MORPHOLOGICAL DEVELOPMENT OF BAGRID CATFISH, *Mystus nemurus* AT EARLY LARVAL STAGE

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THIS DISSERTATION IS SUBMITTED AS A PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE DEGREE FOR THE DEGREE OF BACHELOR OF SCIENCES WITH HONOURS

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I hereby declare that this dissertation is my own independent work, apart from quotations and references which have been probably acknowledged.

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ABSTRAK

Kajian ini menyelidik perkembangan mofologi tentang ikan baung, *Mystus nemurus* dari 0 hari – 15 hari selepas menetas. Larva dihasilkan dengan cara pembenihan dengan menggunakan induk ikan yang 400 – 500g. Larva yang baru menetas memperoleh 4.48±0.08 mm dalam suhu 26.3 – 27.8°C dalam kepanjangan dan bertumbuh ke 17.25±1.01 mm pada hari ke-15 selepas menetas. Masa peralihan zat makanan larva *Mystus nemurus* ialah 39 jam dalam suhu 26.3 – 27.8°C kerana larva mula makan pada 36 jam selepas menetas dalam suhu 26.3 – 27.8°C dan kuning telur larva habis diserap pada 75 jam selepas menetas dalam suhu 26.3 – 27.8°C. Saiz mulut larva semasa berfungsi untuk memakan ialah 738±73.97 µm dan makanan yang sesuai ialah rotifer, *Moina* sp. and *Artemia*. Larva menyerupai induk ikan dari ciri-ciri luar pada hari ke-15 selepas menetas. Spesies ikan ini mempunyai pertumbuhan yang cepat dan boleh menjadi calon akuakultur.

ABSTRACT

This present study investigated the morphological development of bagrid catfish larvae, *Mystus nemurus* from 0 day until 15 days after hatching. The larvae were obtained from the artificial induced breeding by using the broodstock in 400 – 500g. The newly hatched larvae were 4.48±0.08 mm in length at 26.3 – 27.8°C and grow to 17.25±1.01 mm at 15 days after hatching. The nutrition transition period of larvae was 39 hours because the larvae initiated feeding at 36 hours after hatching at 26.3 – 27.8°C while the yolk absorption completed at 75 hours after hatching at 26.3 – 27.8°C. Mouth size at first feeding was 738±73.97μm and the ideal feed was rotifer, *Moina* sp. and Artemia nauplii. The larvae resembled the adult in its external features at 15 days after hatching.

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ABBREVIATION

&	and
et al.	and others (Latin)
cm	centimeter
d AH	days after hatching
°C	degree celcius
g	gram
h AH	hours after hatching
kg	kilogram
l	liter
m	meter
μm	micronmeter
mL	milliliter
mm	millimeter
mm^3	milimeter cube
n	number
%	percent
π	pi
±	plus-minus
RM	Ringgit Malaysia
t/a	tonne per annually

CHAPTER 1

INTRODUCTION

1.1 Aquaculture

Aquaculture is the culture of animals and plants in freshwater, brackish water and marine environment. Man depended on the hunting and gathering for aquatic animals and plants until the Neolithic period and the fishing methods are developed more advanced to increase the catching per unit. Hence, overfishing occurs because of the men's desire and lack of knowledge about the environment concern. So, aquaculture is promoted to increase the food supply of the human, support the economic of countries and to help in overcome the overfishing problem.

1.2 Introduction of Bagrid Catfish, *Mystus nemurus*

The fish species that selected as target species in the experiment is scientifically known as *Mystus nemurus* (Valenciennes, 1840). Its synonym of scientific name included *Macrones nemurus, Hemibagrus nemurus, Bagrus nemurus* (Valenciennes, 1840). The common name that used in international are "tropical catfish" (Khan, 1987), "green catfish" (Amornsakun *et al.*, 1997) and "bagrid catfish" while Malaysia and Indonesia called this species as "*Baung*". For its taxonomy; it belongs to the kingdom of Animalia, phylum of Chordata, subphylum of Verterbrata, order of Siluriformes, family of Bagridae, genus of *Mystus* and species of nemurus. This species can reach to approximate 65cm in maximal size reported for its standard length. *Mystus nemurus* is commercial in fisheries, aquaculture, aquarium and so on (Rainboth, 1996).

This fish normally caught by local community by using seines, hook-and-line, gill nets, cast nets, sets nets and traps, then the fish will be marketed fresh (Rainboth, 1996) with the price range from RM6-RM7 per kilogram. It is one of the popular and highly demanded fish in Southeast Asia region especially in Thailand and Malaysia due to its good taste and non-bony flesh. Besides, this fish is proved to have high nutritive value because it has high content of omega-3 polyunsaturated fatty acids, low content of cholesterol and high content of good quality protein (Mesomya *et al.*, 2002).

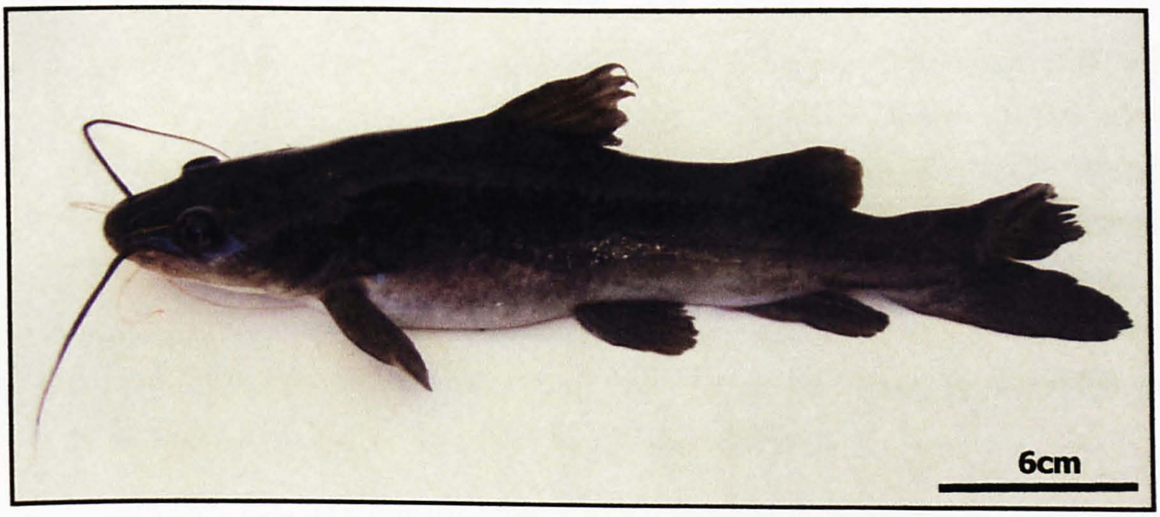

Photo 1.1 Bagrid catfish, *Mystus nemurus* was used for induced breeding.

1.3 Early Larval Stage of Fish

Information on the early larval stage of fish such as yolk absorption, mouth and digestive tract development and starvation of the larvae is needed for optimization of large-scale culture and ultimately for the management of the fish stocks. It is recognized that the critical period of larval rearing begins at the time yolk absorption is completed. If the larvae do not start to eat during that period, they will become weak and eventually die (Holm, 1986; Amornasakun *et al.*, 1997; Amornasakun, 1999b; Amornsakun *et al.*, 2002). However, the rates of early development and thus the timing of the appearance of characters signaling the early development stages differ between species, indicating that such differences are under genetic control (Blaxter, 1974).

Survival of fish larvae at early larval stage is determined by the interplay of various environmental factors, such as temperature, food supply with a suite of species-specific characteristics, egg and larval size, yolk and oil quantity and resorption rates, and time of onset of feeding and feeding behavior (Blaxter & May, 1974). Larvae can use a varying part of their yolk sac energy content for various activities.

1.4 Morphological Development Study

Changes in morphometry can be used as indices of tissue mobilization and yolk utilization rates, providing inexpensive, real-time information about relative larval condition (Rogers & Westin, 1981). Besides that, changes in standard length through endogenous feeding have been used as a relative measure of yolk conversion efficiency (Watanabe *et al.*, 1998), and allow inferences to be made on larval conditions in combination with other measured characters (Reichow *et al.*, 1991). Hence, morphological development study of bagrid catfish larvae was chosen to obtain the real time information about the larval condition in inexpensive way.

1.5 Problems in Aquaculture of Bagrid Catfish

According to Usman *et al.*, 2000, techniques of rearing bagrid catfish larvae have been established. However, in Southeast Asia, only 700 t/a of bagrid catfish's production is available (Müller – Belecke *et al.*, 2002) and the seed supply is very inconsistent. Heavily mortality occurred in the early larval stage of bagrid fish (Usman *et al.*, 2000).

On the other hands, the detailed information about the development of bagrid catfish at early larval stage in Malaysia is very insufficient for further study and the fundamental knowledge of bagrid catfish larvae is very important in order to understand the larval condition to improve the growth and survival of bagrid fish and finally to increase the production of bagrid catfish in Malaysia.

1.6 Objectives

To increase the production of bagrid catfish by improving the growth and survival of larvae, the larval rearing techniques of bagrid catfish must be improved. To obtain the optimum larval rearing techniques of bagrid catfish at early larval stage, the larval condition must be understood by studying the fundamental knowledge of the bagrid catfish larvae. Hence, this experiment was started to:

1) Investigate the morphological development of bagrid catfish larvae.
2) Provide the fundamental information about bagrid catfish larvae for further study.

CHAPTER 2

LITERATURE REVIEW

2.1 Aquaculture sector in Malaysia

Aquaculture sector is identified as one of the major thrust area for the further development of fisheries sector in Malaysia with the output of from coastal capture fisheries reaching its optimal level and uncertainty in deep sea fishery. The minister of Agriculture and Food, Datuk Seri Panglima Yahya Hussin called for the industrialization of aquaculture in the wake of declining of seafood supply in Malaysia, with the transformation through green technology as a key factor in sustainability; this calling was adopted from the opening speech by the minister at the Annual Seminar on Marine Science And Aquaculture at University Malaysia Sabah's (UMS) main campus Likas on 10 March 2010.

With the country's emphasis now on New Agriculture, efforts are being taken by the Malaysian government to promote large-scale commercial farming, wider application of modern technology, production of high quality and value-added products to modernize the aquaculture sector. According to the report adopted from Chinese News Agency, *Xin Hua*, Malaysian Agriculture Minister, Nor Omar, said that Malaysia invited both local and foreign, to participate in the expanding of aquaculture sector, at Asian-Pacific Aquaculture (APA) 2009 and Malaysian International Seafood Exposition (MISE) 2009 on 4th November 2009. Besides that, according to the personal communication by Minister Nor, aquaculture industry is expected to grow ten percent annually over next ten years and offer a good opportunities for investors.

2.2 Morphology of Bagrid Catfish, *Mystus nemurus*

Bagrid catfish's body colour often show brown colour with greenish sheen and its fins are gray with violet tint. The pectoral spines are serrated along the inner edge while the base of adipose fin is shorter than that of dorsal fin and about equal to that of anal fin. It has four pairs of barbels; nasal barbels extending to or beyond eyes, maxillary barbels reach in anal fin, mandibulary barbels reach beyond the base of pectoral fins while the mental barbels is from two over three until three over four the distances between their base and insertion of pectoral fins (Taki, 1974). The head is flattened rather than conical with a rugose skull roof. Its depressed dorsal fin does not reach its adipose fin while its pectoral fin is smooth in front and it has 9 branches anal rays (Rainboth, 1996). According to the report from the fishbase organization, this species is reported to have total dorsal spines of 2 – 2, total dorsal soft rays of 7 – 7, no anal spines and the anal soft rays of 10 – 13.

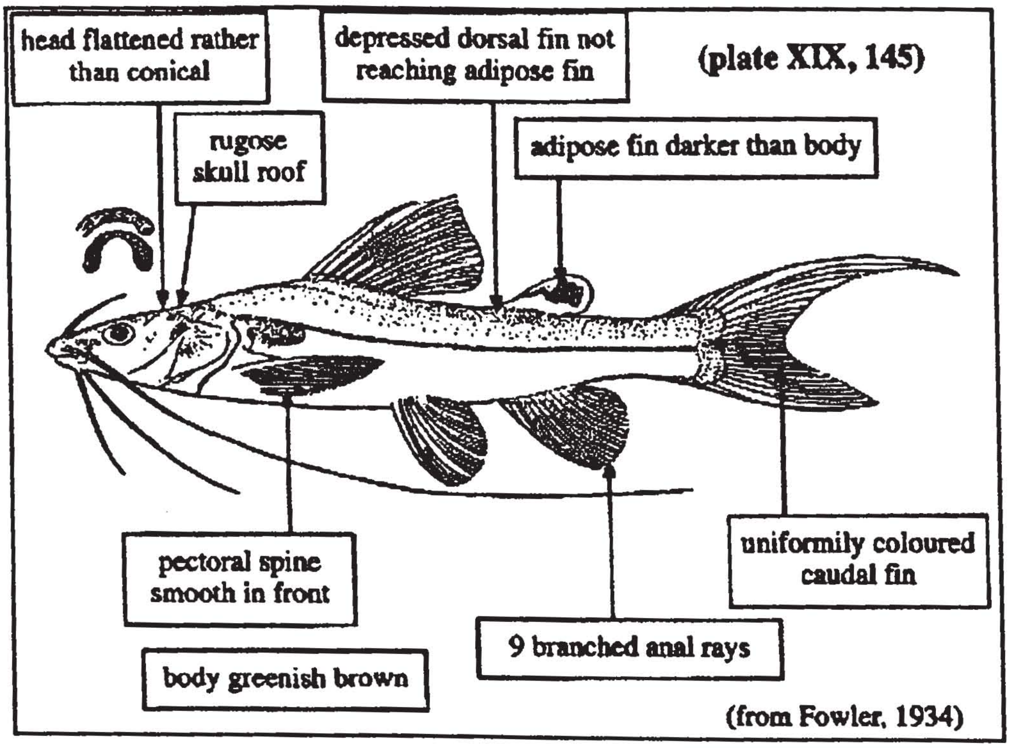

Figure 2.1 Morphology descriptions of bagrid catfish, *Mystus nemurus*. (Adopted from Fowler, 1934)

2.2 Distribution

Bagrid catfish is distributed in tropical area such as Mekong, Sundaland, Chao Phraya and Xe Bangfai basins; Malay Peninsula, Sumatra, Java, and Borneo (Kottelat *et al.*, 1993). In Southeast countries such as Thailand and Malaysia, they can be found in rivers, lakes, swamps and other water bodies (Amatyacul *et al.*, 1995) It has various habitats, but the most frequent in large muddy river which has slow current and soft bottom (Kottelat *et al.*, 1996) and particular for the adults fish, some will stay in standing streams with sandy silt, fast flowing rivers with rocky substrate and stream; and some prefer in turbid pond within logged areas (Ike *et al.*, 2005). They can be found in total freshwater and estuarine (Lilanon & Yamimob, 1981) with the pH range of 7.0 – 8.2 and at the depth of 2 – 40 m (Lilanon & Yamimob, 1981; Wongrat *et al.*, 1994).

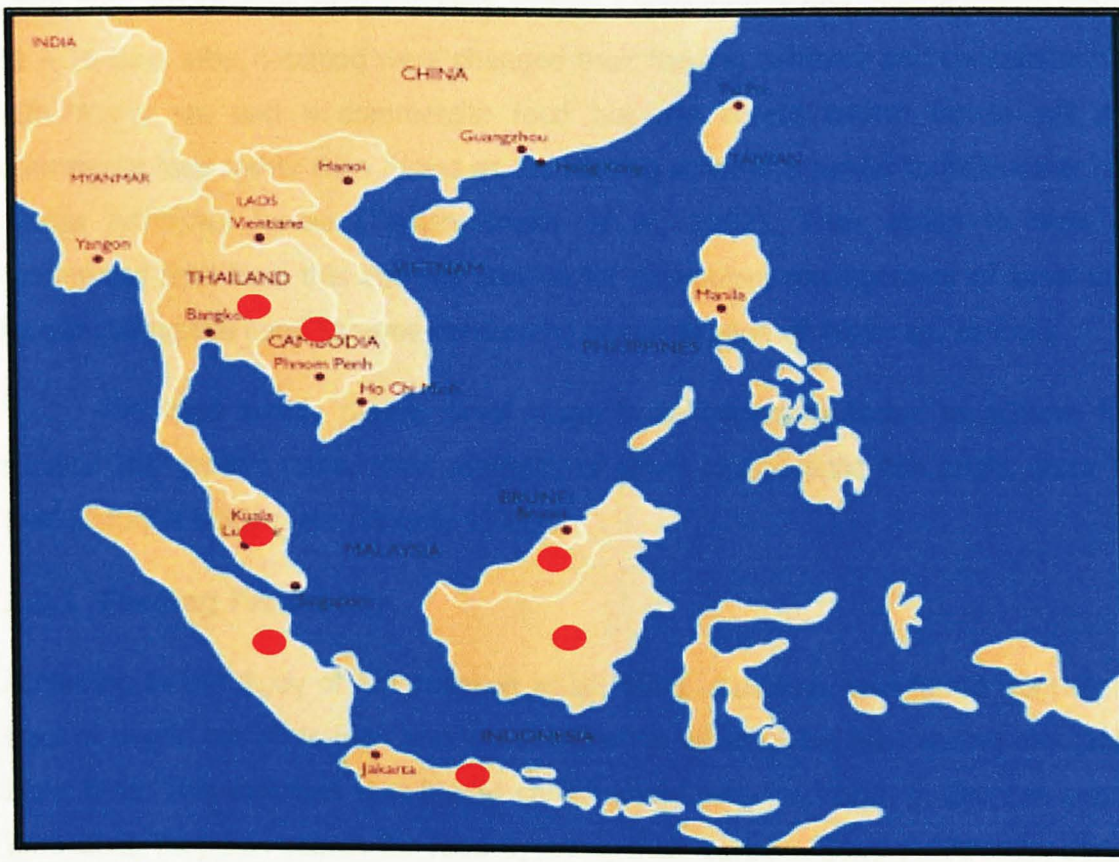

Figure 2.2 Map of Southeast Asia Region and the red dots show the distribution of bagrid catfish (Adopted from Courtesy Lim & Cambodia Ministry of Tourism, 2009).

2.3 Feeding

Bagrid catfish is omnivorous bottom dweller and they feed on exogenous insects, aquatic insects' larvae, shrimps, fish, detritus, vegetations and other benthic crustaceans (Inger & Chin, 1962). Bagrid catfish has similar mouth size which is 489μm with larval sand goby and red-tail catfish at the start of feeding but the type of living food organism was different because larval sand goby feed on rotifer but bagrid catfish and red-tail catfish feed on *Moina* sp. Bagrid catfish was reported to be found in upstream of reservoirs containing living food organisms such as *Volvox* sp., *Cladocera*, and *Chironomid* (Suwannarat, 1971).

According to Amornsakun *et al.*, 1998, bagrid catfish larvae of 2 – 10 days after hatching were fed with *Moina* sp. only and feed completely changed to commercial pellet when they are 16 days after hatching. During a transition period, bagrid catfish larvae at 11 – 15 days after hatching were changed their feeding behavior and concomitantly fed with *Moina* sp. and a commercial feed but the bagrid catfish larvae will prefer commercial feed rather than *Moina* sp. Its feeding scheme is similar to freshwater catfish, *Clarias batrachus* larvae (Tarnchalanukit *et al.*, 1982). Their ability to feed on a commercial feed from this age will provide for convenient management of larval culture by eliminating the need for time-consuming of preparation of *Moina* sp. as food.

The food supply during larval stage is an important factor to achieve higher survival and growth rates. Mass mortality of larval and juvenile fish might occur if the food supply is inadequate (Houde, 1978).

2.3.1 Feeding Periodicity

According to the study of Amornsakun *et al.*, 1998, *Moina* sp. was found from digestive tract of bagrid catfish in high and low illumination when giving feed during day time and night time. This indicates that bagrid catfish could take feed both in daytime and night time since they can search for food by using their barbels. Bond (1979) was described that taste receptors were usually in the region of the mouth, on barbels, the snout and lips. Therefore, to ensure better growth of larval growth of bagrid catfish, the larvae should be fed both at daytime and night time.

2.4 First Feeding Period

First feeding is a time at which fish larvae must start feeding and if it faces starvation, it will be weaken and evenly face to the death. In most oviparous fish with pelagic eggs, organ systems develop that allow the fish larva to switch from endogenous feeding to exogenous feeding during the time between hatching and first feeding. Endogenous feeding is the feeding on its internal nutrient source; yolk sac by resorption while exogenous is the feeding on the prey such as zooplankton, phytoplankton, and commercial feed (Watanabe, 1970). The bagrid catfish and redtail catfish started to feed on *Moina* at 52 h AH and 64 h AH respectively (Amornsakun *et al.*, 1997)

Starvation may be a major cause of the high mortalities that occur during larval period and may affect recruitment (Houde, 1978). Indeed, some studies suggest that recruitment is determined in this period. (Houde, 1978). The identification and availability of appropriate first-feeding organisms is one of the primary interests for optimization of the efficiency of endogenous resource-used through the control of environmental parameters.

2.5 Mouth Size Development

Mouth size development is very important in the first feeding of larvae to match appropriate prey size. Mouth size at first feeding stage of various larval fish to encounter their prey size has been well documented for a number of cultured fish (Shirota, 1970; Fukuhara, 1986). Bagrid catfish started their first feeding when the mouth height reached 553μm while red-tail catfish started feeding on exogenous food when mouth height reached 534μm (Amornsakun *et al.*, 1997).

Starvation is the main reason causing high mortality and it might due to limited mouth size (Liem, 1978). During ontogeny, mouth size and prey-searching ability of fish larvae increase; larger or older larvae are stronger swimmers and can see potential prey at greater distances than smaller or younger stages larvae. These ontogenetic changes are paralleled by increasing of mean prey size (Shirota, 1970). For example, nearly 100% of mackerel *Scomber japonicas* larvae were able to ingest prey of size equal to 57% of the larval mouth width (Hunter & Kimbrell, 1980). Milk fish, seabass and *S. gottatus* larvae are reported to take rotifer from 20 – 80 % of the larval mouth width (Kohno *et al.*, 1990).

2.6 Hatching Time

The time of hatching of similar species, green catfish in Thailand was reported at 18 hours at the water temperature of 27.0 – 30.5 °C while other freshwater species such as Siamese gourami, red – tail catfish and climbing perch have hatching – times out of 22 hour 10 min, 23 hours 40 min and 21 hours (Amornsakun, 1999a; Amornsakun, 1999b; Amornsakun, 2001). *Mystus punctatus* (Jerdon) was reported its incubation period varied from 18 – 24 hours at a temperature of 28.5±1.8°C (Ramanathan *et al.*, 1985).

CHAPTER 3

METHODOLOGY

The experiment was conducted at the hatchery of Borneo Marine Researh Institute, Universiti Malaysia Sabah.

3.1 Broodfish Selection and Hormone Treatment

A one tonne tanks was prepared and about 20cm of water level was added inside the tank. 50 litre of green water was added to maintain the water quality. One female and five male which weighted about 500g were selected for artificial seed production. Six round cages were put into the one tone tank to separate the broodstock. Before selection, the broodfish were anesthetized with Transmore (α-methylquinoline).

Female with soft, distended abdomen and reddish, rounded papilla was selected (Photo 3.1 A). Potential male fish has elongated with red tip of genital papilla; and the milt can be oozed out by applying gentle pressure near its genital pore. Then the selected potential broodfish were put into the prepared tank. The tank was installed with a heater to shorten the time of oocyte final maturation after hormone injection. Broodstock must be handled gently to avoid stress. A wet towel was used during the fish handling to keep the broodstock at least level of stress.

After broodfish selection, hormone injection was done by using Ovaprim. Female broodfish was injected by two injections with dosage of 1.0mL / kg at first injection and 0.5mL / kg at second injection while male broodfish were injected once time only with

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