



**UNIVERSITI PUTRA MALAYSIA**

***THE EFFECTS OF TEMPERATURE ON EMBRYONIC DEVELOPMENT  
AND HATCHING PERFORMANCE IN LAMPAM JAWA, *Barbonymus  
gonionotus* (BLEEKER, 1849)***

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**This project thesis is submitted in partial fulfillment of the requirements for  
the degree of Bachelor of Agriculture (Aquaculture)**

**DEPARTMENT OF AQUACULTURE  
FACULTY OF AGRICULTURE  
UNIVERSITI PUTRA MALAYSIA  
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**2016**

**CERTIFICATION OF APPROVAL**  
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## ABSTRACT

In natural breeding, the environmental factors including temperature are naturally based on climate condition. Thermal tolerance of the embryo in the early stages is very important for survival rate as the environmental condition varies during the development stages. An experiment was conducted to study the effects of temperature on embryonic development and hatching performance in Lampam Jawa, *Barbonymus gonionotus* in captive environment. The experiment was conducted in wet laboratory in Department of Aquaculture. Breeding process was implemented by induced breeding technique using Ovotide hormone with the dosage of 0.4ml/kg for female and 0.2ml/kg for male. After fertilization, the eggs were distributed evenly in three different temperatures as the treatment at  $22\pm 1^{\circ}\text{C}$ ,  $27\pm 1^{\circ}\text{C}$  (room temperature) for and  $32\pm 1^{\circ}\text{C}$  with triplicate. Water temperature was reduced to  $22\pm 1^{\circ}\text{C}$  by using Resun CL500 chiller and the aquariums were covered with Styrofoam to maintain the temperature. Temperature was raised up to  $32\pm 1^{\circ}\text{C}$  using Eheim Jager heater. The embryonic development was observed 24 hours starting from fertilization until hatched. From the observation, found that the fastest embryonic development was in  $32\pm 1^{\circ}\text{C}$  and slowest in  $22\pm 1^{\circ}\text{C}$ . The first hatching process occurs in temperature  $32\pm 1^{\circ}\text{C}$  at 6 hours after fertilization with low eggs mortality and it was faster compared to 17 hours in  $22\pm 1^{\circ}\text{C}$  with higher mortality rate. Based on the results, it show that the hatching percentage between the three treatments were significantly different. The hatching percentage were significantly highest in  $32\pm 1^{\circ}\text{C}$ , which is at 90.3% ( $p < 0.05$ ) and lowest in  $22\pm 1^{\circ}\text{C}$  which is 20.4%. This proves that, the embryonic development of Lampam Jawa, *B. gonionotus* have a higher chance to survive in a warmer water temperature.

**Keywords:** *Barbonymus gonionotus*, Lampam Jawa, effect of temperature, embryonic development, hatching performance

## ABSTRAK

Dalam pembiakan semulajadi, faktor persekitaran termasuk suhu adalah secara semulajadi berdasarkan keadaan cuaca. Toleransi haba embrio di peringkat awal adalah sangat penting untuk peratus kemandirian memandangkan keadaan persekitaran berubah-ubah semasa peringkat pembentukan. Satu eksperimen telah dijalankan untuk mengkaji kesan suhu terhadap pembentukan embrio dan peratus penetasan Lampam Jawa, *Barbonymus gonionotus* dalam persekitaran terkawal. Eksperimen dijalankan dalam makmal basah Jabatan Akuakultur, UPM. Proses pembiakan dilaksanakan dengan teknik pembiakan secara aruhan menggunakan hormon Ovatide dengan dos 0.4ml/kg untuk ikan betina dan 0.2ml/kg untuk ikan jantan. Selepas persenyawaan, telur diagihkan secara sama rata ke dalam tiga rawatan suhu yang berbeza dengan tiga replikasi pada suhu  $22\pm 1^{\circ}\text{C}$ ,  $27\pm 1^{\circ}\text{C}$  (suhu bilik) dan  $32\pm 1^{\circ}\text{C}$ . Suhu air dikurangkan kepada  $22\pm 1^{\circ}\text{C}$  dengan menggunakan penapis penyejuk Resun CL500 dan akuarium dikelilingi styrofoam untuk mengekalkan suhu. Suhu dinaikkan ke  $32\pm 1^{\circ}\text{C}$  menggunakan pemanas thermostat Eheim Jager. Pembentukan embrio diperhatikan 24 jam bermula daripada proses persenyawaan hingga telur menetas. Daripada pemerhatian, didapati pembentukan embrio yang paling cepat berlaku dalam suhu  $32\pm 1^{\circ}\text{C}$  dan paling lambat dalam suhu  $22\pm 1^{\circ}\text{C}$ . Proses penetasan yang pertama berlaku ialah dalam suhu  $32\pm 1^{\circ}\text{C}$  pada 6 jam selepas persenyawaan dengan peratus kematian telur yang rendah berbanding penetasan selepas 17 jam dalam  $22\pm 1^{\circ}\text{C}$  dengan peratus kematian telur yang lebih tinggi. Berdasarkan keputusan, ia menunjukkan bahawa peratus penetasan antara tiga rawatan adalah berbeza secara ketara. Peratus penetasan adalah dengan ketara tertinggi dalam suhu  $32\pm 1^{\circ}\text{C}$  dengan 90.3% ( $p < 0.05$ ) penetasan dan terendah dalam suhu  $22\pm 1^{\circ}\text{C}$  dengan 20.4% penetasan. Ini membuktikan pembentukan embrio Lampam Jawa, *B. gonionotus* mempunyai peluang untuk bertahan hidup dalam keadaan suhu air yang lebih tinggi.

**Kata kunci:** *Barbonymus gonionotus*, Lampam Jawa, kesan suhu, pembentukan embrio, peratus penetasan

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## LIST OF ABBREVIATIONS AND SYMBOLS

ml	-	Milliliter
kg	-	Kilogram
°C	-	Degree Celsius
±	-	Plus minus
%	-	Percent
<	-	Lower than
DAH	-	Day After Hatch
cm	-	Centimeter
ppm	-	Part per million
°	-	Degree
GSI	-	Gonadosomatic index
g	-	Gram

# CHAPTER 1

## INTRODUCTION

### 1.0 Introduction

*Barbonymus gonionotus* (Bleeker, 1849) or its common name Lampam Jawa or Javanese carp is one of important freshwater fish culture in earthen pond by Malaysian farmers. Due to its rapid growth and good taste, there is high demand from the production sector to produce the fry and fingerling for aquaculture (Penman, Gupta & Dey, 2005). This species is widely distributed in Vietnam, Indonesia, Thailand and Cambodia. It is not a native species from Malaysia but it has been introduced in Peninsular Malaysia in 1953 from Indonesian by the Fisheries Department in Sungai Perak and Sungai Terengganu (Chong *et al.*, 2010). Lampam Jawa also has been cultured widely in Sarawak Basin.

Lampam Jawa species have strongly flattened body and elevated back. It has small head and pointed snout with terminal mouth. The fish is silvery white in color and sometimes appear with a golden tint. *B. gonionotus* naturally inhabit at mid-water to the bottom depths in rivers, streams and reservoirs since they prefers stagnant water environment as their habitat. During rainy season, the fish will swim for short distance migration and inhabit flooded forest (Rainboth, 1996) until the water level decreasing.

In natural condition, the male fish usually matured 4 months earlier than female. The female usually matured in age of 8 months (Bentsen, 1996). Female *B.*

*gonionotus* can produce several thousand of eggs per spawning and it takes about 14 hours for the eggs to hatch after fertilization from zygote to newly hatched larval stage. After the eggs fertilized, it undergoes several stages of embryonic development before hatched and every stage are very sensitive to changes in surrounding condition.

### **1.1 Problem statement**

According to Houghton *et al.*, 2001, over the past century global surface temperature has increased by approximately 0.6°C. The Intergovernmental Panel Journal of Sea Research on Climate Change (IPCC) predicts the increasing of world average surface temperature from 1.1°C to 6.4°C for the year 2100 (Solomon *et al.*, 2007). In the ocean, rising of temperature on the sea surface increase the acidification and increasing of sea level affect more than 1600 fish species that live on Great Barrier Reef. Increase in temperature affect essential biological processes of fish including growth, reproduction, swimming potential and behavior. Reproduction is only possible in a small temperature range. Small increases in temperature can dramatically increase egg mortality, especially in tropical species (Gagliano *et al.*, 2007). Increase in sea acidification affect the reproduction process since fish eggs are sensitive to pH change compare to fish larvae and adults. Similarly with freshwater environment, temperature gives a great influence on the early embryonic stage of many fish. Since freshwater have a shallower in depth compare to seawater, the chance of rapid increase of

temperature in freshwater is higher and it will directly affect the embryonic development.

Among abiotic factors, temperature has the highest influence on the development and growth (Blaxter, 1992; Kamler, 1992; Hochachka & Somero, 2002). It also influenced embryonic development period, formation of tissues and structure with it function and the synchronization of these continuous developmental paths (Kamler, 1992; Fuiman *et al.*, 1998, Koumoundouros *et al.*, 1999, Kovač, 2002). This will affect the production since fishes are poikilothermic; the metabolism depends on surrounding temperature. Due to this phenomenon, environmental condition may change rapidly and affect the development of eggs and production of fry.

In natural breeding, the environmental factors including temperature are naturally based on climate condition. Thermal tolerance of the embryos and larvae is very important for survival rate as the environmental condition varies during the development stages (Wiegand *et al.*, 1988). If there are any abnormal changes in temperature occurs, it will affect the development and mortality of the eggs.

While in captive breeding, the temperature is controlled. Captive breeding will have lower mortality rate of eggs compared to natural breeding since the temperature can be adjusted and controlled for optimum embryonic development.

Naturally, embryonic development required lower temperature compared to larval development. Thus, increasing in water temperature in recent days due to global warming will affect the survival rate and development of the eggs as well as

affecting the production of the larvae. However, optimum temperature for spawning, embryonic development and hatching of Lampam Jawa, *B. gonionotus* and the suitable temperature for better performance at 0 Day After Hatching (DAH) larvae were still unknown.

## 1.2 Significant of study

From previous study, there is lack of research on eggs development of *Barbonymus gonionotus* focus on temperature. Since this species is one of highly cultured fish in Malaysia, further study on their eggs development is required to improve and increase the production.

Therefore, the objectives for this study are:

- 1) To determine the most suitable temperature for eggs development of *B. gonionotus* eggs.
- 2) To study the effects of temperature on the development and hatching performance of *B. gonionotus* eggs.



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