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EXTERNAL MORPHOLOGY AND SEXUAL DIMORPHISM OF *ANABAS TESTUDINEUS* IN NATURAL ENVIRONMENT

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ABSTRACT
The study was conducted during January to June 2005 in the laboratory to understand the reproductive biology of *Anabas testudineus* (Bloch). The samples were collected monthly from natural environment of Mohanpur. For the identification of sex, two methods were adopted. First one was the observation of sex through external morphology and second one was by the gonadal dissection. The seasonal development of the gonad was also studied morphologically to know the spawning season and maturation of fish. In the present study, the secondary sexual characteristics like colour of the body, belly structure and vent, were considered but during January and February, there was no remarkable difference in the above morphological features was observed in both sexes. However, with the approach of the breeding season, it was found suitable to identify the sex with the external morphological characteristics i.e., morphometry, belly structure and vent. From the present study, it was found that there was no significant difference in the external morphology of gonad in *A. testudineus* when compared to other teleosts.

KEY WORD: *Anabas testudineus*, colour of the body, belly structure and vent.

INTRODUCTION

A number of species that are currently of great economic significance or of potentials significance for aquaculture but do not reproduce spontaneously under captive or cultured conditions. The environmental difference between wild and culture conditions may induce specific physiological responses or fail to entrain the culmination of the normal reproductive cycle. Alternatively, the culture environment may induce a generalized stress response in the fish, which affects the endocrine control process of reproduction (Donaldson and Hunter, 1983; Sumpter, 1991). The climbing perch, *Anabas testudins* commonly known, as 'Koi' was first introduced to the scientific literature in a memoir (1797) by Daldorf, a lieutenant in the service of the Danish East Company at Tranquebar. The genus *Anabas* is represented by two species viz., *Anabas testudineus* (bigger in size) and *Anabas oligolepis* (smaller in size). These fishes can stay for long time alive, out of water and sold in live condition usually. So they are called as 'live fished'. However, both the species of *Anabas* have high market demand throughout the year in West Bengal (Mishra and Munshi 1958 and Roy, 1994). Some scientists such as Dehadrai *et al.* (1973) and Banerjee and Prasad (1974) have studied external morphology of some air breathing fishes. Unlike other higher vertebrates sexes of fish cannot be segregate from the external observation. Sex of fishes can be determined on the basis of the reproductive organ present in the coelomic cavity open to a single pore called vent (Khanna and Sanwal, 1972). Some fishes exhibit sexual dimorphism (Lehri, 1967) while other do not (Rai, 1965; Khanna and Pant, 1966; Bisht, 1974; Shrestha and Khanna 1976). The sexual differences or sexual dimorphism in fishes are classified as primary and secondary sexual characters. Primary sexual characters are those that are concerned actually with the reproductive process (Bardach *et al.,* 1972). The reproductive organs in the male and female can be seen after dissection because they are present in the coelomic cavity of the body. They can be easily distinguished in the mature fishes but in immature or small fishes it is very difficult to distinguish (Bardach *et al.,* 1972). *Anabas testudineus* is sexually dimorphic, occurs generally with the approach of the breeding season (Dehadrai *et a!.*, 1973).

Current investigation was carried out to external morphology and sexual dimorphism of *Anabas testudineus* in natural environment and observed the secondary sexual characteristics like colour of the body, belly structure and vent.

MATERIAL & METHODS

The study was confined to the laboratory investigation for this the gonad development from the natural environment was conducted during January to June 2005 in the Department of Fisheries Resource Management, West Bengal University of Animal and Fishery Sciences, West Bengal.

Collection and sampling of the fish species

Live adults of *A. testudineus* were collected from Mohanpur, Nadia, West Bengal, for study. Sampling was done in the 3rd week of every month in every sampling, four to five male and four to five female fishes were studied in detail i.e. morphological features of the fish and morphology of the gonad.

Morphological study of the fish

Live fishes were taken in the dissection tray and observed thoroughly. The external features were observed thoroughly via: the colour of the body, fins, vent as well as the structure of the belly. On the basis of the keen observation on the external morphology, the male and female fishes were identified and segregated. The fishes were dissected out and the gonads were removed to confirm the sex as per the observations of external morphology. These characters were observed during onset of breeding season, so termed as secondary sexual characteristics (Lagler *et al.*, 1977).

Morphological study of gonads

The live fishes were dissected and the position and appearance of gonads in coelomic cavity were noted. The gonads were taken out and put into physiological saline solution. The gonads were washed properly to remove the blood, adhering tissues and fats. Then the gonads were observed carefully. The colour, size, length and weight of the gonads were studied carefully. The colour of the gonads was observed by naked eye. The lobular size, volume and transparency of the gonads were observed keenly.

RESULTS & DISCUSSION

External Morphology for Sex Identification

For successful induced breeding, the identification of sex is very necessary. The study of secondary sexual characteristic is helpful for segregation of sex and other biological studies [Rath, 2000]. In the present study, *Anabas testudineus* was observed from January to June 2005 to understand the changes in the external morphology for identification of sex. During this period three important external characters i.e. the colour of the body, structure of belly and vent of the fish were considered as secondary sexual characters as described by Lagler *et al* ., (1977).

Colour

In the present study, some remarkable change in colour of *A. testudineus* was observed. Before breeding season (January and February, the colour of *A. testudineus* invariably to sex was greenish black (rifle green) along the dorsal side with less variation and the yellowish along the ventral side. With the approach of peak breeding season (March to June), the mature males acquired a reddish hue on the ventral part of the body, while a reddish yellow colouration occurred on the pectoral as well as ventral fins. In case of female's similar change in colouration were also observed. (Table 1 and Table 2). Therefore, the sex determination on the basis of body Colour could not be Possible during non-breeding and breeding season.

TABLE 1: External Morphology of male *Anabas testudineus*

Month	Colour of the Body	Size of belly	Colour of the vent	Black spot at caudal region
January	Body riffle green, darker to lighter yellow	Not bulging	Reddish	Slightly bright
February	Darker ventral, yellowish brown	Not bulging	Reddish	Slightly bright
March	Body whitish, Ventral reddish yellow	Slightly bulging	Reddish	Bright
April	Brownish in colour	Slightly bulging	Reddish	Bright
May	Dark brown in colour	Bulging	Reddish	Bright
June	Dark brown in colour	Bulging	Reddish	Not dark spot

During the study, the colour pattern of the body in both male and female *Anabas* were greenish black during January and February. This colour patterns in both male and female were quite similar. So that it was very difficult to identify the male and female *Anabas* during January and February. However, it is agreed with the observation of Dehadraj *et al.*, 1973. According to him, the colour pattern of the *Anabas* may change according to the environment and location. Therefore, the colour pattern of the body has no role for the identification of sex during the non-breeding season (January and February). The present observation is also agreed with the observation of the Banerjee and Prasad (1974).

With the approach of breeding season (March to June), the colour pattern of body became bright in comparison to the non-breeding season (January and February). In case of male and female the colour pattern at the dorsal side was brownish colour and ventral side was reddish hue. However, there was no difference of the colour pattern between the male and female. From this study, it was found that on the basis of colour the sex (i.e., male and female) cannot be distinguished during breeding as well as non -breeding season. But, based on the colour pattern the mature and immature fishes can be identified which is corroborated with the observation of Mookherjee and Mazumdar (1946) and Banerjee and Prasad (1974).

Belly Structure

During non-breeding season (January and February) the belly of *A. testudineus* was found indifferent in both the sexes. The belly size was found almost similar with no bulginess But with the onset of breeding season (March), both male and female exhibited an increase in the belly size, which was found increasing gradually till peak breeding season (May to June). The fully ripe females were found with a prominent bulged belly. Fullness was found in the both the sexes but it was more in female with compared to male (Table 1 and 2). So, sex determination of *Anabas* is not possible during January and February (non-breeding season) on the basis of belly structure. But it is possible, only during (breeding season) May to June. During January and February, the bulginess of belly was found slightly in both the sexes. During breeding season, bulginess of belly was increasing gradually upto the peak breeding season (i.e., May to June). Because during breeding season the gonads (i.e., males = testes and female = ovary) were maturing by increasing their gonadal

material (sperm and egg). So that, both the sexes were increasing the volume of the gonads which in turn increases the size of the belly. But the bulginess of belly was comparatively more in case of female than the male. During this period, the GnSI of female was found more than that of the male. Based on this observation, it was found that there was a bulginess of belly during breeding and non-breeding season in both the sexes. But during breeding season the female can be identified based on their bulged belly than that of male. This is agreed with the observation of Mookherjee and Mazumdar (1946) and Das (2002).

TABLE 2: External Morphology of female *Anabas testudineus*

Month	Colour of the Body	Size of belly	Colour of the vent	Black spot at caudal region
January	Body riffle green, darker to lighter yellow	Not bulging	Reddish	Slightly bright
February	Darker ventral, yellowish brown	Not bulging	Reddish	Slightly bright
March	Body whitish, Ventral reddish yellow	Slightly bulging	Reddish	Bright
April	Brownish in colour	Bulging	Reddish	Bright
May	Dark brown in colour	Bulging	Reddish	Bright
June	Dark brown in colour	Bulging	Reddish	Not dark spot

Vent

During non-breeding season (January and February), there was no remarkable difference of vent noticed in both sexes (Male and Female). The vents of fishes were reddish pink to reddish in colour, with less brightness. With the approach of breeding season (March), the female exhibited a dark red coloured vent with well distinct outgrowth, like that of a genital papilla. This was prominently seen at the vent when a gentle pressure was given to the abdomen of the female during breeding season (March to June). No such structure was observed in the vent of male *Anabas* (Table 1 & 2). So, during non-breeding season (January and February) male and female could not be identified based on structure of vent. But it is possible during breeding season (March to July). During the breeding season, the vent of females of *Anabas* exhibits a bright red with a prominent outgrowth resembling the genital papilla. But, these structures are completely absence in males (Dehadrai *et. al.*, 1973). In the female, during non-breeding season (January and February), this outgrowth at the vent was in rudimentary stage. During this period, this outgrowth was so small that it was very difficult to identify the sex correctly. But the red colour of vent was observed with less brightness during January and February. From March onwards, i.e., with the onset of the breeding season, the vent was observed with bright red with prominent outgrowth resembling the genital papilla. So during this time the sex differentiation can be done from the external features. Therefore, vent of *Anabas* plays an important role for identification for sex during breeding season (Khan, 1972; Dehadrai *et. al.*,1973; Das, 2002) but not during non-breeding season.

MORPHOLOGY OF GONAD

Testicular morphology

The testes of *A. testudineus* were dissected out and found paired and elongated in the Coelomic Cavity (Plate 1). It was found lying ventral to kidney and dorsal to alimentary canal; remain attached to the body wall by means of a thin layer of membrane called mesochrium (Plate 1). During January and February, it was noticed that the structure of testes of *A. testudineus* was thin and delicate with reddish white in colour (Table 3). As the onset of the maturity (i.e. March to June), the testes became thick, flattened, lobulated and occupied more than the posterior two-third portion of the body cavity (Plate 1). In teleosts, the paired testes may vary in their morphology and histology. The testes in different species of teleosts may be either fused along the entire length (Khanna and *Pant*, 1966) or completely separated (Dixit and Agarwal 1974 a).

PLATE 1: Photograph showing the testes in the coelomic cavity of *Anabas testudineus*

Sometimes it is found to be fused at the posterior region reported by Pandey and Misra (1981). In the present study, the testes of *Anabas testudineus* was found separated throughout their length and both the lobes

are also equal in size. The colour of the testes was varied from reddish white to creamy white or pinkish hue due to the enhanced of blood circulation (Table.3). During breeding season, sperm could be oozing out by pressing on the belly. Length and weight of testes was maximum during breeding season (March to June). This study can be corroborated with Dehadrai *et al.* (1973). The colouration of the testes during the study period was varied from reddish white to creamy white or pinkish hue due to the enhanced blood circulation. This observation can be corroborated with the study of Pandey (1987) and Besra (1997). In the present study, the colour of the testes was changing according to the maturation of testes with onset of seasonal rhythm. During this period, the (testes is influence by hormones secreted by pituitary gland to go for spermatogenesis for the further breeding season as these was observed by Swarup (1958) in *Gastresteus aculeatus.*

Ovarian morphology

The ovaries of *A. testudineus*, were one paired and elongated in structure, lying postero-dorsally in the body cavity. Both the ovaries were found free at the anterior end, it was attached to the body cavity by means of a thin layer of membrane called mesovarium (Plate 2).The differences in the colours of the ovary were observed during different period of breeding cycle. The ovaries were delicate and translucent structure with lobulated surfaces during January and February [Table 3]. During the breeding period, the reproductive activities in fishes are rhythmic and the breeding phase is restricted to a particular season of the year. However, the morphological structures of ovary are also changes according to the change in the ovarian cycle, which is influenced by the season. In the present study, the colour of the ovary became less bright during January and February because of the empty lobulation of the ovary (Table.3). This study can be corroborated with the study of Munkittrick *et. at.*, (1984), in *Carassius auratus* and Azad (1990), in *A. testudineus.*

PLATE 2: Photograph showing the ovary in the coelomic cavity of *Anabas testudineus*

TABLE 3: External morphology of Gonads (colour and shape) in *Anabas testudineus*

Gonad / Month	Ovary			Testes		
	Colour	Lobulation	Transparency	Colour	Lobulation	Transparency
January	Brown	Less Lobulations	Slightly opaque	Creamy white	Less Lobulations	Semi transparent
February	Brownish Yellow	Slightly lobulated	Slightly opaque	Creamy white	Less Lobulations	Semi transparent
March	Brownish Yellow	Slightly lobulated	Slightly opaque	Reddish white	Slightly lobulated	Slightly opaque
April	Yellow	lobulated	opaque	Reddish white	lobulated	opaque
May	Yellow	lobulated	opaque	Reddish white	lobulated	opaque
June	Yellow	lobulated	opaque	Reddish white	lobulated	opaque

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