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morphometrical and Gonadal Studies of A Threatened Fish, *Anabas testudineus* with Respect to Seasonal Cycle

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Abstract

The study was conducted in the laboratory to understand the morphometrical measurement and relationship among fecundity to length and weight of fish, length and weight of ovary and volume of ovary as well as relationship among ovary weight of fish to total length and total weight of fish for reproductive biology of *Anabas testudineus.* Adult of *A. testudineus* ranging from the length of 110 to 170 mm and weight of 30 to 60 gm were collected from local market and acclimatized in the laboratory conditions with artificial feed. The length of the testis in different body size varied from 12.0 to 22.7 mm. The weight of testis showed decreasing trend from 0.252 gm in September and 0.236 gm in October. The Gonadosomatic index (GnSI) of testis varied from 0.494 to 0.668. The length of the ovary in different body size varied from 11.0 to 16.2 mm. The Gonado somatic index of ovary varied from to 0.271 to 0.880. The correlation and coefficient of fecundity with different variables like total length, total weight and weight of the ovary and length of the ovary are found significant at 0.05 levels which implies that the fecundity values found during the experiment directly depend on the above independent variable.

Keywords: *Anabas testudineus,* length, weight, testis, ovary and reproductive biology.

INTRODUCTION

Anabas testudineus contains high values of physiologically available iron and copper, which are essentially needed for hemoglobin synthesis (Saha, 1970). In addition to this, it also contains easily digestible fat very low melting point and good many of essential amino acids. So, *Anabas* is considered as a valuable item of diet for sick and convalescent with high market demand. Despite moderate size, market demand and high price, *Anabas testudineus* is regarded as a highly esteemed and eye-catching fish that has been attracting attention of the fish growers since older times.

Reproduction of *Anabas testudineus* occurs in low lying swamps, paddies, lakes, pools, small pits, ditches, streams, rivers, and irrigation canals. *Anabas testudineus* attains sexual maturity in the first year. It is categorized by the International Union for Conservation of Nature and Natural Resources (IUCN) as a vulnerable species (Singh *et al.,* 2012)**.**

In West Bengal a persistent drift from villages to the urban areas for jobs and more income has resulted in overcrowding in cities and loss of manpower in rural areas for development so *Anabas testudineus* can be extensively employed for the stocking ponds and check drift of manpower (Day, 1889). The culture potential of *Anabas* cannot be ignored in West Bengal. Therefore, it is necessary to think about the strengthening the fish culture techniques as well as to restore the population size of *Anabas.* The main constraint of culture of *Anabas testudineus* is non-availability of quality seeds, neither from natural resources nor from artificial propagation. So, before thinking about over the culture of *Anabas,* more emphasis should be given to materialize the problem on availability of seed through artificial propagation (Saxena, 1993). For a deeper insight into the breeding of *Anabas,* it is imperative to have knowledge on its reproductive biology, which may help to explore the possibilities of artificial propagation of the species. With a view to above and in continuance with the study of Das (2002). The objective of the current investigation was carried out to morphometrical studies and relationship with fecundity to other body parts as well as gonads in seasonal cycle to understand the features of the reproductive biology which is required for proper management of the fishery.

MATERIALS AND METHODS

The study was confined to the laboratory investigation and was conducted during September to February in the Department of Fisheries Resource Management, West Bengal University of Animal and Fishery Sciences. Adults of *Anabas testudineus* ranging from the length of 110 to 170 mm and weight of 30 to 60 gm were collected from nearby local fish market of Mohanpur, Nadia district of West Bengal. The standard length (Ls) of the fish samples were measured according to the definitions of body length in Hubb and Lagler (1958). They were transported to the laboratory by plastic buckets with manual aeration. No mortality occurred during transportation. The fishes stocked were reared. From the reared stock, monthly samplings were done from September to February for the further study. Every month 30 numbers of samples were drawn randomly from the stocking specimen and observed.

Morphometrical study of body and gonads:

The live fishes were dissected out; the position and appearance of gonads were noted. The gonads (testis or ovary) were taken out quickly and put into physiological saline solution. The gonads were washed properly to remove blood, adhering tissues and fats. Then the gonads were observed carefully. The colour, size, volume, length and weight of gonads as well as length of coelomic cavity were measured accordingly. The colour of gonad was observed by naked eye. The length, weight and volume of gonads were estimated by centimetre scale, electronic balance and water displacement method respectively. The length of coelomic cavity was also measured by centimetre scale. The lobular size, volume and transparency of the gonads were observed keenly.

Fecundity:

The samples (from middle region) of ovaries were subjected to volumetric counts based on the principles of Kandler and Pirwitz (1957). For the study of fecundity, the middle portion of the ovary was put into the modified Gilson's fluid. Then the numbers of ova were counted manually to get the fecundity by following formula:

$$\text{Fecundity} = \frac{\text{Total volume of ovary x No. of ova counted in sub-samples}}{\text{Volume of the sub samples.}}$$

Gonado Somatic Index (GnSI)*:*

Gonado somatic index values were used as indicator of degree of gonadal development. It was found out by employing the following formula.

$$\text{GnSI} = \frac{\text{weight of the gonad}}{\text{total weight of the fish}} \times 100$$

Statistical analysis :

To interpret the data statistically a standard method (least square) was used to find out the relationships between the different variables (fecundity and fish weight / fish length / ovary volume / ovary weight / ovary length) in the following form Y = a+ b X and in logarithmic form Log Y= log a + b log X Where, Y= Fecundity; X= Different body or gonadal parameters; a (intercept) and b (slope) are constant.

RESULTS AND DISCUSSION

Morphometry of Gonads:

Testicular Morphometry:

The length of the testis in different body size varied from 12.0 to 22.7 mm (Table 1). The weight of testis showed decreasing trend from 0.252 gm in September and 0.236 gm in October. Again it was increased from 0.239 gm in November to 0.488 gm in February. The Gonadosomatic index (GnSI) showed almost parallelism in their activity, being 0.561 in September to 0.494 in October showing decreasing trend, again increased from 0.476 in November to 0.668 in February. The details of testicular morphometry are represented in Table 1. From the testicular observation it was found

that there is an increasing trend of testis weight, volume and length with respect to the increase of fish length and fish weight (Table 6).

Ovarian Morphometry:

The length of the ovary in different body size varied from 11.0 to 20.0 mm. The weight of ovary showed decreasing trend being 0.166 gm in September and 0.159 gm in October. Thereafter, again increased from 0.540 gm in November to 0.317 gm in February. The Gonadosomatic index (GnSI) showed almost parallelism in their activity being 0.316 in September to 0.294 in October showing decreased trend, and again increased from 0.271 gm in November to 0.880 gm in February. The details of ovarian morphology were represented in Table 2. Similarly in female fish of *Anabas testudineus,* gonadosomatic index (GnSI) was 10.4±2.5 during breeding season (Amornsakun *et al.,* 2005).

Fecundity:

Climbing perch is one kind of freshwater fish which has high fecundity. It was found to be similar to the other fishes. In the present study the approximate ovarian fecundity of *Anabas testudineus* was estimated during non-breeding period i.e. September to February.

Fecundity relationship:

The fecundity of *Anabas testudineus* was studied in relation to fish length and fish weight as well as volume, weight and length of ovary (Tables 3 and 4).

Fecundity and fish length*:*

From individual sampling it was normally observed that the larger sized fishes had relatively more ovarian eggs. On an average, fish measured 166 mm in total length had 12,758 numbers of ova, while it was 7,989 eggs for a fish having 117 mm of total length. The length of the fishes ranging from 110 to 170 mm, were arranged in the size groups of 10 mm range intervals to study the fecundity. It was observed that the average fecundity of the different length groups was ranging from 7,989 to 12,758 eggs (Table 3). Above result is similar from female climbing perch was 15.20±1.24 cm in total length. The fecundity was 24,120.5±3,328.24 ova/fish (Amornsakun *et al.,* 2005). The relationship between fecundity and fish length was found be F=9486 +1119 TL and in logarithmic from Log F = 3.4532 + 0.678 Log TL; (r=0.734), Where, 'F' represents fecundity and 'TL' is the total length of the fish. The correlation and coefficient of fecundity with variable fish length is found significant at 0.05 levels which implies that the fecundity values found during the experiment directly depend on the above independent variable (Table 5).

Fecundity and fish weight:

Relationship between Fish weight (somatic + gonad) and fecundity had been computed (Table 4). The average number of ova varied from 5,979 at a mean weight of 32.2 gm to 13,565 at 50.0 gm of fish. This result is similar of female climbing perch was 61.10±17.32 gm in body weight. The fecundity was 24,120.5±3,328.24 ova/fish

(Amornsakun *et al.,* 2005).The data plotted between fish weight and fecundity was found to be F=25645 + 157 FW and in a logarithmic form Log F=3.854 +0.2985 Log FW; (r=0.9324), Where, 'FW' represents the weight (w/w) of fish. The correlation and coefficient of fecundity with variable fish weight is found significant at 0.05 levels which implies that the fecundity values found during the experiment directly depend on the above independent variable (Table 5).

Fecundity and ovary volume:

The average egg production corresponding to average ovary volume had been tabulated in Table 3. The minimum ovary volume was 0.12 ml and fecundity was 7,989. The maximum ovary volume was 0.58 ml and corresponding fecundity was 12,758. The relationship was found to be F = 14034 + 2546 OV and in logarithmic form Log F = 4.5 126 + 0.4846 Log OV; (r=0.9 176), Where, 'F' and 'OV' represent the number of ova and volume of ovary (ml) respectively. The correlation and coefficient of fecundity with variable ovary volume is found significant at 0.05 levels which implies that the fecundity values found during the experiment directly depend on the above independent variable (Table5).

Fecundity and ovary weight :

In order to study the average relationship, the fecundity values were plotted against weight of ovaries. The minimum egg production ranged between 7,989 in ovary having weight of 0.0805 gm and 12,758 eggs were produced from a ovary of 0.586 gm. Percentage of ovary weight in total weight of fish was ranging from 1 to 3 with an average of 1.94 of the total body weight. The relationship between fecundity and ovary weight was found to be F = 22547 + 884 OW and in logarithmic form Log F = 4.2178 + 0.2 156 Log OW (r=0.8642), Where, 'OW' represents the weight of ovary. The correlation and coefficient of fecundity with variable ovary weight is found significant at 0.05 levels which implies that the fecundity values found during the experiment directly depend on the above independent variable (Table5).

Fecundity and ovary length:

The relationship between ovary length and average number of eggs were computed (Table 3). It was observed that the fish having ovary length from 10.3 mm to 20.5 mm had fecundity of 7,989 to 12,758, respectively. The relationship was found to be F = 15865 + 4632 OL and in logarithmic form Log F = 3.976 + 0.5 176 Log OL; (r=0.7 165) Where, 'OL' represents the length of ovary. The correlation and coefficient of fecundity with variable ovary length is found significant at 0.05 levels which implies that the fecundity values found during the experiment directly depend on the above independent variable (Table5).

Ovary weight and fish length:

The weight of ovary was influenced with respect to the size of the fish. The relationship was found to be OW=-11.52+ 1.45 FL and in logarithmic form Log OW = -2.125 + 2.316 Log FL; (r=0.7346**)** Where, 'FL' and 'OW' represent the total length of the fish and weight of ovary, respectively. The correlation and coefficient of

ovary weight with independent variable ovary length is found to be significant at 0.05 level with respect to weight of the fish (Table5).

Ovary weight and fish weight:

The ovary weight (OW) was plotted against the respective fish weight (FW) to observe their relationship. The equation was found to be OW = -1.68 + 0.17 FW and in logarithmic form Log OW = -1.2 134 + 1.342 Log FW; (r= 0.9573), Where, 'OW' and 'FW' represent the ovary weight and fish weight, respectively. The correlation and coefficient of ovary weight with independent variable ovary length is found to be significant at 0.05 level with respect to weight of the fish (Table5).

Table 1: Morphometry of body and testis of *Anabas testudineus* during non-breeding season

Month	Length of the fish (mm)	Weight of fish (gm)	Length of testis (mm)	Testis occupying coelomic Cavity(%)	Volume of testis (ml)	Weight of testis (gm)	Gonodosomatic Index (GnSI) (%)
September	142.62±15.8	62.00±19.63	12.9±0.7	45.42±8.94	0.363±0.05	0.252±0.02	0.561±0.29
October	139.30±11.0	65.14±21.26	13.9±4.9	35.39±2.86	0.337±0.21	0.236±0.13	0.494±0.35
November	122.50±25.0	43.38±3.38	12.0±3.5	50.57±12.21	0.320±0.05	0.229±0.01	0.476±0.07
December	134.10±69.0	51.25±3.93	17.8±4.2	59.21±7.33	0.361±0.04	0.378±0.07	0.482±0.05
January	153.10±12.8	51.67±7.88	26.7±1.9	60.22±7.19	0.483±0.11	0.381±0.06	0.597±0.34
February	135.0±76.0	39.28±8.1	22.7±5.3	63.76±9.44	0.570±0.15	0.488±0.09	0.668±0.03

Table 2: Morphometry of body and ovary of *Anabus testudineus* during non-breeding season

Month	Length of the fish (mm)	Weight of fish (mm)	Length of Ovary (mm)	Ovary occupying Coelomic cavity (%)	Volume of Ovary (ml)	Weight of Ovary (gm)	Gonodosomatic Index (GnSI)(%)
September	124.5±1.50	46.00±4.00	13.3±0.30	37.61±6.01	0.150±0.05	0.166±0.020	0.316±0.32
October	139.0±2.90	51.3±7.36	17.30±4.10	45.61±11.51	0.333±0.125	0.159±0.300	0.294±0.12
November	122.5±2.50	46.0±1.00	11.0±1.00	43.42±10.02	0.400±0.100	0.540±0.001	0.271±0.05
December	135.5±5.50	49.0±1.00	20.0±1.00	49.49±3.62	0.450±0.050	0.198±0.067	0.317±0.04
January	132.6±5.95	37.2±2.56	13.04±1.36	58.85±17.70	0.480±0.212	0.258±0.140	0.506±0.27
February	127.4±5.68	38.0±2.28	16.2±1.17	59.29±0.49	0.500±0.081	0.317±0.075	0.880±0.18

Table 3: Relationship between fecundity with various parameters of body and ovary of *Anabus testudineus* during non- breeding season

Month	Total length of fish (mm)		No. of fish examined	Ovary weight (g)		Ovary volumes (ml)		Ovary Length (mm)		Fecundity (No. of Eggs)	
	Range	Avg		Range	Avg	Range	Avg	Range	Avg	Range	Avg
September	110-120	117.0	2	0.01-0.1	0.0805	0.1-0.3	0.1-2	10.0-12.0	10.33	7352-9761	7989
October	120-130	125.0	3	0.05-0.2	0.1594	0.01-0.3	0.1-15	12.0-14.0	12.8	5536-7856	6137
November	130-140	133.7	4	0.1-0.27	0.2395	0.3-1.0	0.6-5	13.0-16.0	14.75	6124-9568	7884
December	140-150	140.7	5	0.3-0.49	0.4290	1.0-2.1	0.2-5	16.0-18.0	16.4	6956-9916	7116
January	150-160	150.5	2	0.46-0.58	0.5120	0.25-1.65	0.5-5	17.0-22.0	19.57	10518-14526	11991
February	160-170	166.0	2	0.49-0.64	0.5860	0.32-1.0	0.5-8	19.0-22.0	20.5	9735-13516	12758

Table 4: Relationship between weight of fish, ovary weight and fecundity in *Anabus testudineus* during non-breeding season

Months	Weight of fish (g)		No. of fish examined	Ovary weight (g)		Fecundity (No. of eggs)	
	Range	Average		Range	Average	Range	Average
September	30-35	32.2	5	0.010-0.120	0.0805	5536-7698	5979
October	35-40	35.062	3	0.120-0.240	0.1594	7598-9545	8248
November	40-45	41.45	3	0.240-0.360	0.238	9348-11561	9936
December	45-50	46.6	5	0.360-0.480	0.429	10198-13375	12550
January	50-55	50	4	0.480-0.640	0.640	12264-14458	13565

Table 5: The regression and correlation coefficient between the dependent and independent variety of *Anabus testudineus* with equation, used in each case.

Dependent Variate 'Y'	Independent Variate 'X'	Equation LogY=Log a + bLog X	Regression Coefficient (b)	Correlation Coefficient (r)
Fecundity (F)	Total length of fish (TL)	LogF=3.4532 +0.678LogTL	0.678	0.7340*
Fecundity (F)	Total weight of fish (FW)	Log F= 3.854+0.2935LogFW	0.2985	0.9324*
Fecundity (F)	Weight of Ovary (OW)	LogF=4.2178+0.2156LogOW	0.2156	0.8642*
Fecundity (F)	Volume of Ovary(OV)	LogF=4.5126+0.4846LogOV	0.4846	0.9176*
Fecundity (F)	Length of Ovary (OL)	LogF=3.996+0.5176LogOL	0.5176	0.7165*
Weight of Ovary (OW)	Total length of fish (TL)	LogOW= -2.025 + 2.316LogFL	2.316	0.7346*
Weight of Ovary (OW)	Total weight of fish(FW)	LogOW= -1.2134 + 1.342 LogFW	1.342	0.9573*

**Significant at 0.05 level.*

Table 6: Relationship between total length with various parameters of body and testis of *Anabas testudineus* during non-breeding season

Month	Total length of fish (mm)		Frequency	Fish weight (g)		Testis weight (g)		Testis volume (ml)		Testis length (mm)	
	Range	Average		Range	Average	Range	Average	Range	Average	Range	Average
September	110-120	113.5	4	30-35	31.5	0.015-0.01	0.017	0.1-0.2	0.15	0.5-1.0	1.15
October	120-130	123.66	6	35-40	32.5	0.01-0.1	0.045	0.2-0.3	0.207	1.0-1.5	1.27
November	130-140	134.214	3	40-45	36.72	0.1-0.2	0.181	0.3-0.4	0.346	1.5-2	1.623
December	140-150	146.25	4	45-50	42.4	0.2-0.3	0.239	0.4-0.5	0.615	2-2.5	2.323
January	150-160	155.0	6	50-55	47.6	0.3-0.4	0.358	0.5-0.6	0.895	2.5-3	2.785
February	160-170	167.6	5	55-60	53.2	0.4-0.5	0.469	0.6-0.7	1.05	3-3.5	3.58

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