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Ageing and Growth Records of *Anabas testudineus* (Bloch) (Anabantidae : Perciformes)

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Abstract

Observations on otoliths of 115 males and 67 females of 1-11 age group have shown that the transparent (hyaline) and opaque rings are formed annually on the *Anabas testudineus* otolith. The validity of the otolith study has been confirmed by obtaining high co- efficient of correlation (0.94 and 0.93) between total length (TL) and otolith (OR) of 337 males and 387 females of *A. testudineus*. But the significant differences (t=15.80, D. F=722; $P < 0.001$) between the sexes have indicated the use of length intercept separately for back calculation for males and females. Growth rate for females (k=0.174, L=237.12) was found to grow faster than that of males (k=0.182, L=18). From the age length distribution it is inferred that on an average, lengths of 105.30±3.98, 122.56±5.22, 143.24 ±5.66 for males and 106.70±5.17, 127.81±5.20 and 145.59±5.42 for females are attained by the species in the respective ages of 3 years of their life spans .

Keywords: Growth rate, Structures of fish, Rapid metabolism

Introduction

The *Anabas testudineus* is one of the important edible live fish of Bangladesh. It is available in the canals, streams, ponds and inundated fields. In fishery biology the annual 'ring', checks or annuli on certain structures of fish, such as the scales, opercular bones, otoliths, vertebrae, fins rays etc. are used to determine the age and sometimes the growth of fish. Yearly zones of growth on these parts are due to a slowing down of temperature of a more rapid metabolism at a time in the spring. Certain fresh water fishes of the monsoon tropics also show seasonal growth marks that correspond to the on set of the dry season.

For proper management of any fishery programme, studies on the age and growth of fishes are very important. The determination of age of fish is essential in solving many biological problems, in understanding the age-class structure of the stock and the role played by various year-classes in the fluctuation of the fishery. Powell (1981) mentioned that the validity of any skeletal methods to study the growth depends on the occurrence of isometric growth between skeletal structure and body lengths. The growth cheeks or marking as found in the skeleton structures of fishes of temperate regions have been observed in fishes from tropical and subtropical regions and can be made to determine the age from these markings (Pantulu 1963).

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Materials and Methods

Six hundred female and 500 male specimens of the size group of 62 mm to 155 mm in total length were examined and among them the otoliths of 337 males and 387 females were found suitable for interpretation. To remove the otoliths, an incision was made downward and forward from the back of the head, the scalpel being held parallel to the body; the top of the skull was thus sliced off and the brain was exposed. The otoliths were then removed from the optic capsules and after washing in distilled water were stored in dry envelops on which sex, length and weight were noted. Marginal increase for each monthly interval was measured with an stage micrometer to the nearest 0.01 mm from the last completed opaque ring to the edge of the otolith. Here length-frequency methods, were used to determine the length for age groups.

Data Analysis

The relationship between length and weight was estimated by log transformation of least square regression. A't'- test was used to compare mean length at each age of the year sampled. Length and age were fitted to the Von Bertalanffy growth curve by 'Ford-Walford Plot'. The length were back calculated by the Lee method (Tesch 1968).

Results and Discussion

Age of otolith and its validity

The calculation of age was accomplished in the formation site of first opaque ring peripheral to the transparent area. The validity of the study has been justified by a high co-efficient of correlation (r = 0.94 for male and r = 0.93 for female) between otolith radius and total length of fish indicating a rectilinear regression. An analysis of 't' determined between total length (TL) in mm and otolith radius (OR) in mm differed significantly (P< 0.001) between the sexes. Seasonal in both the sexes.

Periodicity of marginal increase and estimation of ages:

The mean marginal increases, their 95% confidence limits, range and sample size have been shown in Table I. The growth was highly from the mid July to September and maximum increase has been observed in March-April, but slightly decreased in November-December. A significant decrease in the marginal increase occurred between March-April and May-June (t = 3.05 ; d. f . 34 ; P< 0.01 for male and t =2.27 ; d .f . 40 ; P<0.01 for female).

All the fishes examined during May- June contained no sign of opaque ring formation, unless a very faint transparent margin remained whereas, the maximum fish examined in mid-July to September had a recently formed narrow opaque (calcareous like) ring encircling the transparent margin. This suggests that most fish resume growth in mid July-September and the calcareous matter are added to the otolith, a year mark at this time.

This fish breed in May to June (Nargis and Hossain 1992) and for the first time producing these were caught during the month of August to October . These fishes became mature in their growth and breed in the next calendar year. It was also observed that the marginal increase of otolith was reduced during breeding season and resumed increase followed by a opaque ring during July-September more or less around the transparent margin. The fish having a single opaque ring more or less around the transparent margin has been designated as the fish of one year and if they were caught 'between their year of hatching to the formation ' of first opaque ring would be placed in age group 0-1. Similarly, the fishes having two or three opaque rings around the completely formed transparent margin have been designated as the first of two and three years and if they were caught between the first opaque ring to the formation of third opaque rings

Table 1. Total marginal increase and its corresponding mean increase with 95% confidence limit in every two months throughout the year for the age group I-II of male (N=119) and female (N=123) of Anabas testudineus

Age group	Months	Marginal increase in stage micrometer unit (male)		Marginal increase in stage micrometer unit (female)		Comparison of Sexes		
I-II		Total	Mean ± 95% C.L.	Total	Mean ± 95% C.L.	t	d.s.	P
	Jan-Feb	0.04-0.12	0.068±0.005 (20)	0.03-0.12	0.065±0.005 (21)	-	-	-
	Mar-Apr	0.05-0.13	0.081±0.007 (17)	0.05-0.12	0.083±0.004 (20)	0.102	2/35	N.S.
	May-June	0.01-0.06	0.026±0.003 (19)	0.02-0.06	0.030±0 (21)	1.0	2/39	N.S.
	July-Aug.	0.02-0.06	0.038±0.003 (16)	0.02-0.07	0.041±0.002 .003 (18)	-	-	-
	Sep.-Oct.	0.03-0.09	0.053±0.0003 (22)	0.04-0.09	0.0058±0 .003 (21)	0.117	2/41	N.S.
	Nov.-Dec.	0.02-0.09	0.045±0.003 (25)	0.02-0.07	0.044±0.002 (21)	0.038	2/44	N.S.

* N.S. = Not significant

[A]Sample size is given in parenthesis

would be placed in the age group I-II and II-III respectively, which agreed with the age grouping of (Sinha and Jones 1967 and Powell 1981).

Relationship between age and length in *A. testudineus*

The relationship between age and length in male fishes varied from 62 mm to 105 mm in age group 0-1; 93 mm to 132 mm in age group I-II; 125 mm to 141 mm in age group II-III and the female fishes range in length from 69 mm to 110 mm in age group 0-1, 97 to 140 mm in age group 1-11 and 131 mm to 150 mm in age group II-III. The females have a better growth rate than those of the males in the same environment (Table IIa and IIb). Similar results were also described by (Thompson 1942) .

Table IIa. Age-length distribution, mean length(X), standard deviation and sample size (N) for male *A.testudineus*

Length(mm)	Number of fish in age group							
	0	I	I	II	II	III	III	IV
	1995	1996	1995	1996	1995	1996	1995	1996
61-70	3	3						
71-80	2	5						
81-90	8	6						
91-100	16	14	9	4				
101-110	15	19	9	12				
111-120			20	15				
121-130			23	10	19	18		
131-140				13	21	12		
141-150				22	25			
151-160							2	3
161-170							1	1
N	44	47	61	54	62	55	3	4
X	104.68	105.87	122.87	122.87	143.19	143.29	156.33	156.25
S.D.	3.84	4.07	4.83	5.66	5.78	5.36	5.13	5.97

[A]Sample size is given in parenthesis

·N.S.= Not significan

Table IIb. Age-length distribution, mean length (X), standard deviation and sample size (N) for female *A. testudineus* during 1995-1996

Length(mm)	Number of fish in age group							
	0	I	I	II	II	III	III	IV
	1995	1996	1995	1996	1995	1996	1995	1996
61-70	5	4						
71-80	7	9						
81-90	9	11						
91-100	8	8	8	6				
101-110	7	9	9	8				
111-120			7	7				
121-130			6	6				
131-140			5	5	12	16		
141-150					11	10		
151-160					1	1		
N	36	41	35	32	32	34	3	2
X	106	107.24	127.94	127.66	144.56	146.56	162.33	161.0
S.D.	5.48	5.31	5.66	4.74	5.07	5.63	6.43	5.66

In both the sexes , growth gradually decreased with advancement of ages and no significant differences in mean length at age between the years detected . The males attained 104.68 ± 3.84 to 105.87 ± 4.07 mm; 122.28 ± 4.83 to 122.87 ± 5.66 mm and 143.19 ± 5.78 to 143.29 ± 5.36 in their first second and third years of life span, while the females attained 106 ± 5.48 to 107.24 ±5.31 mm; 127.94 ±5.66 to 127.66 ± 4.74 mm and 144.56 ± 5.07 to 146.56 ± 5.63 mm in their first, second and third years of life span. (Table III) A uniform rate size at maturity has been found to be the same length and it may be concluded that the fish attained sexual maturity when it is about one year old. This agrees with the result obtained in age and growth study in *Catla catla* by Shafi and Mustafa (1976) and Schrank and Guy (2002).

Similar findings have also been reported by Jhingran (1958) and Natarjan and Jhingran (1963) in their conclusion. According to Chacko *et. al* (1948) , the study of growth con-

Table III. Mean length (S. D.), Sample size (N) and 't' value of mean lengths between year, for male and female from 1995 - 1996

Age group	Mean length S.D.(mm)[A]		Comparison of year		
	1995	1996	t	d.f.	P
Male I	104.68 ± 3.84 (44)	105.87 ± 4.07 (47)	1.61	2 / 89	N.S *
II	122.28 ± 4.83	122.87 ± 5.66(54)	0.72	2 / 113	N.S.*
III	143.19 ± 5.78(62)	143.29 ± 5.36 (55)	1.10	2 / 115	N.S *
Female I	106 ± 5.48 (36)	107.24 ± 5.31 (41)	0.77	2 / 75	N.S *
II	127.94 ± 5.66 (35)	127.66 ± 4.74 (32)	1.12	2 / 6	N.S *
III	144.56 ± 5.07 (32)	146.56 ± 5.63 (34)	1.35	2 / 64	N.S *

N.S. = Not significant

[A] Sample size is given in parenthesis

of growth can not be expected throughout the life span of the individuals (Thomas 1969) and the earlier stages growth rate will be much higher than in later stages (Jones and Hynes 1950). Indications of such differential growth rate at different stages are determined in the present study. The fish grew rapidly attaining about 101-110 mm and 115-120 mm by the male and female respectively at the end of the first year. The stants has led to conclusion that majority of the fish population show phases of growth and some even three, where first phases coincided with the sexual immaturity and third is the period of old age. In *A. testudineus* after the first spawning i.e., after the first year of life, the growth is considerably retarded and the size attained at the end of second and third year are only 120-130 mm, 131-140 mm, by the males and 130-140 mm, 141-150 mm by the females.

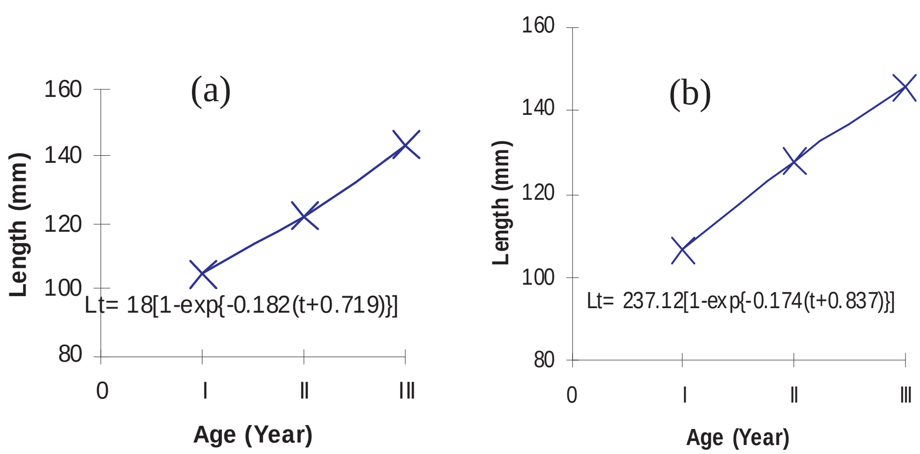

Fig. 1a and 1b: Von Bertalanffy growth curves for male (1a) and female (1b) A. testudineus sampled in 1995 and 1996. Observed mean length and age 1s.d. are represented by horizontal and vertical bars, respectively

Growth in length

All data available from length of age were included in the growth analyse and for least square estimates of the Von Bertalanffy growth curve parameters. Fig. 1a and 1b shows a similar agreement in growth pattern of different ages in *Macrognathus aculeatus* (Nabi and Hossain 1990).

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