Journal of Aquaculture and Fish Health Vol. 14(2) - June 2025
P-ISSN: 2301-7309 / E-ISSN: 2528-0864
doi : 10.20473/jafh.v14i2.55974

Survival Rate and Abnormality of Silver Pompano Fish (*Trachinotus blochii*) Larvae on Different Salinity

Astutiwati[1*], Sadikin Amir[2], Nurliah[2] and Mochammad Amin Alamsjah[3]

[1]Fisheries Sciences Study Program, Faculty of Life Sciences and Technology, Sumbawa University of Technology, Jl. Olat Maras Batu Alang, Moyo Hulu, Sumbawa Regency, West Nusa Tenggara 84371, Indonesia
[2]Marine Science Study Program, Department of Fisheries and Marine Science, Faculty of Agriculture, University of Mataram, Jl. Majapahit No.62, Selaparang, Mataram, West Nusa Tenggara 83115, Indonesia
[3]Fisheries and Marine Biotechnology Study Program, Faculty of Fisheries and Marine, Airlangga University, Jl. Mulyorejo, Surabaya, East Java 60115, Indonesia

*Correspondence :
astutiwatiyasin@gmail.com

Received : 2024-03-13
Accepted : 2025-03-27

Keywords :
Survival rate, Abnormality, Silver pompano, Salinity

Abstract

Silver pompano (*Trachinotus blochii*) is a species of marine aquaculture which is still novel in Indonesia. This study was conducted to determine the effect of different salinity on larval rearing on the survival rate and degree of larvae abnormality of silver pompano fish larvae (*T. blochii*). This research was conducted in June 2014 in Lombok Marine Aquaculture Development Center Aquaculture Department Directorate General for Maritime Affairs and Fisheries Station Sekotong, West Lombok Regency, West Nusa Tenggara Province by using a completely randomized design (CRD), which consisted of five salinity treatments (34, 31, 28, 25, and 22 ppt) with 5 replications. The results showed that silver pompano fish larvae of D17-D35 are able to survive at salinity 22-34 ppt with a survival rate of over 90%. However, in less than 31 ppt salinity, abnormality of silver pompano larvae increased with decreasing salinity level.

INTRODUCTION

Silver pompano (*Trachinotus blochii)*is a highly valuable fishery commodity. The consumption requirement for Bintang Pomfret, whether domestically or globally (export scale), still largely depends on wild capture. Silver pompano has a fast growth rate and is a crucial aquaculture species, having a very high market demand due to its nifty flesh quality (Gopakumar *et al*., 2011). The whole life cycle of this species is located in the sea (Hermawan, 2007), but it has the potential to be cultivated in ponds with low salinity. According to Costa *et al*. (2008) and Arrokhman *et al*. (2012), some closely related species with silver pompano larvae, such as *T. carolinus* and *T. marginatus* are reported to have the tolerance of a wide range of salinity, which is called euryhaline. In fact, according to McMaster *et al.* (2005), *T. carolinus* is able to be cultivated in ponds of low salinity (19-12 ppt) and is resistant to sudden changes in water salinity from 32 ppt media to 19 ppt.

Silver pompano fish farming still relies largely on a natural larval supply. The seeding process still has not been carried out because it frequently has several obstacles. According to Mayunar *et al*. (1991), the main problem in the fish hatchery business is the high mortality rate in the larval stage

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which is caused by some factors such as type and quantity of feed, time and frequency of feeding, stocking density, and maintenance of environmental factors (water quality) of larvae that were not appropriate. Moreover, Nursida (2011) stated that one of the most crucial water quality problems is salinity. An area with a certain salinity is dominated by a particular species related to the tolerance level of the species to salinity.

Some research results, which are summarized by Mukti *et al.* (2009), suggest that other factors affecting the reduced supply of silver pompano larvaes are a large number of abnormal fish larvae having the color and/or shape which are not included in general healthy fish and this can occur due to the environmental change such as water quality. The factors that have been identified as the cause of abnormalities in fish farming, among other factors, include genetics, disease, nutrition, vitamins, pollutants, and the condition of the maintenance medium (water quality).

According to Kumlu *et al*. (2000), in a cultivation process, salinity has a crucial role since it can affect the growth and survival of the organism. Salinity can affect fish survival, and fish abnormalities occur at specific levels for each fish species. According to research findings by Sampaio *et al.* (2003) and Arrokhman *et al*. (2012), it was stated that some species have different levels of tolerance to salinity that can affect the survival rate and abnormality.

Therefore, research on the survival rate and abnormality of silver pompano larvae reared in different salinity is crucial to do, the result is expected to contribute to the scientific information determining the potential of Silver pompano larvae in the framework of the introduction of species of brackish water aquaculture.

METHODOLOGY

Ethical Approval

All animal experiments were conducted in compliance with the guidelines of the Lombok Marine Aquaculture Development Center Aquaculture Department, Directorate General for Maritime Affairs and Fisheries Station Sekotong, and the University of Mataram. The Animal Ethics Committee adhered to the principles outlined in the Guide for the Care and Use of Laboratory Animals.

Place and Time

This research was conducted in June 2014 in the Lombok Marine Aquaculture Development Center Aquaculture Department, Directorate General for Maritime Affairs and Fisheries Station Sekotong, West Lombok Regency, West Nusa Tenggara province.

Research Materials

Equipment and materials used in this study included Silver pompano larvae 30 fish/liter, sea water 3 liters/tub, brackish water 5 ppt, larval food, distilled water 2 liters, all materials were from Lombok Marine Aquaculture Development Center Aquaculture Department Directorate General for Maritime Affairs and Fisheries Station Sekotong, West Lombok Regency, West Nusa Tenggara province.

Research Design

To determine the effect of different salinities on survival rates and abnormalities, this research was designed using a Completely Randomized Design (CRD) consisting of 5 different salinity treatments, namely: P1 (Salinity 34 ppt), P2 (Salinity 31 ppt), P3 (Salinity 28 ppt), P4 (Salinity 25 ppt), and P5 (Salinity 22 ppt). Each treatment was repeated 5 times, so that there were 25 experimental units.

Work Procedure

Preparation of Rearing Container

Containers used for the rearing of larvae were transparent cylindrical containers with a capacity of 10 liters of 25 units. Before being used, all containers were washed and soaked using disinfectant chlorine at a dose of 30 ppm. After soaking with chlorine, a few hours later the container was washed with detergent, then each container was filled with seawater and powered with installed aeration.

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Stocking Silver Pompano Larvae

Larvae obtained from the Lombok Marine Aquaculture Development Center Aquaculture Department, Directorate General for Maritime Affairs and Fisheries Station Sekotong, West Lombok Regency, West Nusa Tenggara province, were taken using a jar container with a volume of 10 liters. Spreading was carried out in the morning to avoid stress on the larvae. Calculations were carried out manually on larvae during larval stocking because the body size was still visible. The stocking density of larvae was 10 Individuals/liter (After preliminary experiments were carried out, the optimal density was obtained), which in one case there were 30 larvae.

Larvae Acclimatization

After the larvae were selected to be acclimatized prior to the time for the experiment, they were adapted to the new environment. Larvae entered the water by using a measuring cup slowly in each basin to avoid stress on larvae and to be able to adapt well to new environments.

Dilution of Rearing Media

The rearing media used was pure seawater with a salinity of 34 ppt (control) and was diluted with fresh water with a salinity of 5 ppt to obtain salinity of 31 ppt, 28 ppt, 25 ppt, and 23 ppt required in this study. Dilution was carried out using the following formula (Rayes *et al.*, 2013):

$$S3 = \frac{S1.V1 + S2.V2}{V1 + V2}$$

Information:
Sn = desired Salinity (ppt)
S1 = Salinity of freshwater (ppt)
S2 = Salinity of seawater (ppt)
V1 = Volume of fresh water (liters)
V2 = volume of seawater (liters)

Mixing was carried out in stages, 3 times a day, with an interval of 4 hours, where the salinity, which was reduced per day, was 3 ppt. This was carried out so that the larvae would not be easily stressed. Considering the volume of fresh water to be added, the water volume was divided by 3 so that the larvae can adapt to the salinity changes.

Silver Pompano Larvae Rearing

Silver pompano fish larvae were reared in the form of jar-sized containers of 10 liters, with 25 experimental units. Larvae were reared at five different salinity treatments, namely 34 ppt, 31 ppt, 28 ppt, 25 ppt, and 22 ppt, and each treatment had five replicates that were acclimatized beforehand. Rearing was carried out for 18 days. Water quality parameters were measured twice a day during the study to maintain the stability of the water quality parameters.

Variable and Measurement Method

Survival Rate

The calculation of silver pompano larvae survival was carried out every day, and the number was noted. The calculation of the number of Silver Pompano larvae surviving was carried out during the study until the final stage of the study.

The survival of fish larvae per container was calculated at the initial and during the study, with the treatments in which the survival was calculated using the following equation (Effendie, 1979):

$$SR = \frac{Nt}{No} x100\%$$

Information:
SR = The survival rate (%)
Nt = Number of larvae that live at the end of the observation (ind)
No = The number of larvae at the larvae of observation (ind)

Abnormality

The percentage (%) of fish abnormalities was also calculated at the end of the study. Abnormality was calculated based on the number of fish larvae that live abnormally, divided by the total number of fish living in the same medium. Morphological abnormalities were defined by deformities or deviations in organ shape, as well as asymmetry in meristic characters between paired bilateral organs. A high level of deformities and fluctuating asymmetry in morphological characteristics indicates low genetic diversity within the fish population. The fish were categorized as abnormal fish if they had a color and/or shape that was not

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in accordance with the general healthy fish. According to Iswanto and Suprapto (2015), in the case of silver pompano larvae, at the age of 10 days, oval-shaped, black with yellow dots on a particular body part. Furthermore, the shape and the color will change gradually to white. Then, it is stated that when the fish larvae were white at the age of ≥35 days, the larvae were quite normal, as well as the shape and fins were not bent. Conversely, the fish larvae were categorized as abnormal, and the abnormality was calculated using the equation (Supriono *et al.*, 2005) :

$$\text{Abnormality} = \frac{\text{Total Abnormality of fish(A)}}{\text{Total survival fish (Nt)}} \text{x}100\%$$

Water Quality

Water quality parameters were measured once a day. Temperature, salinity, pH, and DO were measured at the end of the observation at 18.00, which was after all the treatments had been given. The parameters which were measured included pH with a pH meter (MW102 PRO, Milwaukee), temperature with a thermometer (digital thermometer, MN Measurement), salinity with a refractometer (SainSonic Refractometer, Amazon), and DO meter (DO-5510, Taiwan).

Data Analysis

Data were analyzed using analysis of variance (ANOVA) at the 5% significance level using the Costat program, and if the result was significant, a further test would be carried out in the form honest significant difference test (HSD).

RESULTS AND DISCUSSIONS

Survival rate

The survival rate of larvae during the study tended to decrease with a decrease in salinity.

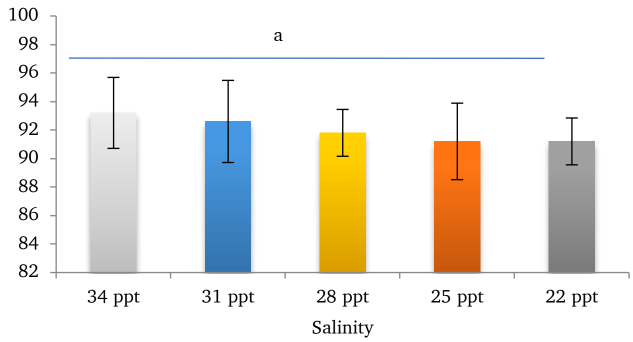

Figure 1. Survival rate of silver pompano larvae (mean ± STDEV) at the age of D17-35.
Description : The highest survival was 93.2% at a salinity of 34 ppt (control), and the lowest was survival of 91.2% at 22 ppt salinity (Figure1). Nevertheless, the results of analysis of variance (ANOVA) at the 5% significance level, indicated no difference in survival rates between the salinity of 34 ppt (control), 31 ppt, 28 ppt, 25 ppt and 22 ppt, (P> 0.05).

Table 1. Values ± standard deviation of silver pompano larvae survival rate (*Trachinnotus blochii*) during maintenance.

Parameter observations	Day	Treatment				
		P0	P1	P2	P3	P4
Survival Rate (%)	17	100	100	100	100	100
	35	93.2 ± 2.48^a	92.6 ± 2.88^a	91.8 ± 1.64^a	91.2 ± 2.68^a	91.2 ± 1.64^a

Description : P0: 34 ppt., P2: 31 ppt, P3. 28 ppt, P4: 25 ppt, P5: 22 ppt. Superscript were not significantly different (results of a BNT 5% test).

Abnormality

Abnormal fish larvae are characterized by the color and shape of the larval body, which looks different from normal larvae in general (Figure 2). The highest percentage of abnormal fish larvae (32.804%) was found at a salinity of 22 ppt, and the lowest percentage of abnormal fish

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larvae (10.03%) was found at a salinity of 34 ppt (control). The results of analysis of variance (ANOVA) at the 5% significance level indicate that the abnormalities in 34 ppt salinity treatment (control) and salinity of 31 ppt were lower than the abnormality at 28 ppt salinity, 25 ppt, and 22 ppt ($P < 0.05$).

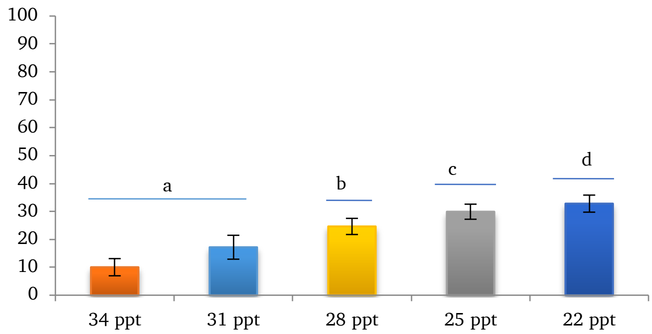

Figure 2. Abnormalities of silver pompano fish larvae (mean ± STDEV) to D35.
Description : The highest percentage of abnormal fish larvae's 32.804% at a salinity of 22 ppt and abnormal fish larvae's lowest percentage is 10.03% at a salinity of 34 ppt (control) Results of analysis of variance (ANOVA) at the 5% significance level, indicating that the abnormalities in salinity treatment (control) of 34 ppt and salinity of 31 ppt were lower than the abnormality at 28 ppt salinity, 25 ppt and 22 ppt ($P < 0.05$).

Table 2. Values ± standard deviation of abnormality of silver pompano larvae (*Trachinnotus blochii*) during the rearing period.

Observed parameter	Day	Treatment				
		P0	P1	P2	P3	P4
Abnormality	17	0	0	0	0	0
(%)	35	10.03 ± 3.07^{a}	17.18 ± 4.27^{a}	24.63 ± 2.88^{b}	29.90 ± 2.70^{c}	32.80 ± 3.05^{d}

Description : P0: 34 ppt., P2: 31 ppt, P3. 28 ppt, P4: 25 ppt, P5: 22 ppt. Superscript values were significantly different (results of BNT 5% test).

Survival rate is the rate that explains the survival of living organisms during cultivation. The survival rate maintained by silver pompano larvae in this study was not significantly different at all salinity treatments (34, 31, 28, 25, 22 ppt) given (Table 1). This is presumably due to the ability of silver pompano larvae to adapt to environmental conditions (different salinity).

According to Costa *et al*. (2008) and Arrokhman *et al*. (2012), several types of silver pompano larvae are euryhaline, including *T. carolinus* and *T. marginatus*. Therefore, the ability of *T. blochii* larvae to adapt to the lower salinity is allegedly because it is classified as euryhaline (Retnani and Abdulgani, 2013). This is supported by Rayes *et al.* (2013) and Saoud *et al.* (2007), who stated that each of them used white snapper and barramundi. The results shown by the two studies are similar to those obtained in this study, although these fish inhabit the sea but they can survive in the low salinity range because they are euryhaline.

Within the research, these fish larvae can still survive to live if they are raised in water with a salinity of 22 ppt. Retnani and Abdulgani (2013) state that this indicates the fish's body can make the best energy utilization. Due to their inability to utilize their bodies' energy, a certain marine fish species' larvae at their most vulnerable age can not survive in environments with low salinity. This is related to the fish's capacity for osmoregulation. Silver pompano larvae can occasionally be discovered on the coral reef and mangrove roots near the coast where the salinity is at least 30 ppt.

According to Bone and Moore (2008), the osmoregulation capability of seawater fish is associated with the ability to detect euryhaline osmotic pressure (Osmo-

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sensitivity) of chloride cells. Chloride is a receptor cell that is sensitive to salinity levels in the environment. When the euryhaline seawater fish enters the environment with different salinity, chloride than the cells will send signals to the central nervous system, which will trigger a change in the amount of hormone GH (growth hormone) secretion.

GH hormone will further regulate the development of chloride cells in organs such as gills osmoregulation, kidneys, and digestive tract, which then will lead to changes in the number of chloride cells or changes in the physiological mechanisms in the secretion/absorption of the chloride ion cells. If the fish enters the environment with higher salinity, then the number of chloride cells will increase and vice versa if it enters the environment with lower salinity. Thus, they can survive the salinity changes.

Abnormality is a condition when something is unusual or remarkable in contrast to the others, or deviates from the norm because it is different from others (Supratiknya, 2006). Abnormalities occur due to internal and external factors, namely genetics and disturbances in the living environment which causes inappropriate growth of organs and tissues in fish (Shafira, 2018).

Abnormalities of silver pompano fish larvae obtained in this study indicated that abnormalities in salinity treatment of 34 ppt (control) and salinity of 31 ppt were lower than the abnormalities at 28 ppt salinity, 25 ppt and 22 ppt (Table 2). At low salinity, abnormalities were inversely related. This means that at low salinity there was high level of larval abnormality while at higher salinity levels there was low abnormality of silver pompano fish larvae. This can be seen in the large number of fish larvae that can not develop well towards the next phase as normal fish larvae in general.

Morphological abnormalities are defined by deformities or deviations in organ shape, as well as asymmetry in meristic characters between paired bilateral organs. A high level of deformities and fluctuating asymmetry in morphological characteristics indicates low genetic diversity within the fish population. The fish were categorized as abnormal fish if it has a color and/or shape which were not in accordance with the general healthy fish. According to Iswanto and Suprapto (2015), in the case of silver pompano larvae, at the age of 10 days, they are oval-shaped and black with yellow dots (spots) on a particular body part. But then the shape and the color will change gradually to white, if fish larvae after white age ≥35 days, the larvae are quite normal, as well as the shape and fins are bent, otherwise then it is classified as abnormal.

The results of several studies summarized by Mukti *et al.* (2009) mention that abnormal fish have a negative impact such as slow growth, survival is low, susceptibility to disease, ease of stress, and low commercial value in the market.

In this study, low salinity is one of the factors affecting the increase of the number of abnormal body of fish silver pompano which can adapt and survive on water salinity brackish/low salinity but physiologically the salinity of the body has not been able to develop properly / quickly at such low salinity seawater in the general reading media.

CONCLUSION

Based on these results, it can be concluded that silver pompano fish larvae of D17-D35 are able to survive at salinity 22-34 ppt with a survival rate of over 90%. In less than 31 ppt salinity, larvae abnormality silver pompano of D17-D35 age increases with decreasing salinity.

CONFLICT OF INTEREST

The research was carried out on the researcher's personal initiative and funding, there was no funding or sponsorship from external parties, such as certain organizations and institutions and other parties who had no interest in this research.

AUTHOR CONTRIBUTION

First Author (Astutiwati) conceived and designed the study, performed the data

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collection and analysis, the initial draft of the manuscript was written, and substantial revisions were provided. And three other authors reviewed and approved the final manuscript and took full responsibility for the integrity of the research.

ACKNOWLEDGMENTS

Researchers would like to thank the three supervisors and the Lombok Marine Aquaculture Development Center Aquaculture Department Directorate General for Maritime Affairs and Fisheries Station Sekotong, West Lombok Regency, West Nusa Tenggara province and Study Program of Aquaculture, University of Mataram.

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