GROWTH AND SURVIVAL OF TOP SHELL LARVAE (*TROCHUS NILOTICUS*) AS A FUNCTION OF LIGHT INTENSITY

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ABSTRACT

Light is an important factor controlling the activity of the nocturnal snail *Trochus niloticus*. The importance of light for the survival and growth of the larvae was studied in aquaria exposed to the sunlight and compared to similar groups shaded by black nylon net. A higher number of larvae metamorphosed in the aquarium exposed to sunlight, but the average survival rate was highest in shaded aquaria. Survival increased significantly as a function of increasing degree of shading. A survival of 93.03 ± 2.86 % after 49 days was achieved after proper shading, thereby eliminating the major problem of high mortality of *T. niloticus* in aquaculture. No significant difference was observed between light intensity and growth.

INTRODUCTION

Trochus niloticus Linné, 1767 is one of the largest species in the family Trochidae, which is widely distributed in the Indo-Pacific region (Smith 1987). Intensive harvest has occurred for decades due to the high value of the nacreous shell and edible meat (Hahn 1988; Heslinga *et al.* 1984; Latama 1995). Being aware of the species becoming endangered, the Indonesian government has regulated business through a declaration issued by the minister of forestry (No. 12/ KPTS-II/1987).

T. niloticus is a nocturnal animal hiding in shady areas to avoid sunlight during the day. For this reason the juveniles are hard to find during the day. In aquaria without substratum the snails will gather (clump) in one area. Soon after sunset they start to spread all over the surface of the bottom to search the food, indicating that light controls the activity of this species. High mortality of larvae in hatcheries has been reported (Heslinga & Hillman 1981; Hahn 1988), but without explanation. Hahn (1988) found that less than 20 % of the larvae survived 2.2 months (18.7 % survival), and after 4 months survival was only 8.7 %.

The quality of the substratum is important for the larval settlement. Competent larvae prefer hard surface over the sand (Hahn 1988).

Hahn (1988) and Heslinga (1981) observed that the snails maintain nocturnal feeding behaviour even when unlimited food is present. I can confirm this finding. Growth of *T. niloticus* has been studied by many authors, but larval growth has received little attention (Smith 1987). The purpose of this work is to obtain a better understanding of the effect of sunlight on growth and survival of the larvae of *T. niloticus*. In culture it is important to choose the right light intensity needed for better growth and survival of larvae of *T. niloticus*.

MATERIALS AND METHODS

1,500 larvae of *T. niloticus* were used. The larvae were produced in the Marine Station of Hasanuddin University, Barang Lompo Island. One day after hatching the shell measured about 0.20 mm. Larvae were kept in aquaria, 30 x 30 x 30 cm, filled with 20 litre, 5 µm filtered sea water, provided with aeration during the treatment. Every treatment consisted of 3 replications, each encompassing 100 larvae. Series of treatments were made by covering the aquaria with black net: One set without covering; one set with 1 layer of net; one set with 2 layers; one set with 3 layers; and one set with 4 layers. The net reduced sunlight in the day-time about 30 % (Tab. 1). Temperature was stand-

Table 1. Range of light intensity (Lux) measured under three different weather conditions.

Treatment	Rainy	Cloudy	Clear
no net	890 - 1.360	2.305 - 2.951	max value
one layer	661 - 739	2.078 - 2.625	18.208 - max
two layers	441 - 739	1.564 - 2.071	15.560 - 18.721
three layers	250 - 386	1.264 - 1.402	12.775 - 16.549
four layers	217 - 305	718 - 1.220	6.695 - 11.415

Table 3. Size of *T. niloticus* after 49 days of culture.

Treatment	length (mm)
no net	1.36 ± 0.36
one layer	1.31 ± 0.17
two layers	1.49 ± 0.06
three layers	1.31 ± 0.23
four layers	1.73 ± 0.08

ardised by placing the aquaria under a transparent roof in order to achieved the same temperature at different light intensities. Food was standardised (*Tetraselmis* sp.) Larvae were put in the aquaria 12 hours after hatching.
Data were collected more frequent during larval development from the trochophore to the veliger stage. Competent larvae metamorphosed and started to feed on the surface of the aquaria. After metamorphosis, data were collected every 3 days. Absolute growth and mortality were measured after culture during 49 days.

RESULTS AND DISCUSSION

Larval development

T. niloticus has lecithotrophic larvae. The time from hatching to metamorphosis varies among individuals. Heslinga & Hillman (1981) found that it ranged from about 70 hours to three weeks. I found that light intensity had a strong effect on the time needed from hatching to metamorphosis. Tab. 2 shows that on the first day a high percentage of trochophores developed into veligers in the tank without covering. Shading with 1 to 4 layers of the black net resulted in a decreasing number of larvae developing from trochophore to veliger. In general, the reduction of light decreased the speed of metamorphosis during all stages of development.
Of course, light intensity is not the only factor stimulating larval metamorphosis. Algal film, red coralline algae (*Porolithon*) and gamma-aminobutyric acid (GABA), have been experimentally shown to induce and stimulate metamorphosis (Heslinga & Hillman 1981; Hahn 1988). GABA and algal film proved especially useful for stimulation of metamorphosis in large scale culture (Heslinga & Hillman 1981; Hahn 1988).

Growth

Absolute growth had a tendency to be best under the most shaded conditions, but there was no significant difference between the

Table 2. *T. niloticus.* Data show % larvae ± Sd according to the phase of development of the larvae as a function of shading. Development from trochophore to veliger (day 1-3), and veliger to metamorphosis (day 6-9).

Treatment	day 1	day 3	day 6	day 9
no net	73.18 ± 8.58	96.67 ± 5.77	100	94.44 ± 9.62
one layer	66.67 ± 11.55	93.33 ± 11.57	100	55.56 ± 9.62
two layers	46.67 ± 11.55	78.25 ± 16.14	100	53.33 ± 5.77
three layers	10.00 ± 10.00	56.67 ± 5.77	100	23.33 ± 15.39
four layers	3.33 ± 5.77	53.33 ± 5.77	100	11.11 ± 9.62

Table 4. Average survival rate after 49 days.

Treatment	Survival Rate (%)
A: no net	18.68 ± 32.26
B: one layer	23.05 ± 7.08
C: two layers	66.65 ± 11.16
D: three layers	43.83 ± 17.16
E: four layers	93.03 ± 2.86

Table 5. t-test survival rate of *T. niloticus* after 49 days. Significance is indicated by *.

Treatment	Average	t-test
E: four layers	93.03	(E-C), (E-D)*, (E-B)*, (E-A)*
C: two layers	66.65	(C-D), (C-B)*, (C-A)
D: three layers	43.83	(D-B), (D-A)
B: one layer	23.05	(B-A)
A: no net	18.68	-

treatment without net and the treatment with four layers of shading net (Tab. 3).

Survival rate

The average larval survival rate displayed a clear trend of increasing survival as a function of increasing degree of shading (Tab. 4). There was a significant difference between exposure to sunlight and the 4 layer shading, showing that a survival of more than 90 % can be achieved. (Tab. 5, *t*-test, P> 0.05). The data show that shading is beneficial to survival of juveniles in culture. I suggest that strong light may stress the larvae, and stressed larvae will react by increased swimming activity. This will increase the risk that larvae hit the surface of the water and the wall of the aquarium. Such encounter can cause damage of the velum, and the larvae can become trapped in the surface (pers. comm. Kurt Ockelmann 1995).

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