Effects of Water Flow, Salinity Gradient and Light Intensity on the Larval Performance of the Devil Stinger *Inimicus japonicus*

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Introduction

Devil stinger *Inimicus japonicus* is a commercially valuable demersal fish in Japan (Fig. 1) and seedling production has been conducted in many hatcheries. However, rearing results fluctuate by mass mortality during larviculture, even though using the eggs from the same batch and rearing in the same temperature and tank proportions (Kadomura et al. 2007; Ruttanapornvareesakul et al., 2007).

We hypothesized that this fluctuation is due to the differences in the rearing environment, such as water flow and light intensity in the rearing tanks, and examined the different flow field and light intensities on the larval performance of this species.
3 different experiments were conducted from hatching to settlement (juvenile), and growth and survival of fish were compared.
Newly hatched larvae were stocked into 1 kL cylindrical black tank (Ø130 cm, 70 cm depth) at a density of 12000 larvae/tank. Fish were reared at the same temperature (25°C), water exchange rate (100 %/day) and feeding regime (Olsen et al. 2003).

Fig. 1. Development of devil stinger *Inimicus japonicus* larvae: (a) day 1, 3.2 mm SL; (b) day 6, 4.6 mm SL; (c) day 7, 5.5 mm SL. Note the well developed pectoral fin.

Experiment 1: Effects of Water Flow

A total of 10 rearing tanks were used and 5 different aeration rates (0, 50, 300, 600 and 1200 mL/min) were set with duplicate. Growth and survival until settlement (day 21) were monitored. There was a positive relationship between aeration rate and the final survival rates (Fig.2). High aeration rate tank (>300 mL/min) showed stable survival, but body length (8.5-9.0 mm) were not significantly different among aeration rates.

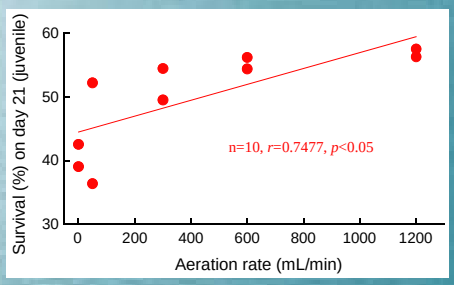

Fig. 2. Relationship between aeration rate and survival of devil stinger

Experiment 2: Effects of Light Intensity

A total of 9 rearing tanks were put under the natural light condition and different light intensities in the daytime were set using shade. Average light intensities in the daytime varied from 0.2 to 4700 Lux among rearing tanks. Survival rates of devil stinger juveniles reared at more than 6 Lux (37.2-65.6%) were higher than those from under 2 Lux (0-15.3%) (Fig.3). Negative correlation between survival rate and body length was found. Feeding of larvae was observed even in low light intensity (0.2 Lux) and positive correlation was found between light intensity and number of feed in larval gut (Fig.3).

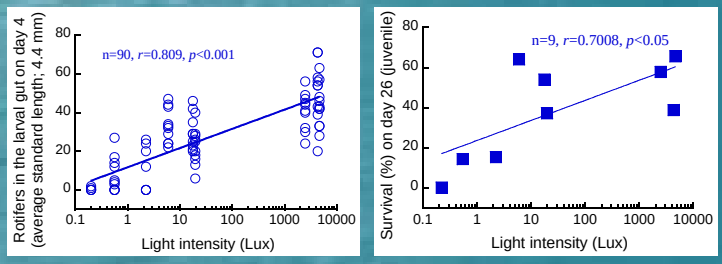

Fig. 3. Effects of light intensity on feeding activity and survival of devil stinger

Experiment 3: Effects of Salinity Gradient

Salinity gradient in a rearing tank was formed by pumping brackish water (22 ppt) from the surface and seawater (34 ppt) from the bottom at the same time (Fig.4). Control rearing tanks were aerated at 300 mL/min. Fish were reared until day 23.

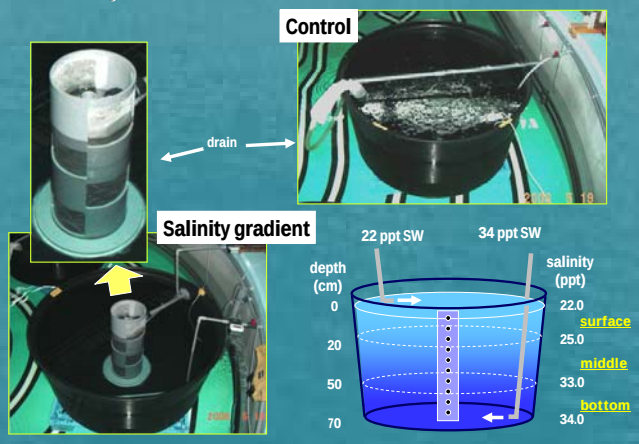

Fig. 4. Overview of Salinity Gradient Tank and control tank

Fish distribution was apparently different between treatments and fish started settlement around day 20 (Fig.5).
Growth and development was synchronized in the salinity gradient tanks (Fig.6) with little standard deviation, although average survival at settlement in the salinity gradient tank (47.3 %) was lower than the aeration tank (68.2 %) (Table 1).

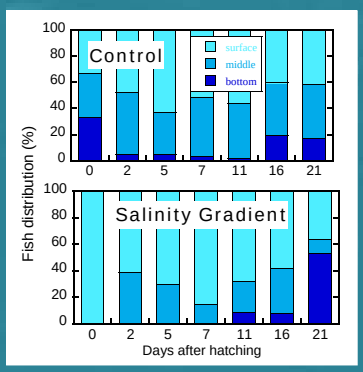

Fig. 5. Changes in fish distribution in the rearing tank

Table 1. Survival and growth of the devil stinger on day 21

	Control	Salinity gradient
Survival (%)	68.2±6.0*	47.3±0.9
Standard length (mm)	8.28±0.33	8.96±0.13

* t-test, p<0.05

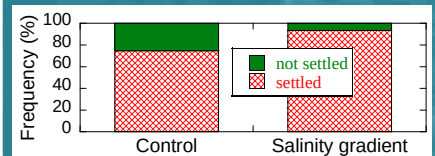

Fig. 6. Developmental stage of devil stinger on day 21

Conclusions

From these results, the optimal environmental conditions for larval rearing of devil stinger can be at the light intensity of over 6 Lux and the aeration rate of over 300 mL/min. It is noteworthy that survival rate became stable at the environment with stronger water flow as ever reported (Sakakura et al., 2007), since devil stinger larvae with long pectoral fins had been believed as fragile (Fig. 1).
Introducing salinity gradient can be a novel approach for enhancing larval performance.

Acknowledgements
The authors are grateful for the financial aid from the Prefectural Collaboration of Regional Entities for the Advancement of Technological Excellence, JST and the MEXT Special Education Research Project, Japan.

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