Fecundity Relationship, Maturity Size and Spawning Season of Shark Catfish *Helicophagus waandersii* Bleeker, 1858 in the Mun River, Thailand

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ABSTRACT

A 48 shark catfish *Helicophagus waandersii* from the Mun River, Thailand was monthly sampled in 19 consecutive months (June 2003 – December 2004) for studying in fecundity relationship, maturity size and spawning season. The fecundity ranged from 21,547 to 191,539 eggs which the average was 85,174±43,206 eggs fish^{-1}. The maximum fecundity belonged to a fish with 54.2 cm in total length (TL) and 1,067 g in body weight (BW) whereas the minimum fecundity belonged to a fish with 36.0 cm and 290 g. Fecundity increased with the increase of length and weight. The regression equations of fecundity (F) on total length (TL) and body weight (BW) were $\log F = 0.8445+2.4518 \log TL$ (r=0.67) and $\log F = 2.8492+0.7308 \log BW$ (r=0.7), respectively. The length at 50% maturity was estimated using frequency of occurrence of matured female was 42.01 cm which gave the expected fecundity as 66,933 eggs. Maximum GSI was in June and the minimum GSI was in November. Shark catfish was a group-synchronous spawner with a short spawning season during the rainy season from May to July. Shark catfish started moving from the Mekong mainstream since January and developed the eggs in the Mun River. After spawning, parental stock moved back to deep pools in the Mekong mainstream whereas the juvenile moved farther to the upstream floodplain for nursing and feeding purposes. Then it moved backward and joins with adult stock in September.

Key words: shark catfish, *Helicophagus waandersii*, fecundity, maturity, spawning season, Thailand

INTRODUCTION

Shark catfish (*Helicophagus waandersii* Bleeker, 1858) or "Pla sa wai noo" is a scaleless freshwater fish belongs to Family Pangasiidae. It distributes mainly in the Southeast Asian waters *i.e.* Mekong and Chao Phraya basins and also from Sumatra, Indonesia (Rainboth, 1996). Shark catfish is one of the commercial native species in the Mekong River basin. People consume it both in fresh and salty grilled style and become one of the economic species in this area.

Spawning season of shark catfish in the Mekong River basin depends on locality. Most of the spawning occurs once a year. In the Mekong main stream, the spawning season begins from March to July, mainly in May through June, based on thepresence of eggs in abdomen of the female. In Don Thap Province (Lao PDR.), shark catfish spawns throughout the year because of the presence of fry all year round (Chan *et al.*, 1999). In Hoo Som Yai, Champasak, spawning season probably occurs in September to October (Singhanouvong *et al.*, 1996).

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The Mun River is the longest river in the northeastern region of Thailand, originated in the Eajarn Mountain in Nakorn Ratchasima Province. The confluence of Mun River to the Mekong is Pak Mun, Khong Jiem District, Ubon Ratchathani Province (Duangswasdi and Chookajorn, 1991). The Mun River system is known as one of the productive river system in the Lower Mekong Basin and shark catfish is one of the major species that can be captured all year round with different magnitude (Jutagate *et al*, 2005). Unfortunately, biological aspects especially reproduction and spawning season of shark catfish in this area has not well-studied. It is therefore the major source of shark catfish comes from riparian fisheries only because it cannot be presently cultured.

Knowledge on reproductive biology is essential; not only benefit in life history and stock management but also for evaluating the potential in successful culture (Rahman *et al*., 2006). Fecundity is one of the most important aspects of reproductive biology that must be well understood to explain variation in the level of production and breeding success (Lagler, 1949). Fecundity can apply in many senses such as:- maturity stage of female broodstock, size at maturity, spawning season and breeding potential. In view of the above, this study was aimed to study reproductive biology based on fecundity, maturity size, gonadosomatic index in order to investigate the spawning season of shark catfish in the Mun River. The objective of this study also was to establish the empirical relationship between fecundity with length and body weight of this species from this area. It will be useful background for further studying the possibility in fish culture.

MATERIALS AND METHODS

Collection of samples

The study was carried out in the Mun River, Ubon Ratchathani Province, Thailand (15^{o} N and 105^{o} E). Five study sites were selected as the representatives of different habitats from upstream through downstream areas. Fish was sampled on monthly basis for two consecutive rainy seasons (June 2003 to December 2004). Catches were sex determined, total length was measured to the nearest 0.1 cm and body weight was also recorded to the nearest 0.01 g. Females were further used for studying in reproductive biology.

Laboratory studies

Individual shark catfish was sectioned. Maturity stage of ovaries was examined according to the criteria of Pankhurst and Carragher (1991); King (1995). Frequency of occurrence on matured female was recorded separately in one-cm class interval of total length.

1. Fecundity: Paired ovaries were carefully removed, washed, cleaned with distilled water. Blotting paper was used to help the ovaries as dried as possible before weighing to the nearest 0.01 g. Ovaries were fixed in Gilson's fluid, shaken vigorously and stored in the dark. At least fortnight, eggs were counted gravimetrically (Bagenal and Brown, 1978). Fecundity was estimated on the basis of total weight of ovaries. The fecundity was obtained by using the following ratio (LeCren, 1951):

$$F = \frac{\text{No. of samples eggs x Gonad Weight}}{\text{Sample Weight}}$$

2. Maturity size: Length at 50% maturity (L_m) was estimated by fitting a logistic function between proportions of cumulative frequency of occurrence on matured female (P_F) and total length (TL). This method was modified from probability of capture in trawl selection curve (Sparre and Venema, 1998) as:

$$P_F = \frac{1}{1+e^{(a-bTL)}}$$

Therefore, the L_m was estimated from:

$$L_m = \frac{-a}{b}$$

3. Gonadosomatic index (GSI): GSI was estimated on monthly from the formula:

$$GSI = \frac{\text{Weight of ovary}}{\text{Fish body weight}} \times 100$$

Data Analysis

The values of total length, body weight and fecundity were transformed to common logarithms. Fecundity was regressed on length and weight by the simple linear.

Maturity profiles of shark catfish in term of GSI and numbers of gravid females were plotted for determining the spawning season.

RESULTS AND DISCUSSION

Sexual Characteristics

Shark catfish could not clearly express the secondary sexual characteristic except during the period of spawning that the difference between male and female shark catfish could be distinguishable observed. For female, the belly is enlarged, swelled, white and round shape. Genital pore is magnified, round and reddish. Male, has a protrude papillae at genital pore and smaller size of the pore than female. The belly is stiffer than female. Sex ratio during the spawning season is 1:1 (Nongkhai Inland Fisheries Station, 1985).

Fecundity

Egg character of shark catfish is rounded-shape with an average diameter of 1 mm. Ripened egg is pale-yellowish colour, transparentand glossy. The egg type is demersal and sticky after absorbed water.

The profile of monthly average fecundity had high variances according to the fish size. No evidence of mature females and spawning activities during January-February 2004 and August 2004. The trend of mature females was high from May to July and corresponding to GSI.

Fecundity was widely ranged from 21,547 to 191,539 eggs, with a mean of 85,174 ±43,206 eggs. It showed the different number of eggs compared with the report of Insiripong (2001) which studied under the pond condition. Moreover, Nongkhai Inland Fisheries Station (1985) reported the fecundity of shark catfish broodstock that was higher than this study: for female with BW = 300 g, had 82,500 eggs whereas the expected fecundity from this study was 45,649 eggs and the female with BW = 1,500 g had 190,000 eggs whereas the expected fecundity from this study was 147,515 eggs, respectively. The difference in the number of eggs could be due to different time, culture or natural condition and environmental factors. In pond condition, feeding regime seems to give better condition that producing variation in metabolism although it was not measured (Rahman *et al.*, 2006).

The relationships of total length (TL) and body weight (BW) *versus* fecundity (F) were given as the followings:

$$\log F = 0.8445 + 2.4518 \log TL \ (r = 0.67)$$

and

$$\log F = 2.8492 + 0.7308 \log BW \ (r = 0.7)$$

respectively. All these relationships have been shown in Fig. 2 and 3.

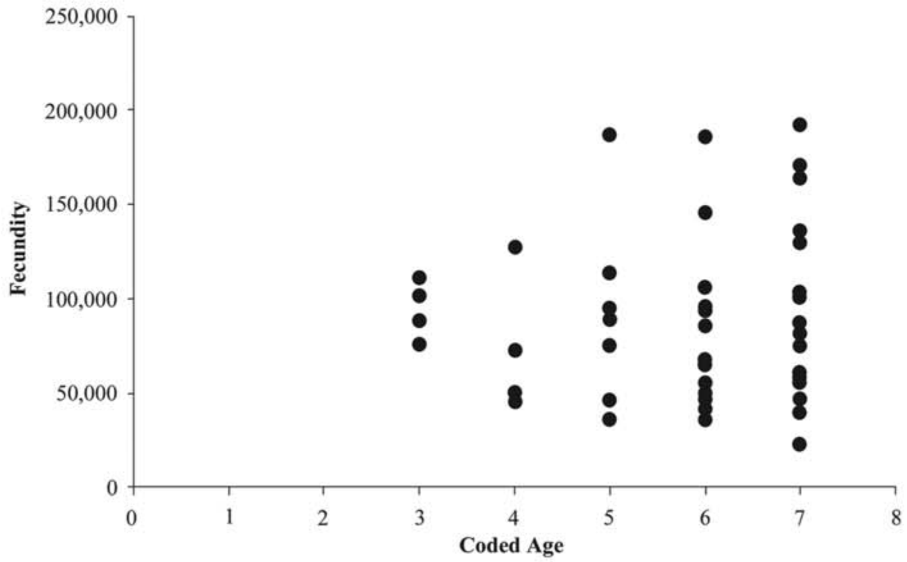


Figure 1 Fecundity profile of shark catfish in the Mun River. Note: Coded Age 1 is January 2004.

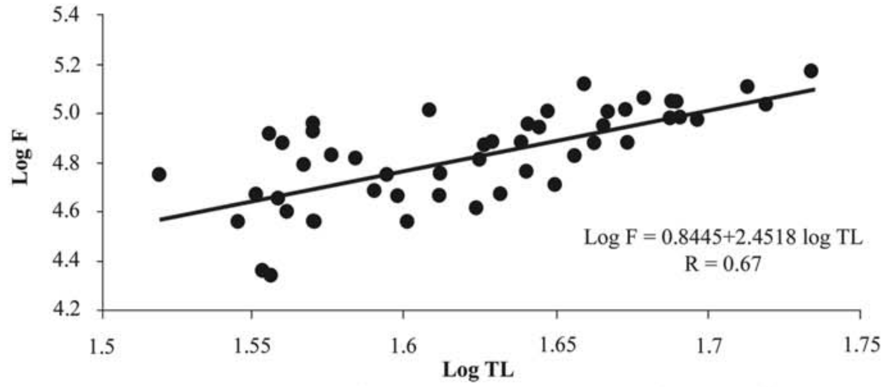


Figure 2 Logarithmic relationship between fecundity and total length of shark catfish in the Mun River.

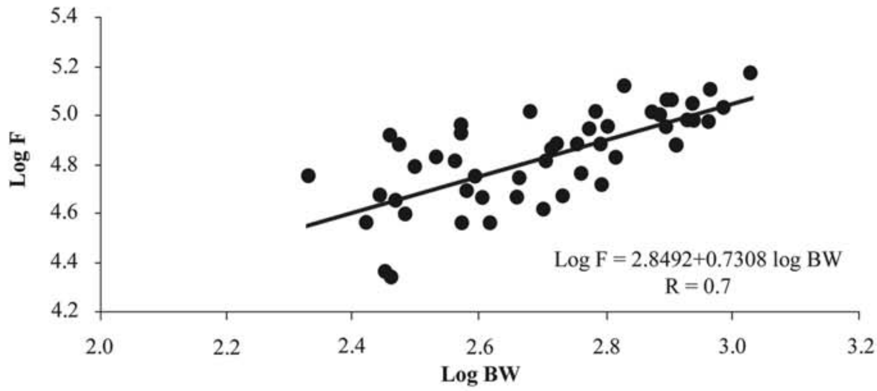


Figure 3 Logarithmic relationship between fecundity and body weight of shark catfish in the Mun River.

In the study on fecundity of fish, it usually has a distinguishable different in the number of eggs at the same length, especially the large fish. Bagenal (1968) pointed out that large fish has a more variable number of eggs since the effect of multiple-spawner in one spawning season (Bagenal, 1966). Pitcher and Macdonald (1973) also mentioned about the underestimating of fecundity in the large fish. They stated that in the fish, especially larger than the mean length of each age group; usually produce more eggs than the smaller ones. The fecundity also varied with the seasons, climatic conditions, environmental habitat, nutritional status and genetic potential (Bromage *et al*., 1992).

The relationship between fecundity -length was found to be less correlated than fecundity-body weight. Since the number of eggs are not independent of weight (Bagenal, 1967) but fish lengths are more consistent and easily measured (Pitcher and Macdonald, 1973). If this is so then a little bit difference of correlation as in this study was acceptable. It is therefore the function can also be expressed in the power form.

Maturity Size

In this study, the proportion of mature female (P_L) in each length class could not be calculated. The frequency of occurrence on matured female (P_F) was applied to estimate the maturity size of female shark catfish under the condition of probability. The input data were proportion of cumulative frequency and total length as shown in Table 1.

A scattered plot from Fig 4 showed the logistic trend line. A nonlinear regression analysis was conducted by SPSS. The logistic function was:

$$P_F = \frac{1}{1+e^{(12.3975-0.3017TL)}} \; ; R = 0.99$$

and gave the L_m as 42.01 cm with the expected fecundity as 66,933 eggs, respectively.

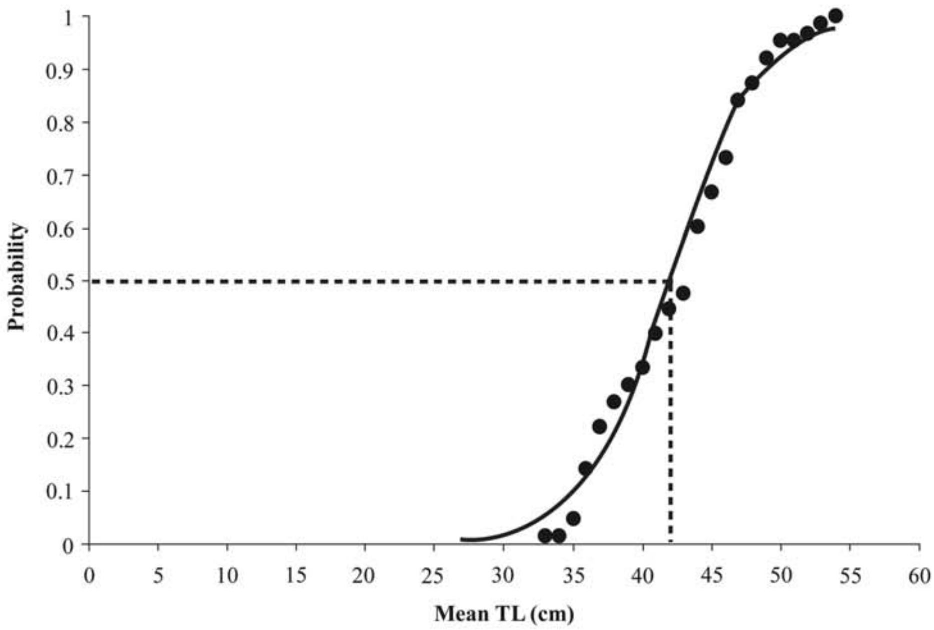


Figure 4 Maturity size of female shark catfish in the Mun River, estimating from frequency of occurrence of matured female.

Table 1 Cumulative fecundity frequency of shark catfish.

TL (cm)	Frequency of occurrence of matured female	Cumulative Frequency	P_F
33.0	1	1	0.021
34.0	0	1	0.021
35.0	3	4	0.083
36.0	6	10	0.208
37.0	4	14	0.292
38.0	1	15	0.313
39.0	4	19	0.396
40.0	2	21	0.438
41.0	1	22	0.458
42.0	5	27	0.563
43.0	3	30	0.625
44.0	3	33	0.688
45.0	3	36	0.750
46.0	2	38	0.792
47.0	3	41	0.854
48.0	2	43	0.896
49.0	2	45	0.938
50.0	0	45	0.938
51.0	1	46	0.958
52.0	1	47	0.979
53.0	0	47	0.979
54.0	1	48	1.000

This method was modified from probability of capture in trawl selection curve as mentioned by Sparre and Venema (1998). The advantage from this method is that the estimation when the data cannot extrapolate PL. This method will be a good application for the researcher who has only fecundity data and manipulate to the frequency of occurrence of matured female.

Gonadosomatic Index (GSI)

The monthly average GSI of female shark catfish in each sampling station is shown in Table 2. The magnitude of average GSI could be displayed in Fig 5.

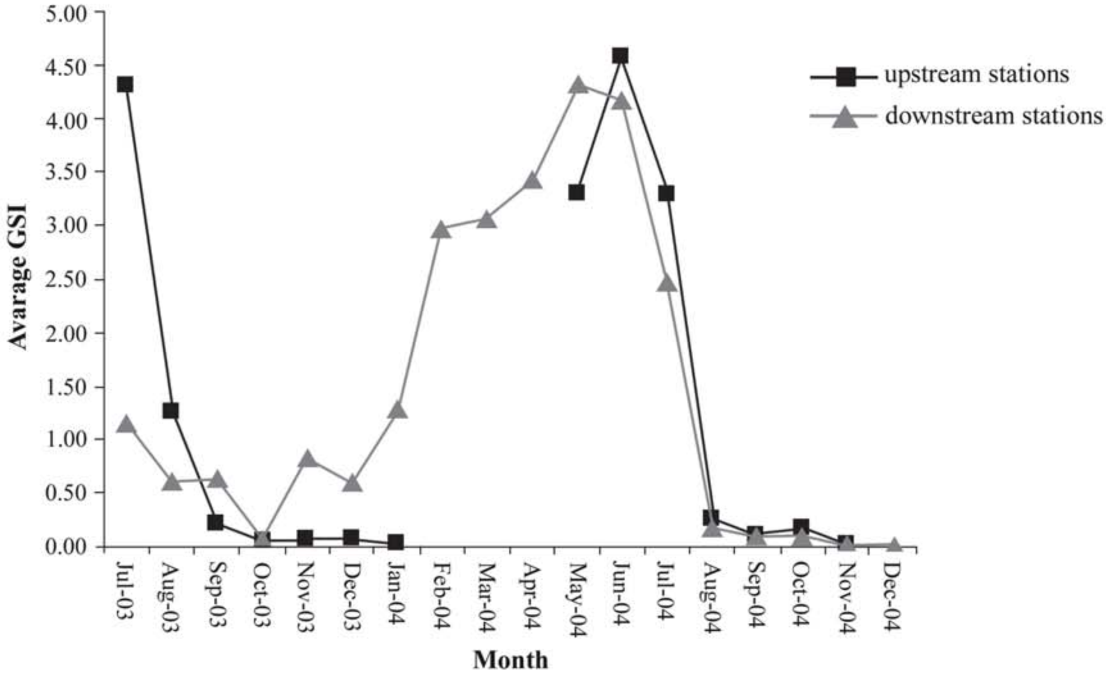


Figure 5 Monthly GSI of female shark catfish in the Mun River.

Gonadosomatic index (GSI) is a useful parameter for evaluating the breeding cycle of fish. After eggs are spent, the GSI will markedly decrease. Wootton (1992) suggested sub-tropical and tropical fishes usually have an extended breeding season with females spawning many times and show small changes in the amplitude of the GSI. In this study, the variation of GSI during two cycles of sampling was peaked in the same period, May to July, which is the beginning of the rainy season.

The magnitude of GSI, compared with up- and downstream stations, the result showed the relative GSI values. The GSI of downstream and upstream were paralleled trends month by month. The GSI of downstream stations were higher than upstream stations from January to April 2004. Then the GSI of upstream stations were higher than downstream stations from June to October 2004. There were not samples during the dry season in the upstream areas, February-April and December 2004.

Most of silurids species are rapids-dependent (Amornsakchai *et al*., 2000). For example, *P. hypophthalmus* in the Lower Mekong Basin, the spawning takes place in the stretch of the Mekong River between Kratie town and the Khone Falls on the Cambodian/Lao PDR. border. The habitat consists of rapids and sandbanks, interspersed with deep rocky channels and pools (van Zalinge *et al*., 2002). From this study, the mature females with gravid ovaries were caught more in downstream, where the rapids are located. It can be said that rapids in the Mun River are the spawning grounds of shark catfish.

Table 2 Average GSI of shark catfish in the Mun River.

Month	Station	
	upstream	downstream
Jul-03	4.310	1.140
Aug-03	1.260	0.600
Sep-03	0.200	0.630
Oct-03	0.040	0.070
Nov-03	0.070	0.810
Dec-03	0.070	0.590
Jan-04	0.010	1.270
Feb-04	n.d.	2.970
Mar-04	n.d.	3.070
Apr-04	n.d.	3.430
May-04	3.300	4.320
Jun-04	4.580	4.180
Jul-04	3.280	2.470
Aug-04	0.250	0.180
Sep-04	0.090	0.090
Oct-04	0.150	0.090
Nov-04	0.010	0.020
Dec-04	n.d.	0.025

n.d. = no data

Spawning Season

The monthly modes of egg stage, compared with up- and downstream areas, were shown in Fig 6. The egg stage followed by month in each station was expressed in Fig 7.

Few samples were caught from November to April in the upstream area and gravid ovaries were found in the both areas. Although it was found some samples in January at the river mouth but the samples were in immature stage (Figure 7 a and b). During May through July, however, samples could be caught both up- and downstream areas with mature ovaries. While in August, only immatured fishes could be caught in both areas.

In August to September, small sized females with immatured ovaries were caught both in up- and downstream areas. A volume of catch moved orderly month by month from upstream to downstream. In December, a few shark catfish with undeveloped gonad was found only in the river mouth.

All pangasiids are known as migratory species with diverse patterns. In the Mekong mainstream, shark catfish showed relatively short upstream migration during the late dry season and/or early flood season (Poulsen and Jørgensen, 2001). The purposes of movement are both spawning and feeding migrations and some of the migrants move into major tributaries such as Nam Ngum, Mun and Songkhram Rivers. In addition, an early dry season feeding migration has also been observed (Warren *et al.*, 1998).

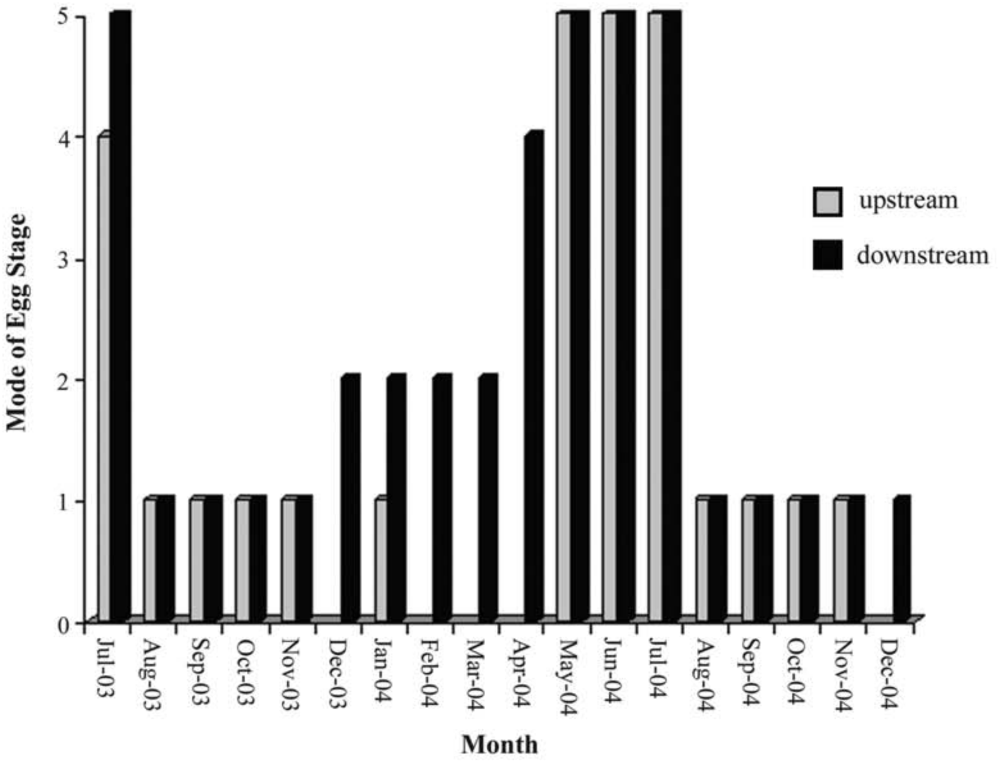
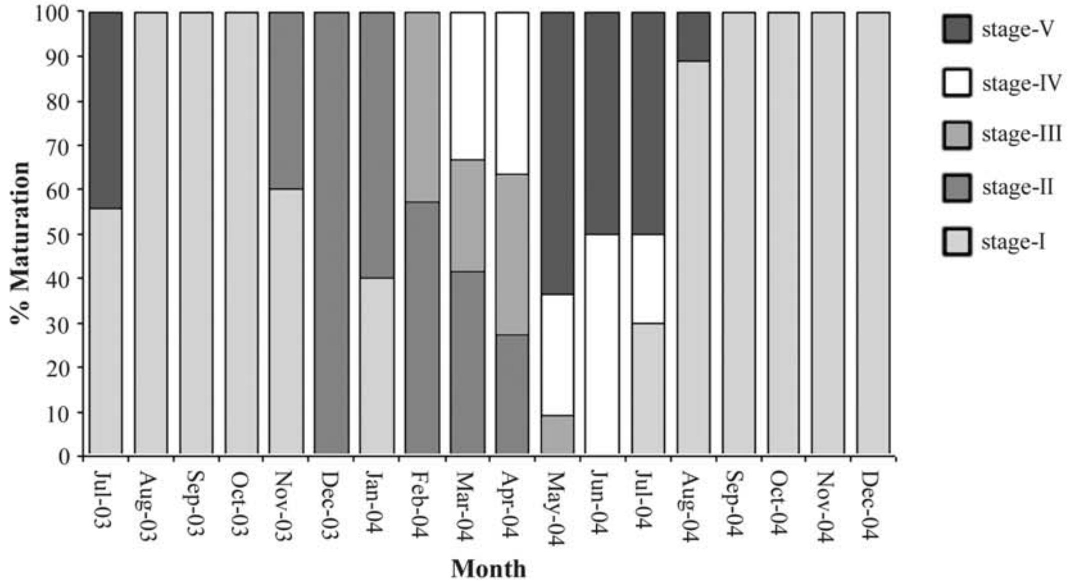
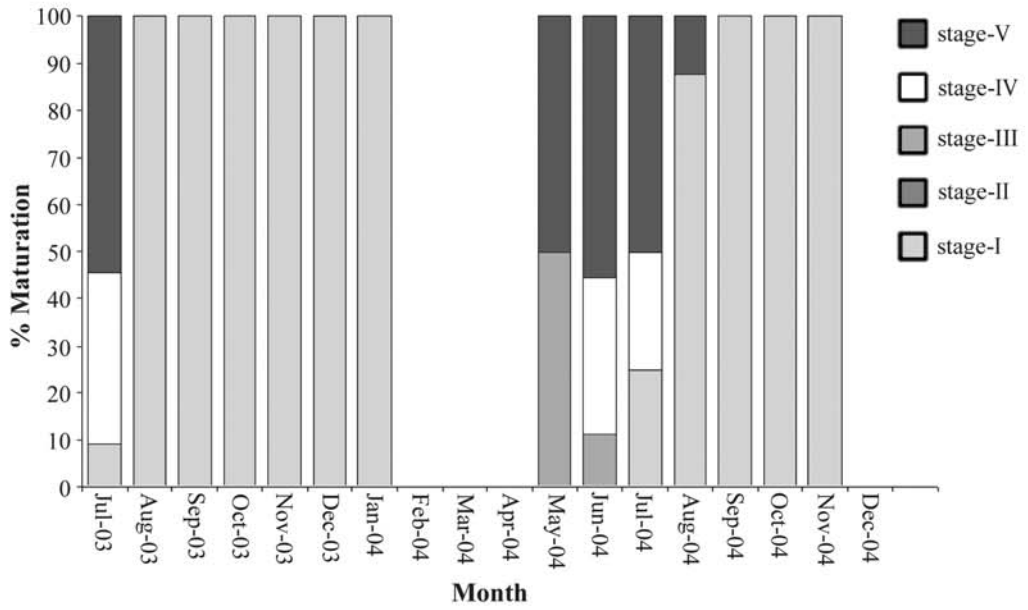


Figure 6 Monthly modes of egg stage of shark catfish compared with up- and downstream areas in the Mun River.



a. downstream stations



b. upstream stations

Figure 7 Monthly egg stage of shark catfish in the Mun River followed by sampling station.

It could congregate from all aspects of the studies on reproductive biology that, shark catfish reproduces once in a year and has a short spawning season during the rainy season. Shark catfish moves upstream from the Mekong River since January with stage-I and stage-II ovaries. Then the ovary is developed from stage-III to stage-V in the Mun River and spawn during May through July. The occurrences of mature/spent fishes in both up- and downstream areas implied that shark catfish need not move upstream too far to spawn. As all pangasiids species are rapids-dependent (Amornsakchai *et al*., 2000); shark catfish could spawn in both up- and downstream rapids. All rapids, where fast flowing and oxygenated, are the ideal spawning grounds for many fishes in the rainy season (Viravong *et al*., 2005). In addition, shark catfish was reported to inhabit in deep pools, which located near the rapids, during the dry season (MRC, 2002). Therefore, the spawning area of shark catfish should be covered from Kang Sapue to Kang Tana Rapids because of a lot of rapids and the demersal-adhesive eggs of shark catfish can be found (Riparian fishermen, *pers. comm.*).

For the longer distance movement, the purpose movement of shark catfish relates to feeding more than spawning. Catch of shark catfish at the upstream area was higher during the rainy season and coincided with the highest peak of bivalves, *Corbicularia* sp., which was the main food item found in the stomach of shark catfish (Payooha *et al*., 2004). This concurred with the finding of Viravong *et al*. (2005). They reported that after fish had reproduced in the deep pools, it moved to floodplain feeding ground and joined sub-adults (Poulsen and Jørgensen, 2001). Rainboth (1996) also mentioned that shark catfish moved downstream, from the flood forests,when water clears at the end of the flood season. Therefore, the absence of samples in the upstream area implied that fish already migrated back to the deep pools in the Mekong mainstream.

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