UNIVERSITI PUTRA MALAYSIA

EFFECT OF TEMPERATURE ON LARVAE GROWTH AND PHYSICAL DEVELOPMENT OF LAMPAM JAWA, Barbonymus gonionotus (Bleeker, 1849)

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

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CERTIFICATION OF APPROVAL
DEPARTMENT OF AQUACULTURE
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This is to certify that I have examined the final project report and all corrections have been made as recommended by the panel of examiners. This report complies with the recommended format stipulated in the AKU4999 project guidelines, Department of Aquaculture, Faculty of Agriculture, Universiti Putra Malaysia.

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ABSTRACT

Temperature is one of the most important environmental factors that affect the growth and physical development of fish larvae. The temperature in both natural environment and captive breeding are dissimilar. In captive breeding, the temperature is controlled to achieve higher survival. The effect of water temperature on development of Lampam Jawa (*Barbonymus gonionotus)* larvae was studied. An experiment was designed to observe the effect of temperature changes on the growth and physical development of *Barbonymus gonionotus* in captive breeding. It was conducted in wet laboratory of UPM, Serdang, Selangor. Broodstock were induced with artificial hormone Ovatide at 0.2ml/kg of male and 0.4ml/kg of female. The larvae were reared in three different temperature periodically at 22 ± 1^{o}C, 27 ± 1^{o}C (room temperature) and 32 ± 1^{o}C. Water temperatures were decreased to 22 ± 1^{o}C, by using Resun CL500 chiller and increased at 32 ± 1^{o}C using Eheim Jager heater. The growth of these larvae were measured daily based on their length and weight. The larvae development was monitored for 28 days during the experiment. Developmental rate increased with increasing temperature. The mean length was significantly bigger ($p<0.05$) at 8.82± 1.94 mm and the mean weight was at 1.46 g in 32 ± 1^{o}C. Whereas, in 22 ± 1^{o}C, the length was at 6.35 ± 0.52 mm and the mean weight at 0.76 g. In 32 ± 1^{o}C temperature, the fully development of fin can be seen in day 20. Whereas in temperature 22 ± 1^{o}C, the fully development of fin cannot be seen throughout the 28 days experimental period. Results showed that the survival was significantly higher in 32 ± 1^{o}C at 96.31% ($p<0.05$) and lowest at 36.23% in 22 ± 1^{o}C. In conclusion, the *Barbonymus gonionotus* has better performance towards high water temperature.

KEY-WORDS: *Barbonymus gonionotus,* temperature, growth, physical development

ABSTRAK

Suhu adalah salah satu faktor alam sekitar yang paling penting yang mempengaruhi tumbesaran dan perkembangan fizikal larva ikan. Suhu di antara persekitaran semulajadi dan pembiakan yang terkawal adalah berbeza. Dalam pembiakan yang terkawal, suhu boleh dikawal untuk mencapai kemandirian yang tinggi. Kesan suhu air kepada perkembangan larva Lampam Jawa (*Barbonymus gonionotus*) telah dikaji. Satu eksperimen telah direka untuk memerhati kesan perubahan suhu terhadap tumbesaran dan perkembangan fizikal *Barbonymus gonionotus* dalam pembiakan yang terkawal. Kajian ini telah dijalankan di makmal basah di UPM, Serdang, Selangor dan hormon Ovatide telah digunakan ke atas induk pada kadar 0.2ml / kg diberikan kepada induk jantan dan 0.4ml / kg diberikan kepada induk betina. Larva telah dibiakkan dalam tiga suhu yang berbeza secara berkala pada 22 ± 1^{o}C, suhu 27 ± 1^{o}C (suhu bilik) dan 32 ± 1^{o}C. Suhu air telah diturunkan pada 22 ± 1^{o}C, dengan menggunakan Resun CL500 penyejuk dan suhu dinaikkan pada 32 ± 1^{o}C menggunakan pemanas Eheim Jager. Tumbesaran diukur setiap hari berdasarkan panjang dan berat larva ikan. Larva ikan dipantau selama 28 hari semasa eksperimen. Peningkatan suhu mempercepatkan kadar perkembangan. Purata panjang lebih besar ($p < 0.05$) pada 8.82 ± 1.94 mm dan purata berat adalah 1.46 g pada 32 ± 1^{o}C. Manakala, pada 22 ± 1^{o}C, panjangnya adalah 6.35 ± 0.52 mm dan berat purata pada 0.76 g. Pada suhu 32 ± 1^{o}C, perkembangan sirip sepenuhnya dapat dilihat pada hari ke-20. Manakala, pada suhu 22 ± 1^{o}C, sepanjang 28 hari eksperimen, perkembangan sirip tidak dapat dilihat sepenuhnya. Keputusan menunjukkan bahawa kemandirian adalah lebih tinggi pada 32 ± 1^{o}C pada 96.31% ($p < 0.05$) dan terendah pada 36.23% pada 22 ± 1^{o}C. Kesimpulannya, *Barbonymus gonionotus* mempunyai prestasi yang lebih baik pada suhu air yang tinggi.

Kata kunci: *Barbonymus gonionotus*, suhu, tumbesaran, perkembangan fizikal

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LIST OF ABBREVIATIONS

^{o}C	- Celsius
DO	- Dissolved Oxygen
NH_3	- Ammonia
NO_2^-	- Nitrite
NO_3^-	- Nitrate
kg	- kilogram
g	- gram
L	- Litre
ml	- Millilitre
mm	- Millimetre
SE	- Standard Error
sp	- Species
DAH	- day after hatch
ppm	- part per thousands

CHAPTER 1

INTRODUCTION

1.0 Introduction

The Fisheries and Aquaculture Department of Food and Agriculture Organization of the United Nations (FAO) reported that *Barbonymus gonionotus*, or locally known as Lampam Jawa is usually discovered in streams, rivers and sometimes even in reservoirs. It also known that, this species prefers standing water habitats. Furthermore, *B. gonionotus* is also documented in Vietnam, Laos, Cambodia Thailand and Indonesia. The first finding recorded in Peninsular Malaysia is located from Rajang Basin in Sarawak (FAO). *Barbonymus gonionotus* was introduced from Indonesia to Peninsular Malaysia by the Fisheries Department (Soong, 1963), and then raised at the Tapah Fish Breeding Centre in Perak (Welcomme, 1953). Although it was introduced into Sungai Terengganu and Sungai Perak, the species does not naturally exist in Peninsular Malaysia (Chong *et al*., 2010).

This species is widely cultured in ponds, water channels and roadside canals where the other carp species do not perform well. *Barbonymus gonionotus* is suitable to be cultured for domestic marketing because of its rapid growth. This species is omnivorous, feeds on grasses, algae and aquatic plants (Phaohorm, 1970; Srisuwantach, 1981). In addition, this species mainly prefers phytoplankton than zooplankton also known as planktivores (Mondol *et al.*, 2005).

1.1 Statement of Problem

Temperature is one of the most important parameters affecting the development of fish embryos (Kokurewicz, 1971) and the survival and growth of fish larvae. Temperature, either it is low or high, may affect the growth, food consumption and physical development of *B. gonionotus.* It has been presented that temperature can affect fish populations in their natural environments hence this experiment is focusing on the relationship between temperature and fish development (Backiel and Horoszewicz, 1970; Kokurewicz, 1971; Herzig and Winkler, 1986).

Furthermore, the natural temperature of the ecosystem is increasing rapidly due to global warming. Since 1861, it is noted that the global temperatures have increased around 0.6 degree Celsius in the last century and the past two decades were recorded as the warmest in history (Houghton *et al.*, 2001). According to NASA's Goddard Institute for Space Studies (2010) - since 1880, average temperatures have scaled to 0.8^{o}C (1.4 degree Fahrenheit) globally and are increasing year by year with no sign of cooling down. The global surface temperatures may also increase from 1.1^{o}C to 6.4^{o}C in the year 2100 as predicted by The Intergovernmental Panel on Climate Change (IPCC) (Solomon *et al.*, 2007). Although it may seem rather significantly small in number, but one-degree global change may warm all the oceans, land and atmosphere of the earth. Consequently, this phenomenon will cause in the increase of temperature in the habitats of water species and affect them, either in the development of the fish or during the production stage itself.

Despite the expectancy of decreasing fishery products from the sea, the aquaculture field will be assumed to increase production of fish supply and one of the economically important freshwater fish in Malaysia is the *B. gonionotus* species.

Besides that, the increasing production of *B. gonionotus* culture in Malaysia is highly dependent on the availability of larvae. The culture of *B. gonionotus* will help the aquaculture production in order to increase fish supply. Since *B. gonionotus* is highly valued in local and fisheries, which is mainly based from the easy culture, it is envisioned that the aquaculture production for this species will increase year by year.

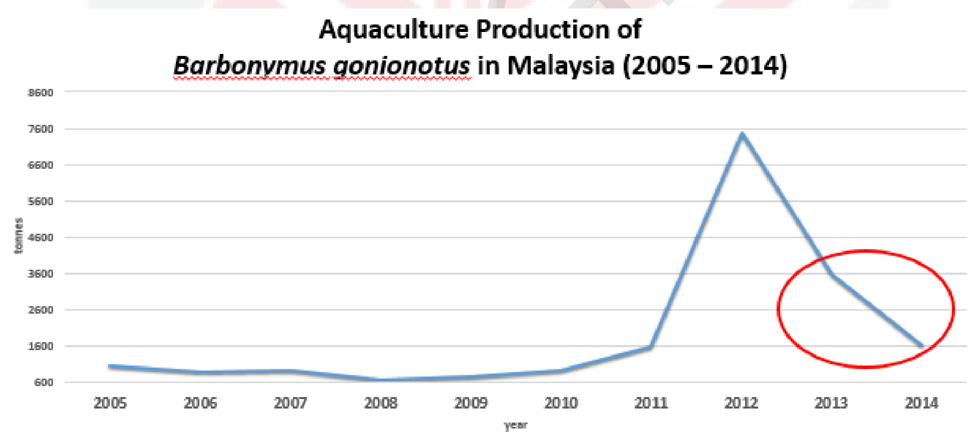

Figure 1.1: FAO Fishery Statistics of Aquaculture production of *Barbonymus gonionotus* in Malaysia (2005 – 2014).

Unfortunately, in 2013 and 2014, the production of *B. gonionotus* in Malaysia declined drastically (Figure 1.1). As aquaculturist, the solution to increase the aquaculture production either in Malaysia or global should be discovered.

With regard to this case, the availability of larvae depends solely on the temperature (Kokurewicz, 1971). To put it simply, the temperature in both natural environment and captive breeding are dissimilar in nature. In captive breeding, the temperature is controlled to achieve the optimum breeding temperature. In contrast, the natural environment temperature depends on the weather, which sometimes can either be too cold or too hot which distorts the growth of the larvae. Theoretically, in order to develop larvae - the process of spawning, embryonic, larval, and juvenile development requires a different temperature conditions (Herzig and Winkler, 1986).

The possibility to increase the production of larvae in captive breeding is possible since several parameters can be controlled in hatchery environment. For instance, a 3^{o}C decline of temperature of rearing the tropical fish marine species *Amphiprion melanopus* can cause in longer larval durations, decreased growth rates and slower swimming development of larvae (Bridget and Rebecca, 2004). Hence, it can be hypothesized that the temperature plays an important role in the production of healthy larvae.

Previously, there is no significant study on the effect of temperature on growth, food consumption, and physical development of *B. gonionotus* larvae. In conjunction, this research hopes to find the optimum temperature that suitable to culture the *B. gonionotus* and similarly will help to increase the production of this species.

Thus, the objectives of this research were:

1. To study the effects of temperature on larvae growth and physical development of Lampam Jawa, *Barbonymus gonionotus* larvae (Bleeker, 1849).
2. To determine the best temperature on larvae growth and physical development of Lampam Jawa, *Barbonymus gonionotus* larvae (Bleeker, 1849).

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