittatus* was biannual monsoon breeder and iteroparous species. It had a major spawning season coinciding with the north-east monsoon during November and January with a spawning peak in January and another spawning season synchronized with the south-west monsoon in June. The females were significantly bigger than males at all seasons of the year, and there was a preponderance of females only in spawning months, otherwise both the sexes were found in almost equal numbers.

## REFERENCES

1. Ain, C., Rudiyaniti, S. and Isroliyah, A., Food habits and ecological niche of silver barb fish (*Barbonymus gonionotus*) in Jatibarang Reservoir, Semarang. IOP Conference Series: Earth and Environmental Science, 2021; 750(012028): 1–11.
2. Arachi. J.M.A.P. Reproductive Cycle of the freshwater loach *Lepidocephalus thermalis* from the River Tambrabarani, Tirunelveli, South India European Journal of Biomedical and Pharmaceutical Sciences, 2020; 7, 2: 257-268.
3. Ardelia V., Fahleny R., Karolina A. and Irawan R., Growth, reproduction and feeding habits of Java Barb. Fisheries Science and Technology, 2023; 3(1): 37–48.
4. Arevalo, E., Cabral, H.N., Villeneuve, B., Possémé, C. and Lepage, M., Fish larvae dynamics in temperate estuaries: A review on processes, patterns and factors that determine recruitment. Fish and Fisheries, 2023; 24(3): 466–487.
5. Efizon, D., Batubara, A.S., Muchlisin, Z.A., Elvyra, R., Rizal, S. and SitiAzizah, M.M., Reproductive aspects of naleh fish (*Barbonymus sp.*): A native species from Nagan river, Aceh Province, Indonesia. Biodiversitas, 2021; 22(5): 2682– 2690.
6. FAO., 2022. The State of World Fisheries and Aquaculture. Towards Blue Transformation. FAO, Rome. 32 P.
7. Hasan, M., Hosen, M.H.A., Miah, M.I., Ahmed, Z.F., Chhanda, M.S. and Shahriar, S.I.M., 2020. Fecundity, length at maturity and gonadal development indices of river catfish (*Clupisoma garua*) of the old Brahmaputra River in Bangladesh. Egyptian Journal of Aquatic Research, 2022; 46(3): 259–263.
8. Hasnidar, Hasnidar., Tamsil, A., Akram, A.M. and Hidayat, T., Chemical analysis of sailfin catfish (*Pterygoplichthys pardalis* Castelnau 1855) from Tempe Lake, South Sulawesi, Indonesia. Journal of Indonesian Fisheries Product Processing, 2021; 24(1): 78–88.
9. Hasnidar, Hasnidar., Tamsil, A., Ernarningsih, E., Hasrun, H. and Akram, A.M., Reproductive biology of betok fish *Anabas testudineus* (Bloch 1792) in Tempe Lake, Wajo Regency, South Sulawesi. Journal of Indonesian Ichthyology, 2022; 22(1): 17–34.
10. Indira R, JMA. Prabhu Arachi and D. Varadharajan. Studies on the reproductive biology of Red Jewel Fish *Hemichromis bimaculatus* (Gill 1962). International Journal of Environmental Biology, 2013; 3(4): 160-172.
11. MehediHasan, Md.Hafiz AllHosen, Md. Idris Miah, Zoarder Faruque Ahmed, Mousumi Sarker Chhanda, and Sheik Istiak Md. Shahriar Fecundity, length at maturity and gonadal development indices of river catfish (*Clupisoma garua*) of the old Brahmaputra River in Bangladesh, Egyptian Journal of Aquatic Research, 2020; 46, 3: 259-263.
12. Michael A.P. Arachi, J. Fecundity of the freshwater killifish *Aplocheilus lineatus* (Valenciennes, 1846) from the River Tambraparanei of Tirunelveli Dt, European Journal of Biomedical and Pharmaceutical Sciences, 2023; 10.9: 215-220.
13. Michael Antony Prabhu Arachi. J. Reproductive cycle of the freshwater Indian Killifish *Aplocheilus lineatus* (Valenciennes, 1846) in The River Tambraparanei from Tirunelveli District, World Journal of Pharmacy and Pharmaceutical Sciences, 2023; 12, 9: 1934-1950.
14. Michael Antony Prabhu Arachi.J and M. Sumaiya. Gonadal biology of the Indian native Killifish *Aplocheilus lineatus*. Uttar Pradesh Journal of Zoology, 2025; 46(9): 420-434.
15. Mridul Kr Borthakur (2018). Study of gonadosomatic index and fecundity of fresh water fish *Xenontedon cancila*, Journal of Entomology and Zoology Studies, 2018; 6(3): 42-46.
16. Muddasir Jan and Neelofar Jan, Studies on the fecundity (F), gonadosomatic index (GSI) and hepatosomatic index (HSI) of *Salmo trutta fario* (Brown trout) at Kokernag trout fish farm,

- Anantnag, Jammu and Kashmir *International Journal of Fisheries and Aquatic Studies*, 2017; 5(6): 170-173.
17. Murua, H., G. Kraus, F. Saborido-Rey, P.R. Withames, A. Thrsen, S. Junquera Procedures to estimate the fecundity of marine fish species in relation to their reproduction strategy, *Journal of Northwest Atlantic Fisheries Science*, 2003; 33: 33-54.
  18. Nursyahrani, Kariyanti, Ilmiah, Jayadi and Andi Yusuf. Fecundity and egg diameter of endemic fish (*Telmatherina bonti* Weber and De Beaufort, 1922) from Towuti Lake, South Sulawesi, Indonesia, *International Journal of Fisheries and Aquatic Studies*, 2021; 9(3): 378-382
  19. Rasheed. S, and J. Mustaqim Size at sexual maturity, breeding season and fecundity of three-spot swimming crab *Portunus sanguinolentus* (Herbst, 1783) (Decapoda, Brachyura, Portunidae) occurring in the coastal waters of Karachi, Pakistan, *Fisheries Research*, 2010; 103(1-3): 56-62.
  20. Sidik, R.A., Herawati, T., Sahidin, A. and Herawati, H., Growth pattern of silver barb, *Barbonymus gonionotus* (Bleeker, 1950) in Downstream Cimanuk River of West Java Province. *Global Scientific*, 2020; 8(1): 551-558.
  21. Sukarman, R.A., Population dynamics of tawes (*Barbonymus gonionotus*) in the waters of Lake Tempe, Wajo Regency, South Sulawesi. Hasanuddin University, Indonesia, 2022; 27.
  22. Tamsil A and Hasnidar H. Reproductive biology of silver barb, *Barbonymus gonionotus* (Bleeker, 1850), in Lake Tempe, Indonesia, *Iranian Journal of Fisheries Sciences*, 2024; 23(6): 877-892.
  23. Tripathi, P.N. Ved Prakash Tripathi and N. P. Singh Studies on Fecundity and fertility of a freshwater catfish *Mystus vittatus* (Bloch) in Eastern Uttar Pradesh, *J. Exp. Zool. India*, 2010; 13, 2: 449-453.
  24. Victor B, M. Mannar Mannan, M. Maridass, U. Ramesh and J.M.A. Prabhu Arachi. Fecundity and sex-ratio studies on fresh water fish, *Puntius filamentosus* (Valenciennes) in Tamparabarani River, Tamil Nadu. *J. Inland Fisheries Society of India*, 2004.
  25. Zar, J.H. *Biostatistical Analysis*. 2nd Edition, Prentice-Hall, Inc., Englewood Cliffs, 1984; 718.
  26. Zin T, Than AA. Naing TT. Fecundity (F), gonadosomatic Index (GSI), hepatosomatic index (HSI), condition factor (K) and length weight relationship (LWR) in *Channa orientalis* Bloch and Schneide, 1801. *Uni. Res. Journal*, 2011; 4: 47-62.