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## An investigation on breeding biology of Vietnam strain of climbing perch, *Anabas testudineus* (Bloch) reared in a commercial hatchery

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### Abstract

An investigation was conducted to know the breeding biology of Vietnamese climbing perch (*Anabas testudineus*), locally known as Koi. Monthly samples were collected from Rupali Fish Hatchery throughout the period from January to July 2014. Five gross ovarian stages i.e. immature (mean ova diameter  $0.17 \pm 0.05$  mm), maturing (mean ova diameter  $0.33 \pm 0.05$  mm), mature (mean ova diameter  $0.63 \pm 0.11$  mm), ripe (mean ova diameter  $0.76 \pm 0.08$  mm) and regressing (mean ova diameter  $0.29 \pm 0.09$  mm) were observed. The highest mean GSI value for female and male were 14.91 and 8.33 respectively in May that indicates the peak breeding season. Size at first maturity for female was approximately 20.5 cm in total length and fecundity was ranged from 50610 to 227378. The relationship between fecundity and total length (TL), fecundity and body weight (BW), fecundity and ovary weight (OW) and fecundity and ova diameter (OD) were linear. The present study provides the first detailed information about the breeding biology of Vietnamese Koi in Bangladesh. Therefore, the results will play a vital role for the induced breeding, proper management and conservation of this species.

**Keywords:** Vietnamese climbing perch, maturity stages of ovary, GSI, size at first maturity, fecundity and peak breeding season.

### 1. Introduction

Bangladesh is enriched with vast natural water resources scattered all over the country in the form of ponds, lakes, beels, haors, baors, small and large rivers etc. In the past, these water bodies were abundant in different kinds of fish species which fulfilled major protein demand of the country. Climbing perch (*Anabas testudineus*) is a very important indigenous fish among all of those whose local name is Koi. This kind of fish is famous among the people of Bangladesh due to its high nutrition value as well as for great taste and flavor. The demand of this species is very high because it can be marketed as alive. It is highly esteemed for its highly nourishing quality and prolonged freshness out of water and a valuable diet for sick and convalescent [8, 9, 10]. However abundance of this native species is declining drastically due to the ecological degradation, indiscriminate fishing, use of pesticides and fertilizers, destruction of habitats, obstruction to breeding migration, management failure etc [16].

Considering the importance of native Koi, the breeding technology of this species had successfully been developed in the institute of freshwater Station. However, its slow growth and small size does not favour sustainable production per unit area in a culture system [12]. To solve this problem, another fast growing climbing perch known as Thai Koi (*A. testudineus*) has been introduced from Thailand in 2002. Due to the technical inefficiencies of the hatchery owners, it has lost its appetizing taste and high productivity characteristics. In this situation, Sharnalata Agro Fisheries Limited has introduced Vietnamese Koi (*A. testudineus*) in 2010 whose growth rate is 60% higher than Thai Koi. It can be cultivable in pond and take artificial feed as Thai Koi. Farmers can have high financial return in low investment because of its high production. But the major constraint in the culture of this species in a large scale is the non availability of quality seeds from the hatchery. 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 [4].

Since, Vietnamese Koi is a newly introduced species in aquaculture of Bangladesh, there is no research available about its breeding biology.

The present study was performed to describe the breeding biology such as maturity stages of ovary, size at first maturity, GSI and fecundity and peak breeding season of Vietnamese Koi which will help to produce high quality seeds in the hatcheries for supporting the sustainable aquaculture production in Bangladesh.

## 2. Materials and methods

### 2.1. Sample collection

The brood fishes were monthly collected from Rupali Fish Hatchery's own brood ponds, Jessore (during January to July 2014). The fishes were cultured as a monoculture in a particular stocking density at the pond. Then the broods were caught by a cast net from the pond and the live fishes were carefully transported to the laboratory after recording the sex.

### 2.2. Water quality measurement

Water quality parameters were measured weekly including temperature using a Celsius thermometer. Dissolved oxygen and pH were measured using a digital DO (HANNA, model HI 9142) meter and a direct reading digital pH meter (HANNA, model HI 9025) respectively.

### 2.3. Morphometry

The total length of each fish was measured using a centimeter scale and the body weight was determined by an electronic balance. The fishes were killed by piercing a pin on the head and dissected out by scissors. Then size, colour and appearance of the ovary were recorded.

### 2.4. Gonad-somatic index (GSI)

Gonad-somatic index is the percentage of gonad weight to the total weight of the fish. GSI of the male and female were determined separately using the following method.

$$GSI = \frac{\text{gonad weight of fish (g)} \times 100}{\text{body weight of fish (g)}}$$

### 2.5. Ova diameter

Diameter of the ova was measured from each of the anterior, central and posterior portion of the ovaries by a photographic microscope (model: Zeiss Primo Star, Germany) with 10 X × 10 X individual fishes magnifications.

### 2.6. 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 [17]. The fishes were grouped into 1 cm size classes and the percentage mature in each size class was calculated.

### 2.7. Fecundity

The fecundity or the numbers of eggs were estimated from ovaries of fishes in mature stage III and ripe stage IV [5]. The method used for fecundity which involved counting of the number of mature ova in a portion of known weight of ovary and then calculating the total number of mature ova by the formula,

$$\text{Fecundity} = \frac{\text{Total ovary weight} \times \text{No. of eggs}}{\text{Weight of small portion of total ovary}}$$

The relationship between fecundity and various parameters such as the total length (TL), body weight (BW), ovary weight

(OW), ova diameter (OD) were estimated by the least square method [22].

## 3. Results

### 3.1. Water quality parameters

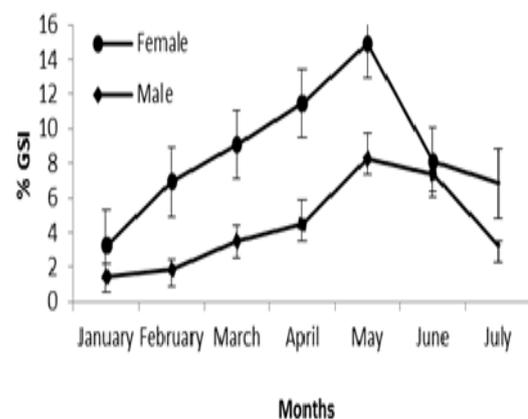
The mean values of the water quality parameters with standard deviation (SD) in different months are shown in Table 1. The maximum temperature 33.6 °C was recorded in the month of May whereas the minimum temperature 17.5 °C was in January. There were no significant differences in the pH and dissolved oxygen in different month during the study period.

**Table 1:** shows monthly changes in the water quality parameters (mean± SD) of broods pond.

Months	Water quality parameters		
	Temperature (°C)	pH	Dissolved oxygen (mg/l)
January	17.5±0.46	7.20 ±0.14	5.17±0.95
February	20.7±0.34	7.31±0.32	4.98±0.65
March	26.2±0.43	7.44±0.20	4.76±0.69
April	27.6±0.29	7.56±0.28	4.71±0.48
May	32.6±0.29	7.78±0.31	4.70±0.69
June	30.4±0.50	7.71±0.24	4.82±0.37
July	27.1±0.99	7.59±0.16	4.90±0.64

### 3.3. Gonado-somatic index (GSI)

The GSI values of female Vietnamese Koi were ranging from 3.29 to 14.91 and male were 1.53 to 8.33. The highest GSI values in both sexes were recorded during the month of May that indicates the mature stage of ovaries with the highest ova diameter of female Vietnamese Koi. The mean ova diameter varied from 0.17±0.05 mm to 0.76±0.08 mm and reached to the peak in the month of May and the minimum was found in January.



**Fig 1:** Monthly variation in mean GSI for males and females Vietnamese Koi

### 3.4. Maturity stages of the ovary

In the present study, the ovaries were grouped into five maturity stages and were defined as immature (stage I), maturing (stage II), mature (stage III), ripe (stage IV) and regressing (stage V) on the basis of gross appearance such as colour and size of ovary, relative space occupied in the body cavity with ovary and microscopic observations such as their yolk content and ova diameter measurements [6, 20].

#### Stage-I (Immature)

The ovaries were small, translucent, thread like and occupying 1/4 of the body cavity. They were orange in color and the ova were difficult to define clearly without a microscope. The

ovary was irregular in shape and transparent ova are nearly round shaped with central nucleus.

**Stage-II (Maturing)**

Ovaries grew in size and occupying about 1/3 of the body cavity with light orange in colour. In this stage, the ovary became slight opaque due to the deposition of yolk and the ovary wall was still irregular. The nucleus was not clearly visible.

**Stage-III (Mature)**

The ovary became enlarged and spherical, occupying about 2/3 of the body cavity. Ovarian wall was slightly thin and the ova were seen with open eyes but the nucleus was invisible due to heavy deposition of yolk and the colour of the ovary became yellowish.

**Stage-IV (Ripe)**

The ovary became light yellowish and grew in size and the ovarian wall became very thin. During this stage the eggs came out easily due to pressing the abdomen.

**Stage-V (Regressing)**

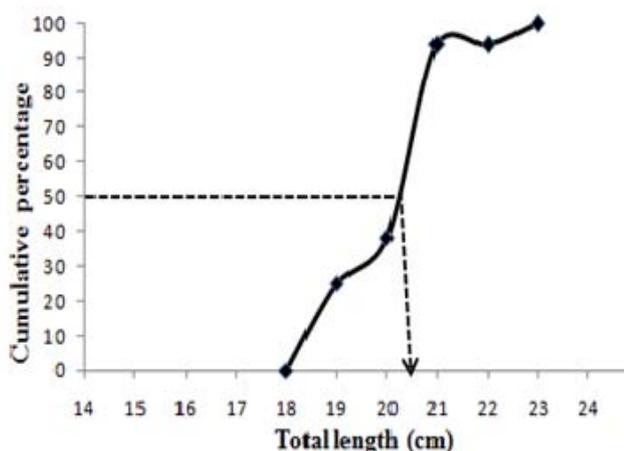
Ovaries were flaccid, reduced in volume and size with brownish colour. The ova were of different in size, few maturing ova were still being seen through the ovary wall with a few ripe ones.

**Table 2:** Maturity stages of ovary with different size and colour of ovary and ova diameter

Maturity stages of ovary	Size of ovary (mm)		Ova diameter (mm) (Mean ± SD)	Colour of ovary
	Length	width		
Immature	10 to 22	2 to 5	0.17±0.05	Red orange
Maturing	20 to 42	6 to 12	0.33±0.05	Orange
Mature	40 to 75	15 to 30	0.63±0.11	Yellowish
Ripe	60 to 95	25 to 36	0.76±0.08	Light yellowish
Regressing	35 to 60	12 to 20	0.29±0.09	Brownish

**3.5. Size at first maturity**

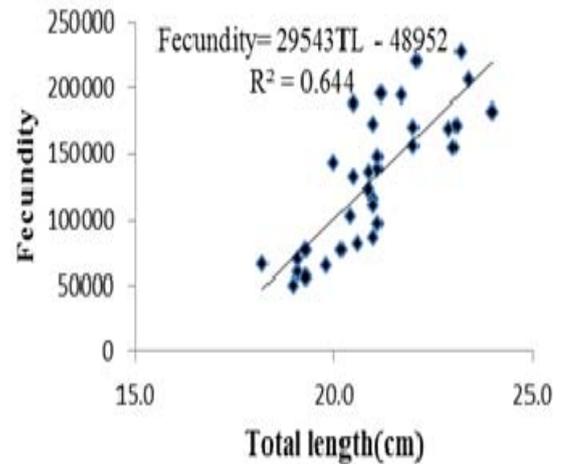
Fig. 2 showed the smallest mature females, which measured at 19 cm and the highest mature females were observed at 23 cm and the size at first maturity i.e. 50% matured females were approximately 20.5 cm in total length.



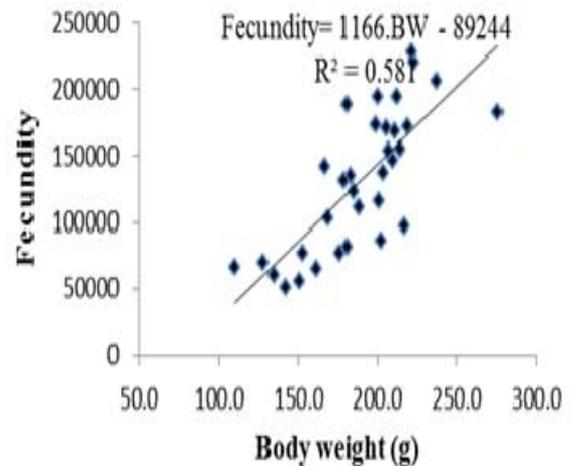
**Fig 2:** Size at first maturity for female Vietnamese Koi

**3.6. Fecundity**

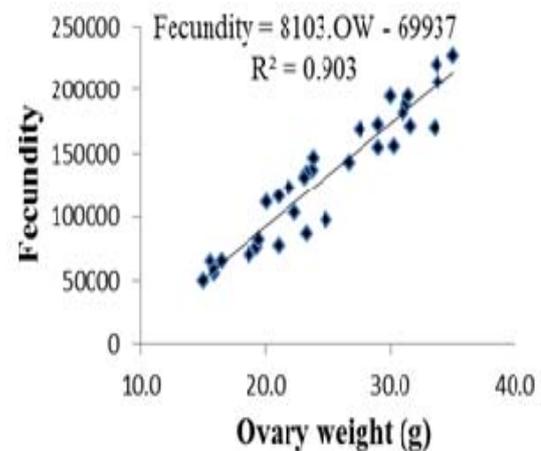
Fecundity is one of the important factors of the biology and population dynamics of fish [1]. In the present study, fecundity varied from 50610 to 227378 in individuals of total length from 19 to 24 cm, whole body weight between 110.1 g and 276.1g, ovary weight between 15.0 g and 35.1g and ovary diameter between 0.43 and 0.88 mm.



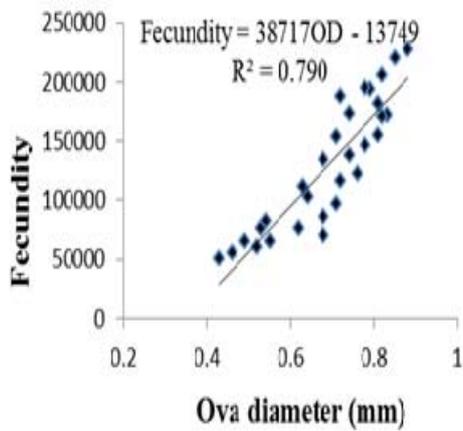
**Fig 3:** Relationship between fecundity and total length in Vietnamese Koi



**Fig 4:** Relationship between fecundity and body weight in Vietnamese Koi



**Fig 5:** Relationship between fecundity and ovary weight in Vietnamese Koi



**Fig 6:** Relationship between fecundity and ova diameter in Vietnamese

#### 4. Discussion

A suitable water quality parameter is an important prerequisite for healthy aquatic environment, better production and breeding success. In the present study, the water quality parameters such as temperature, pH and dissolved oxygen (DO) were ranged from 17.5 to 33.6 °C, 6.9 to 7.6 and 4.18 to 5.57 mg/l respectively during the month of January to July (Table 1). The outcome of the research slightly varied from the previous reports done by other researchers [9, 10, 13] on cage-pond culture of Vietnamese Koi in Mymensingh, Bangladesh. Variations among the research outcomes happened due to the environmental changes in different seasons.

In the present study, the largest Vietnamese Koi was recorded 25.5 cm which is larger than the local / Thai Koi [2, 7, 21]. It might occur due to the different strain, environmental habitat, nutritional status and genetic changes etc.

Research on the ovarian development provides information about maturation stages of ovary indicating reproductive periodicity that helps us to know about the spawning season, breeding period as well as the active breeding period of that species [19]. In this study, single long breeding season was observed where breeding was possible several times in the form of immature, maturing, mature, ripe and regressing stages [14, 15]. The stages repeat in cyclic order in which ovarian development continues and the fish get ready to breed again.

In the present study, the highest mean GSI value of male and female were 8.33 and 14.91 in May whereas the lowest were 1.53 and 3.29 respectively. The highest GSI value for both female and male was May that indicated the peak breeding season of Vietnamese Koi.

The length at first maturity of female *A. testudineus* was found 20.5 cm in this study. Few researches [3, 11] 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.

In the present study, the fecundity of Vietnamese Koi varied from 50610 to 227378 eggs whereas the fecundity of Thai Koi and local Koi found in the range of 3965 to 60500 eggs and 6478 to 44395 eggs respectively in other studies [2, 7, 21]. The above result indicates that bigger sized fish contributed a higher number of eggs and smaller fish had a smaller number of eggs. This study showed a positive relation between fecundity and fish length, fish weight, ovary weight and ova diameter of *A. testudineus*. The trend of outcome of research is in line with the study done by others [7, 18] in this species.

#### 5. Conclusion

Study on the breeding biology of Vietnamese Koi is essential for a tactful and skillful nature to help successful breeding program of this species. The outcome of the present study has provided first detailed information about the breeding biology of Vietnamese Koi that will play an important role in proper management and conservation of this species in Bangladesh.

#### 6. Acknowledgements

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