AN INVESTIGATION ON BREEDING BIOLOGY OF FEMALE CLIMBING PERCH, *ANABAS TESTUDINEUS*(BLOCH, 1792) FROM THANATPIN CREEK, BAGO REGION

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Abstract

An investigation was conducted to observe the breeding biology of climbing perch (*Anabas testudineus*), locally known as Nga-pyae-ma. Monthly samples were collected from Thanatpin creek which situated south from Thanatpin Township, Bago Region through the period from January to December 2018. The highest GSI value for female was 15.74±2.08% in July that indicates the peak spawning season. Size at first maturity for female was 17.2 cm in total length and fecundity was range from 7033 to 93258. Specimens in this study were found to have mature gonads in the dry and wet season months, indicating no seasonality in breeding patterns. Growth ovarian stages i.e. maturity stage III, IV and V occurred from April to September, indicating that mature females were actively spawning throughout these months. The relationship between total length (TL) and bodyweight (BW), fecundity and total length (TL), fecundity and body weight (BW), fecundity and ovary weight (OW) were linear. The present study provides the first information about the breeding biology of female *Anabas testudineus* because it potentially indicates their current population condition in the study area.

Keywords: Climbing perch, maturity stages of ovary, GSI, size at first maturity, fecundity, peak spawning season

Introduction

Anabas testudineus(climbing perch) is a small sized food fish, inhabits both freshwater and brackish water and found in most tropical or subtropical area including India, Pakistan, Bangladesh, Nepal, China, Myanmar, Thailand, Cambodia, Philippines, Indonesia, Singapore and Sri Lanka (Mirsa, 1962). It is one of air breathing fishes in Myanmar forming an economically important group of fishes. It is indigenous fish of Myanmar highly favoured by the consumersdue to its high nutrition value as well as for great taste and flavor.It has been kept under Data Deficient-ver 3.1 category of IUCN Red List of Threatened Species (IUCN, 2014). To utilize and manage this species wisely in culture system understanding of breeding biology is very essential. Studies on the breeding biology of any fish is essential for evaluating the commercial potentialities of its stock, life history, cultural practice and actual management of small indigenous fishes (Doha and Hye, 1970).This fish is highly esteemed for its highly nourishing quality and prolonged freshness out of water. This species inhabits in all types of freshwater and also survive in brackish water. It also inhabits standing and sluggish waters of lakes, flood plains, canals and ponds.There are few reports on the breeding biology of *A.testudineus* in Myanmar. It will help to produce high quality seeds in the hatcheries for supporting the sustainable aquaculture production in Myanmar. The present study was to assess the breeding biology such as maturity stages of ovary, size at first maturity, GSI, fecundity and biometric indices, and peak breeding season of climbing perch, *A.testudineus* from the study area.

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Materials and methods

Sample collections

Samples of studied species were monthly collected from Thanatpin creek which situated south from Thanatpin Township, Bago Region (during January to December 2018).This creek is about 17 milesfrom north to south miles and connected with Bago-Sittaung canal and heavily used by fishermen and farmers. Samples were caught by the local fisherman using three fishing gears such as cast net or kun (let-pyit-kun), lift net or portable lift net (yagwin) and stow net (tiger mouth) in the study site.

Study period

The study period lasted from January to December, 2018.

Morphometry

Total length of each fish was measured using a centimeter scale and the body weight was determined by an electronic balance. Size, color and appearance of the ovary were recorded. The sample size varies depending on the abundance of fish catch. Sample sizes ranging from 13 to 22.00 cm were collected for female *A.testudineus*.

Gonadosomatic index (GSI) and Hepatosomatic index (HSI)

$$GSI = \frac{\text{Gonad Weight}}{\text{Body Weight}} \text{ x } 100 \text{(Alam and Pathak, 2010)}$$

$$HSI = \frac{\text{Liver Weight}}{\text{Body Weight}} \text{ x } 100 \text{ (Cek and Yilmaz, 2009)}$$

The condition factor (K) was calculated according to Pauly (1983).

$$K\ (\%) = \frac{\text{Liver Weight}}{\text{Length}^3} \text{ x } 100$$

where K = condition factor; W = weight in gram; L = length in cm

Fecundity

$$N = \frac{Wt}{Ws} \text{ x Ns (Bagenal, 1978)}$$

Wt = Total weight of ovaries; Ws = Weight of subsample;

Ns = Number of oocytes in the subsample

Size at first maturity

Size at first maturity, which is defined as the total length (cm) at where 50% of the sample in maturity stage III, were analyzed using cumulative percentage (Murua*et al*., 2003). The fish were grouped 1 cm size classes and the percentage mature in each size class was calculated.

Linear relationship and correlation coefficient (r) between fecundity and biometric indices were analyses in Microsoft Excel, 2007.Histological sections were assessed for the morphological characteristics of the eggs. The spawning periodwas determined by monthly

evaluation of the gonadosomatic index and percentage of maturity stages of each of the female fish samples. Gonadal stages of females will be examined macroscopically and microscopically classified to Jacob (2005) and Agarwal (1980). The estimated fecundity was computed from the number of mature and ripe oocytes (Lagler, 1971) that were counted.The preserved specimens were identified by Jayaram (1981), Talwar and Jhingran (1991).A test with a $p<0.05$ indicates a significant statistical analysis.

Results

Length-Weight Relation (LWR) and condition factors

Monthly variations in mean relative condition factor and other body parameters for female *A. testudineus* were presented in Table 1. The regression equation for the length-weight relationship of females was calculated as follows:

$$\text{Log } Y = 3.017 \text{ Log } X - 1.721 \quad (p < 0.05)$$

Where $R^2 = 0.836$, $r = 0.911$, Y =body weight, X =body length

The values of coefficient 'b' for length-weight relationship was 3.017 for female (N =236) (Fig. 1).

Gonadosomatic index (GSI) and hepatosomatic index (HSI)

Monthly mean variations of gonadosomatic index (GSI) and hepatosomatic index (HSI) were presented in Table 1 and Fig. 2. The GSI was recorded highest in the month of July which may suggest the peak breeding season and then it gradually decreased and attained its lower value in December for female. The present study showed that a high hepatic activity in females during November while low hepatic activity in August during the study period.

Maturity stages of ovary

In the present study, the ovaries were categorized into five maturity stages and monthly percentage occurrences of gonadal stages in female *A. testudineus* were presented inTable 2 and Fig.3. The seasonality of the reproductive stages of female *A. testudineus* using the GSI, fecundity data and monthly proportion of gonadal maturity stages of female *A. testudineus* was predicted as shown in Table 3. Microscopic observation of ovary of female was shown in plate1.

Fecundity estimation (F)

In the present study, the eggs from 125 matured females were analyzed for fecundity. The mean fecundity was found to be maximum (70593±12583) eggs with a fish having mean total length 18.99 cm and mean body weight 129.16 g with mean ovary weight 20.30 g in July. While the minimum mean fecundity (8946±2705) eggs was recorded with a fish of mean total length 16.35 cm and body weight 101.10 g with mean gonad weight 1.44 g in March. High fecundity was observed in July (40.73%) and low in March (0.34%) (Table 4).

Relationship between fecundity and total body length

The scattered diagram of log of body length and log of fecundity suggested that there is a linear relationship between the two variables (Table4 and Fig. 4).

$$\text{Log } Y = 4.986 \text{ Log } X - 1.631 \quad (p < 0.05)$$

Where $R^2 = 0.431$, $r = 0.688$ Y = fecundity, X = body length

The fecundity was correlated with the body length and comprised a correlation coefficient of 0.431, which means approximately 43% of changes in fish fecundity was explained by fish body length.

Relationship between fecundity and body weight

The scattered diagram of log of body weight and log of fecundity suggested that there is a linear relationship between the two variables (Table4 and Fig. 5)

$\text{Log } Y = 2.191 \text{ Log } X + 0.129 \ (p < 0.05)$

Where $R^2 = 0.518$, $r = 0.755$, Y = fecundity, X = body weight

The fecundity was correlated with the body weight and comprised a correlation coefficient of 0.518, which means approximately 52% of changes in fish fecundity was explained by fish body weight.

Relationship between fecundity and ovary weight

The scattered diagram of log of ovary weight and log of fecundity suggested that there is a linear relationship between the two variables (Table4 and Fig. 6)

$\text{Log } Y = 0.782 \text{ Log } X + 3.782 \ (p < 0.05)$

Where $R^2 = 0.943$, $r = 0.983$, Y = fecundity, X = ovary weight

The coefficient of correlation between the numbers of eggs with ovary weight was positive as the value of R^2 was 0.943. This implied 94% changes in fecundity could be explained by gonadal weight.

Size at first maturity

Sexual maturity was attained in female *A. testudineus* at highly variable sizes. In the present study, the smallest mature females matured at 14.50 cm and the highest mature females were observed at 17.30 cm and the size at first maturity i.e. 50% mature females were approximately 16.22 cm. (Table 5, Fig. 7).

Table 1 Monthly variations in body parameters, condition factor and gonadosomatic index of *A. testudineus*

Months	N	Average length (cm)	Range	Average weight (g)	Range	GSI (%)	HSI (%)	K (%)
January, 2018	11	16.52±0.64	14.50-17.50	97.51±9.69	81.65-114.64	0.50±0.37	1.15±0.38	2.16±0.08
February, 2018	17	16.65±0.66	15.50-17.50	99.94±17.16	59.19-120.67	0.35±0.10	1.25±0.36	2.14±0.17
March, 2018	16	15.98±0.73	15.00-18.00	80.87±22.84	54.45-135.45	0.54±0.37	1.55±0.37	1.94±0.27
April, 2018	27	17.74±1.52	16.30-22.00	100.42±24.16	66.19-150.89	6.54±2.96	0.85±0.23	1.78±0.14
May, 2018	23	16.55±1.08	15.00-19.50	90.09±15.74	66.33-110.16	9.26±4.47	0.87±0.16	1.98±0.16
June, 2018	26	16.31±0.53	15.00-17.50	100.09±10.82	84.38-122.72	11.76±5.98	0.86±0.19	2.31±0.22
July, 2018	30	18.97±0.99	16.50-20.50	129.16±18.14	101.89-172.39	15.74±2.08	0.76±0.22	1.89±0.19
August, 2018	6	18.08±1.32	16.50-19.50	120.91±17.44	88.11-134.6	14.74±3.40	0.69±0.31	2.06±0.35
September,2018	20	15.87±0.58	14.50-17.00	82.56±14.10	58.92-98.82	4.14±3.82	0.99±0.61	2.05±0.23
October, 2018	19	16.46±1.24	14.00-19.00	99.90±35.79	40.36-184.4	0.37±0.11	1.41±0.55	2.25±0.30
November, 2018	20	15.78±0.77	14.00-17.00	82.43±15.19	55.87-112.78	0.18±0.07	2.00±0.37	2.08±0.15
December,2018	21	14.00±0.81	13.00-16.50	49.26±11.98	38.12-95.56	0.28±0.14	1.81±0.50	1.77±0.12

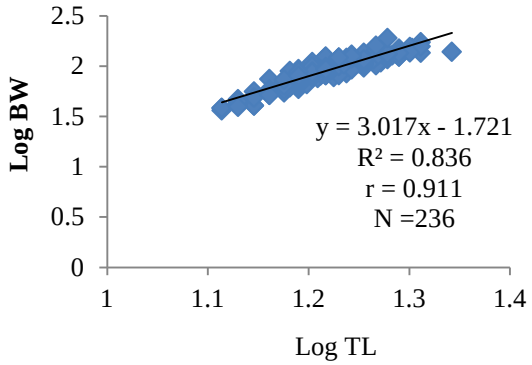


Figure 1 Length-weight relationship of female *Anabas testudineus*

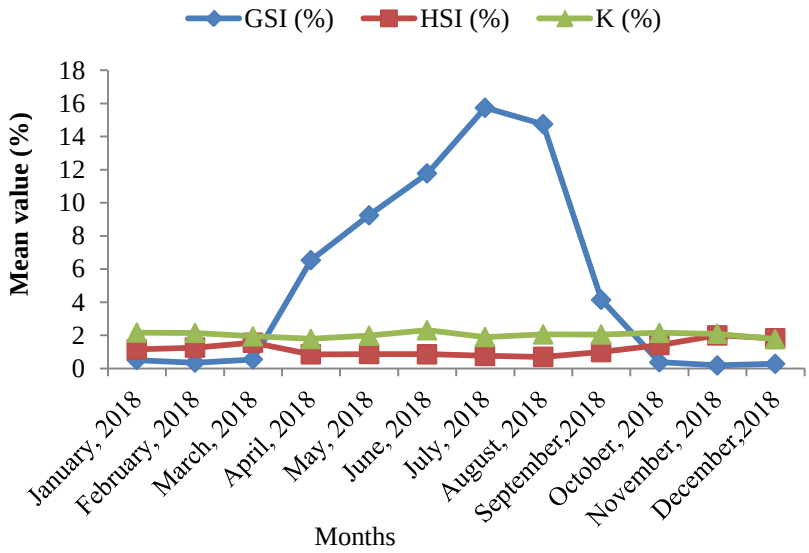


Figure 2 Monthly fluctuation of mean gonadosomatic index, hepatosomatic index and condition factor of female *A. testudineus*

Table 2 Monthly percentage occurrences of gonadal stages in female *A. testudineus*

No.	Month	Sample size	Stage I Immature)	Stage II (maturing)	Stage III (mature)	Stage IV (Ripe)	Stage V (Spent)
1	January	11	55	36	0	9	0
2	February	17	47	47	0	0	6
3	March	16	31	56	13	0	0
4	April	23	0	0	57	43	0
5	May	27	0	0	93	7	0
6	June	26	0	0	81	19	0
7	July	30	0	0	70	30	0
8	August	6	0	0	33	67	0
9	September	20	10	5	40	10	35
10	October	19	50	22	0	0	28
11	November	20	5	0	0	0	95
12	December	21	19	76	0	0	5

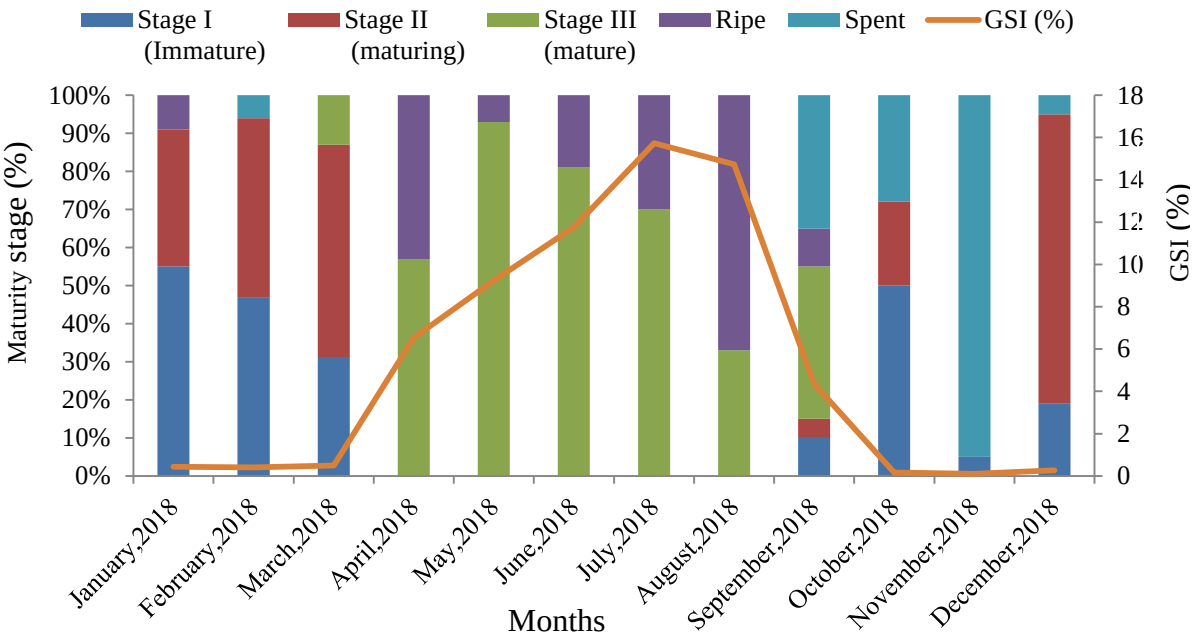


Figure 3 The proportion of gonad stages and GSI of female *A.testudineus* at sampling period

Table 3 Seasonality of reproductive stages based on some aspects of reproductive biology of *A. testudineus*

Period	Months
Maturation period (immature and maturing)	Jan-March and December
Spawning season (mature and ripe)	April - September
Breeding season (spent)	September-November

Table 4: .Monthly variation of mean absolute fecundity with weight and length for gravid female *A.testudineus*

Period	Sample size(n)	Body weight(g)		Total length(cm)		Ovary weight(g)		Fecundity	
		Mean±SD	Range	Mean ± SD	Range	Mean±SD	Range	Mean±SD	(%)
January, 2018	1	114.64	_	17.5	_	1.84	_	11068	0.21
March, 2018	2	101.1 ±2.81	99.11-103.08	16.35± 0.21	16.2-16.5	1.44±0.34	7033-10858	8946±2705	0.34
April, 2018	23	100.42±24.16	66.19-150.89	17.74±1.52	15.8-22	6.96±4.74	10717-70678	25766±14064	11.40
May, 2018	27	90.09±15.74	61.27-123.79	16.5 ±1.08	15-19.5	8.66±5.04	8455- 55872	28793±14698	14.95
June, 2018	26	100.09±10.82	84.38-122.72	16.31±0.53	15.2-17.5	11.85±6.23	12521-72948	42517±21410	21.26
July, 2018	30	129.16±18.14	101.89-172.39	18.99±0.99	16.5-20.5	20.30±3.60	49863-93258	70593±12583*	40.73
August, 2018	6	120.91±17.44	88.11-134.6	18.08±1.32	16.5-19.5	18.07±5.89	29872-89854	60951±23399	7.03
September,2018	10	85.74 ±8.93	72.63-98.82	15.76±0.56	14.5-16.3	6.28±2.76	7128-28455	21106±6005	4.06
Total	**125**								

Maximum*

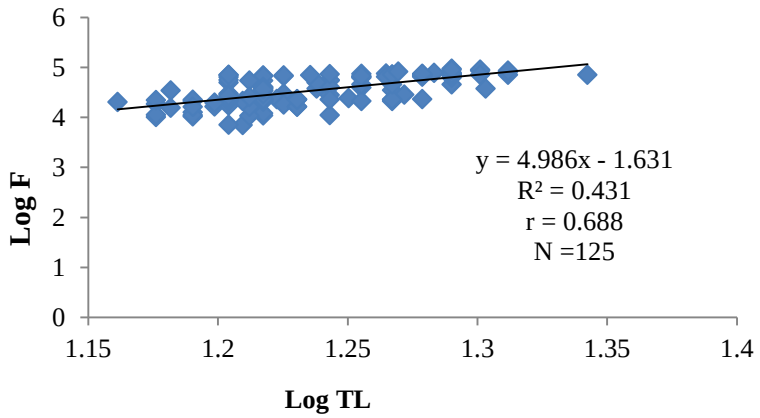


Figure 4 Relationship between fecundity and total length in female *A.testudineus*

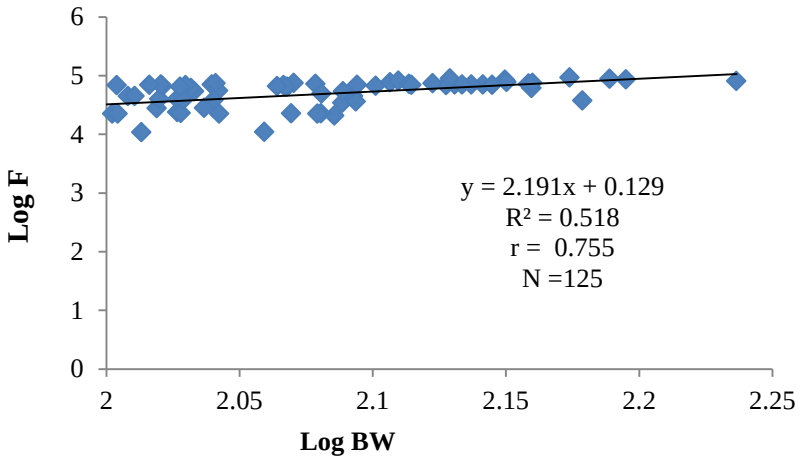


Figure 5 Relationship between fecundity and body weight in female *A. testudineus*

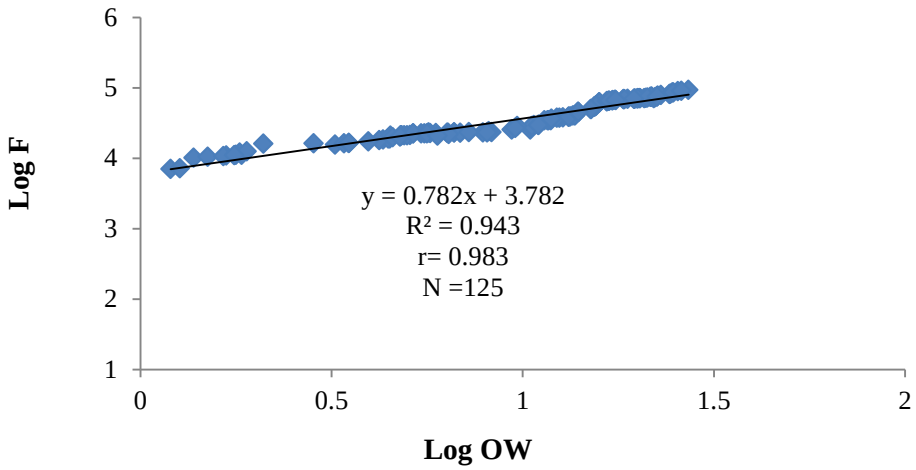


Figure 6 Relationship between fecundity and ovary weight in female *A. testudineus*

Table 5 Size at first sexual maturity of observed female *A. testudineus*

Months	Sample size (n)	Size range of mature female fish (cm)	Minimum size of mature female fish (cm)
March, 2018	2	16.20-16.50	16.20
April, 2018	25	15.00-19.50	15.00
May, 2018	13	15.80-22.00	15.80
June, 2018	21	15.50-17.00	15.50
July, 2018	21	17.30-20.50	17.30
August, 2018	2	16.50-19.00	16.50
September, 2018	8	14.50-16.30	14.50

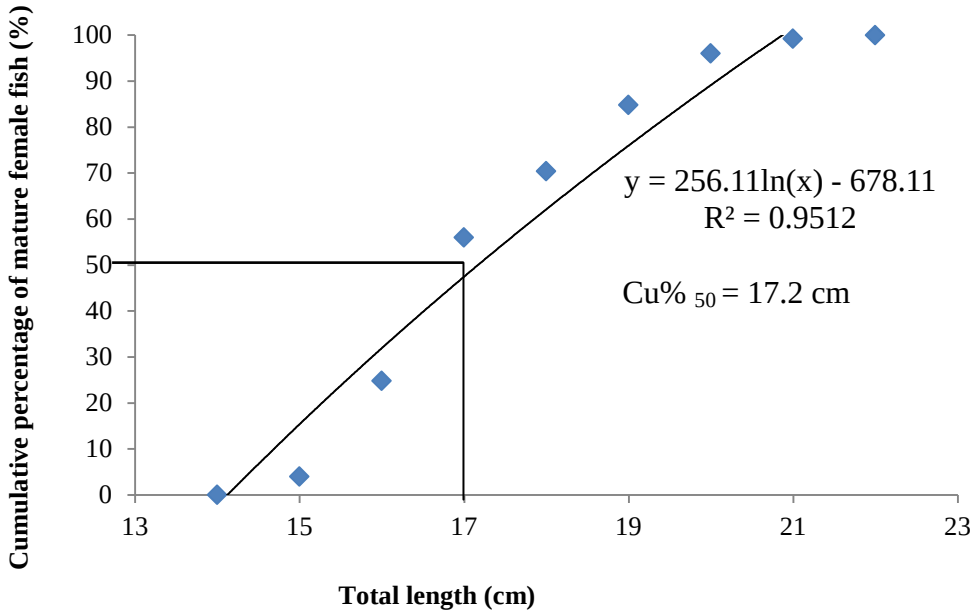
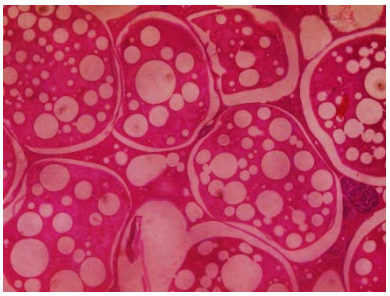
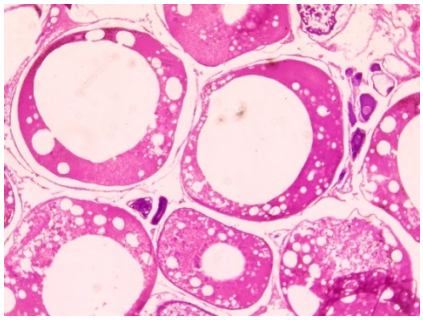


Figure 7 Size at first maturity for female *A. testudineus*

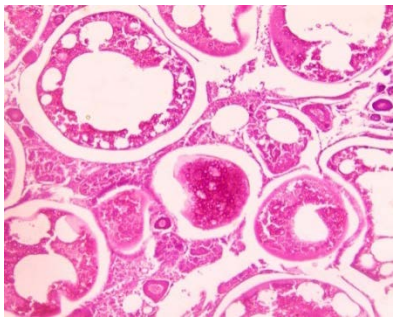
A. The ovary in the coelomic cavity



B. Maturing stage of female fish



C. Mature stage of female fish



D. Ripe stage of female fish

Plate 1: The reproductive stages of female *Anabas testudineus*

Discussion

The maximum size of this female fish reported by (Rahman, 2012) in Assam, India was 13.40 cm, but the largest female specimen observed in this study was 22.00 cm. The growth performance in female was found high since the correlation coefficient 'r' exhibits high degree of positive allometric correlation between the length-weight relationship. The positive allometric growth can be due to higher proficiency in feeding (Saikia *et. al.,* 2011) and better condition for survival for the species (Gohain and Goswami, 2013).Degree of variation of exponential value of length-weight relationship indicated by 'b' value in female *A. testudineus* was 3.0. The value of exponent 'b' is found to be in normal range between 2.5 and 4.0 as suggested by Hile (1936) and Martin (1949).Variation in 'b' value can be attributed due to feeding (Le-Cren, 1951) and sex (Hile and Jobes, 1940), development stages of gonads, specially the ovary affect the weight (Weathely, 1972) and state of maturity (Frost, 1945). In the present study, 'b' remains constant at 3.0 showing isometric growth pattern in an ideal environment (Gohain and Goswami, 2013).

Condition, fatness or well-being of fish expressed by 'K' factor, is an index to monitor feeding intensity and growth rate (Oni *et al*., 1983) is based on hypothesis that heavier fish for given length are in better condition (Bagenal and Tesch, 1978). Fish with high value of 'K' are heavy for its length, while with low 'K' are lighter. 'K' value greater than 1 indicates better condition of fish (Le-Cren, 1951).The present study showed that monthly variations of condition factor were all resulted above one indicating the food supply of studied species were stable and good in the study area.

The GSI indicates gonadal development and maturity of fishincreases with the maturation of fish declining thereafter (Parameswam *et al*., 1974). Bernal *et. al*. (2015) reported GSI of

female climbing perch peaked in May during the onset of the wet season (May to November) in the Candaba wetland, Philippines. During the study period, the GSI of female peaked in June, July and August, and the spawning season was from April to September. The present study agreed with the study of Morioka *et al.,* (2009) which they also mentioned this species has extended breeding period following the peak between April to August. The GSI and HSI value in the present study were found to be inversely related with each other which reveal liberation of energy from liver into the ovary.

The GSI values for the 236 female fish ranged from 0.05-9.19% with a mean of 5.84%. This indicated that *A. testudineus* on the average used 5.84% of its body weight for egg production. Nikolsky (1963) said that the ovaries weight was around 15% from the body weight but Scott (1947) reported the values between 15%and 30%.Maturity stage III, IV and V occurred from April to September, indicating that mature females were actively spawning throughout these months. The months with the highest peaks in the GSI may be indicated of fish species respective spawning periods.

The peak fecundity observed for *A. testudineus* during the months from April to September suggested the possible spawning season of the fish species. In this study period, the correlation between fecundity and ovary weight was more correlated than that of total length and fish weight. It suggested that fecundity generally was increased in direct proportional to ovary weight. Variation in fecundity may be due to environmental conditions and food availability in the study area. This variation was also reported by some previous study of other fish (Doha and Hye, 1970).

Size at first maturity i.e. 50% of matured female *A.testudineus* was approximately 17.2 cm in total length. Few researchers result on length at first maturity is different from that of the researches done in India. Most likely genetic variation and environmental influences played a major role on the changes (Chanchal *et. al*., 1978).

Conclusion

Specimens in this study were found to have mature gonads in the dry and wet season months, indicating no seasonality in breeding patterns. The periods predicted to be the spawning, maturation, and breeding season coincide with the GSI data. The months of September to December that showed decrease in the AF values, GSI values and occurrence of gonad stage V (spent) may possibly indicate the maturation-to breeding season. Catching female *A. testudineus* with a minimum size limit to allow them time to reach maturity and produce eggs in order to substain their population and prohibition on fishing the fish in the spawning season should be instituted in this area. The information on the reproductive biology of this species is important because it potentially indicates their current population condition in the study area.

Acknowledgements

The author is grateful to Dr. Lu Lu Aung, Professor and Head, Zoology Department, Dagon University for her permission to present this paper and also thankful to Dr. Sann Aung, Joint Secretary, Myanmar Academy of Agricultural Forest, Livestock and Fishery Sciences for his valuable suggestion and criticism of the manuscript.

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