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Judul: EFFECTS OF DIFFERENT SALINITIES ON SURVIVAL AND GROWTH OF SEAPLAN (LATES CALCARIFER) LARVE

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EFFECTS OF DIFFERENT SALINITIES ON SURVIVAL AND GROWTH OF SEA BASS (*Lates calcarifer*) LARVAE

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THIS DISSERTATION IS SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR BACHELOR OF SCIENCE WITH HONOUR

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UNIVERSITY OF MALAYSIA SABAH

2007
DECLARATION

I declare that this dissertation is the results of my own independent work, except where otherwise stated.

March 2007

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ABSTRACT

Sea bass is one of species that has wide range salinity tolerance. An experiment was conducted to study the effects of different salinities on survival and growth of sea bass (*Lates calcarifer*) larvae. Six treatments were compared in this experiment which was 5 ppt, 10 ppt, 15 ppt, 20 ppt, 25 ppt and 30 ppt as control. Each treatment has three replicate and conducted for 15 days. Every experimented tank was provided with one hundred tails of 2 dAH larvae. Desired salinity was decreased 5 ppt from seawater (30 ppt) within 1 hour. Rotifers (*Brachionus plicatilis*) were fed as the first feeding until 10 dAH and continued by *Artemia*. Water exchanged, bottom cleaning and larval observation were conducted daily. The water quality parameters were monitored, such as dissolved oxygen (mg/l), pH, and water temperature(°C). Every five days, the total length of the larvae was measured for growth performance. The results showed that highest survival and growth was achieved in 20 ppt. Analyses of data revealed that there were significant difference among six treatments (P<0.05) on larvae survival and growth when analyses with one-way ANOVA.

*Keywords:* *Lates calcarifer*; salinity tolerance; survival; growth
ABSTRAK


*Kata kunci: Lates calcarifer; ketahanan saliniti; daya hidup; pertumbuhan*
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<tr>
<td>°C</td>
<td>degree Celsius</td>
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<tr>
<td>%</td>
<td>percentage</td>
</tr>
<tr>
<td>BW</td>
<td>Body Weight</td>
</tr>
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<td>centimetre</td>
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<tr>
<td>d AH</td>
<td>day after hatch</td>
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<tr>
<td>DO</td>
<td>dissolved oxygen</td>
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<tr>
<td>g</td>
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<td>liter</td>
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CHAPTER 1

INTRODUCTION

1.1 Development and production of aquaculture in Malaysia

Recently aquaculture sector has been given a special attention by the Malaysian government. The action plan and strategy to develop the sector has been spelled out in the Third National Agricultural Policy (NAP3 1998-2010), a long term plan for agricultural development. This sector is a well developed and fast growing industry in Malaysia. This is because Malaysia has a massive potential to be involved in high volume and mass production of aquaculture products for local and export market. Wide coastal and land areas, good quality waters full of microbes, climate, free from typhoon, strong support from government are the advantages that help Malaysia to become a major player in the aquaculture industry in the Asia Pacific.
There has been significant increase in demand of fishes and seafood in Malaysia and throughout the world. This is expected to continue to increase to fulfil the requirements of protein as consumers become more health-conscious. Aquaculture could decrease overall seafood prices and making it an attractive alternative to other food sources.

The most common method in cultivating marine life are earthen ponds, cages, raceways and tanks. Species of interest in Malaysian aquaculture are sea bass (*Lates calcarifer*), snapper (*Lutjanus johni*), tiger grouper (*Epinephelus fuscoguttatus*), mouse grouper (*Cromileptes altivelis*) and tilapia (*Oreochromis niloticus*).

Since this sector has a bright potential, the research and development (R&D) of aquaculture has been widely practiced. In order to produce a good aquaculturist, it has become a degree course in several universities in Malaysia such as Universiti Malaysia Sabah (UMS) and Kolej Universiti Sains dan Teknologi Malaysia (Kustem). Nowadays, aquaculture sector has improved with the application of biotechnology for higher growth rate, artificial egg collection, higher survival rate, and disease resistance.

These days, aquaculture is not only involved in food supply but also as a major component in sea ranching programs. Sea ranching program is to ensure that the seafood supply is enough to meet the high demand. When hatcheries or nurseries produce seeds or fries, they will be stocked to the sea. Normally, selected marine animals are involved such as sea bass (*Lates calcarifer*) and banana prawn (*Penaeus merguiensis*) in Malaysia.
1.2 Problems in aquaculture industry

There were some problems that are faced by aquaculturist and fish farmers in aquaculture industry. Even though it has a bright future and rapid growth, but this industry is known as risky industry. Systematic management and knowledge is important to maintain a sustainable aquaculture development. Sometimes problems are caused by unavailability of fish feed supply, transportation, seawater or freshwater supply that is free from pollution and also disease outbreak. Major problem in aquaculture is diseases infection that cause tremendous economic losses in the aquaculture industry. One of the most important issues in aquaculture is disease control. Factors that lead to a culture having a susceptibility to a disease include improper storage of feed, exposure to ammonia, foreign parasites existence, stress and high stocking density. Stress free fish are able to fight off disease. Management is very important because of its high investment in this sector. Since that, good government support has been given to this sector, so it brings interest to people to try on where if it is sustainable and the profit would be luxurious. However, they should consider not to selfish by affecting the ecosystem balance.

Seed supply of marine fish culture in Malaysia still constrained in development. Presently, local seed production centres are still too small to fulfil the demand especially when dealing with multi species fish production.
Cages aquaculture in ocean also has some impacts to the ecosystem. Normally cages are made of mesh or wire that allow complete exchange of water into and out of the culture area itself. The waste effluent can effect the outside environment potentially contaminating it with parasite and disease. The river and sea pollution with hatchery or fish farm waste is a common happening.

In promoting aquaculture, at the same time the environment must be protected and it is a serious matter. Care must be taken to ensure that any aquaculture venture is ecologically compatible with its environment.

1.3 Sea bass culture

Sea bass (Lates calcarifer) or locally called siakap or selunsung in Malaysia, barramundi or barra in Australian region and other names such as giant sea perch, red eye, and bloch. This species is widely distributed in tropical and semi-tropical areas of the Indo-Pacific, from the Persian Gulf to India to Northern Australia (Yue et al., 2006). They are typically catadromous, carnivorous and dioecious species. Lates calcarifer has been categorised as a euryhaline species. It means that they can tolerate wide range of salinity fluctuation. That is why they also can be found in the estuarine areas.

This species is commonly cultured in cages, hatcheries and fish farms because of its high commercial value, great demand and its good taste. Sea bass has been cultured in Southeast Asia for more than ten years. Moreover, sea bass is highly potential in mass
production that associated with ongrowing facilities. Normally the broodstock is cultured in 27-30 ppt (part per thousand) salinity. They spawn at lower salinity and higher temperature, 28-30°C with enough feed such as chopped fish. According to Jobling (1997), growth is maximised at an optimal temperature within the thermal tolerance range. The water pH in the tanks is held at around 8.3 (Barnabe, 1995).

Cages are sometimes used to hold maturing stocks. The eggs of sea bass have a lipid globule for buoyancy. After 15-17 hours, they will hatch at 28-30°C (Barnabe, 1995). Extensive sea bass larvae rearing culture in 30 ppt seawater has been practiced in most hatcheries. Newly hatched larvae were measure 1.5 mm in length.

The first feeding is live feed such as enriched rotifer, *Brachionus plicatilis* on second or third day after hatch. The water used for rearing is provided with microalgae, a single-celled green algae (*Nannochloropsis* sp.) to feed the rotifers. *Nannochloropsis* is widely used for feeding the larvae as it contains highly nutritional compounds such as sterols (Veron *et al*., 1998) and polyunsaturated fatty acid (PUFA) (Rocha *et al*., 2003).

Stocking density of the larvae ranges from 3 to 50 larvae/l and for rotifer around 20 larvae/ml (Barnabe, 1997). The feed was changed to bigger live feed, *Artemia salina* nauplii on the 11 day after hatch. Enriched *Artemia* containing high level of the highly unsaturated fatty acid (w3-HUFA) that gave higher survival rate than those fed with the low of contain w3-HUFA diet (Chantarasri *et al*., 1989). The sea bass larvae are sensitive to pollutants and the early larval stages are most susceptible to disease infection.
1.4 Salinity

Effective salinity ranges for reproduction and growth vary with different species, life stage, and may be modified by other environmental factors such as temperature. Euryhaline is classified to marine animals species that can tolerate to wide range of salinities such as sea bass, *Lates calcarifer*.

In saline water, there will be an osmoregulation or osmotic regulation process and ionic regulation process. Osmoregulation is the maintenance of a relatively constant internal salt concentration against external salinities that are higher, lower, or fluctuating. While ionic regulation is a process to control ionic composition of the fish tissue and body fluids. Generally, in fish they have a specific internal salt concentration that different from the water in which they swim.

Marine fish maintain internal salt concentration in the range of 12-15 ppt, which is hypotonic to the external medium (33-37 ppt). Fish in estuarine conditions are exposed to variable external salt concentrations. However, they tend to osmoregulate at around 9-15 ppt through a process called osmosis. Osmosis is a process where water moves through a semipermeable membrane, such as the gill epithelium of fish from the region of low salt concentration to that of higher concentration of the membrane.

Osmoregulation involves a metabolic process requiring active transport of ions to maintain internal salt concentration. The more salt the body of an aquatic animal must
take in or excrete, the more energy is required and growth is restricted. Euryhaline species may grow well over a broad range of salinity. The effects of salinity on growth in fish are related not only to total concentration of dissolved solids, but also influenced by the concentration of divalent ions due to their effects on membrane permeability and osmoregulation.

Marine and brackishwater cages in bay and estuaries encounter unstable salinities that may vary well below full-strength seawater due to freshwater runoff. Euryhaline species that can tolerate such changes may be important in some locations, since control of salinity is generally difficult under these conditions.

1.5 Problems in sea bass larval rearing

In aquaculture, sea bass is a favourable species cultured in most fish farms and hatcheries since that it has high potential in mass production. However, there were some problems in early larval stage. Sea bass is known as a carnivorous species. Since larval stage, serious cannibalism problems have occurred among sea bass larvae.

Cannibalism is the act of killing and consuming the whole or major part of an individual belonging to the same species (Komen et al., 2005). It can occur between unrelated animals and between siblings, and can be exerted by parents on their offspring or vice versa (Baras and Jobling, 2002). This occurs because a number of factors potentially influence the rate of cannibalism in fish.
The factors were divided into two major categories, which is size-related and behavioral factor. Factors that found to affect into cannibalism are food availability, population density, refuge, water clarity, light intensity, feeding frequency and frequency at which alternative prey is presented (DeAngelis et al., 1979; Fox, 1975; Hecht and Appelbaum, 1988; Katavic et al., 1989). The influence of stocking density on cannibalism at larval stages has already been evidences in a number of studies (Li and Mathias, 1982; Giles et al., 1986; Hecht and Appelbaum, 1988; Smith and Reay, 1991).

Water quality management for larval rearing is an important component for successful in larval culture. Since, larval stage is easily stressed by environmental disturbance. Stress of larvae will bring some effects to them, especially to their appetite, activities, cannibalism and stunted growth. Inappropriate water quality will effects the growth and survival of the sea bass larvae overall. This is very important for sustainable mass production in aquaculture, where by cost and time effective management has been practiced.

Further research will be done and application of biotechnology has been used to improve the time and cost effective. The common water quality parameter that has been seriously monitored is dissolved oxygen (DO) level, pH, salinity, temperature and nitrite level.

Sea bass larvae can tolerate wide ranges of salinity fluctuation. Salinity can affect the osmoregulation process and the metabolic rate. The larvae utilize energy for
osmoregulation and ionic regulation process. The more energy used in both process, the lower metabolic rate resulted. The lower metabolic rate will lower the growth rate.

It is about 20-50% of the total energy budget of fish is dedicated to osmoregulation, however it can be as low as 10% (Boeuf and Payan, 2001). That is why by knowing the most appropriate salinity will minimise the energy used for osmoregulation process.

1.6 Objectives

Serious cannibalism and mass mortality problems during sea bass early larval stage has been common in aquaculture. However, these problems need to be overcome since sea bass has potential commercial value. Seed production is very important because sea bass is among the most favourable species for fish farmers to culture. Well seed production is resulted from successful larval rearing, since it is the critical period in fish production. At this time, they are easily stressed and susceptible to bacteria and virus infections.

One of the water qualities that have been concerned about besides DO and pH is salinity. Wide range of salinity tolerance is an advantage for the sea bass larvae. Feeding and temperature of the larval rearing have been known to give impact to the growth and survival of larvae. However, salinity also an important parameter that believed can influence the survival and growth performance in sea bass larvae.
By knowing the most preferable salinity of sea bass larvae, the amount of energy that will be used for osmoregulation process could be minimising. It is close related to the metabolic rate that brings to the growth rate.

The objectives for the research:

1. To identify the most preferred salinity by sea bass larvae for their best growth and survival.
2. To improve larval rearing technique. The rearing technique aimed to optimise water quality and stocking density.
REFERENCES


