Effects of Aeration Rate and Salinity Gradient on the Survival and Growth in the Early Life Stages of the Devil Stinger *Inimicus japonicus*

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Abstract: We examined the effects of a flow field in the rearing tank exhibited by different aeration rate and salinity gradient on the larviculture of the devil stinger *Inimicus japonicus*. Two different rearing experiments using 1 *kl* rearing tanks were conducted from hatching (day 0) to settlement. In the Experiment 1, fish were reared until day 21 in 5 different aeration rates (0-1200 *ml*/min). There was a significant and positive relationship between survival and aeration rate, and fish survival became stable at an aeration rate of more than 300 *ml*/min. In Experiment 2, the 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. Control rearing tanks (34 ppt) were aerated at 300 *ml*/min and fish were reared until day 23. Growth and development was synchronized in the salinity gradient tanks with little standard deviation, although average survival at settlement in the salinity gradient tank (47.3 %) was lower than the aeration tank (68.2 %). The optimal aeration rate for devil stinger larviculture is stronger than 300 *ml*/min and introducing a salinity gradient can be a novel approach for enhancing performance of the fish.

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Physical environments in the rearing tanks are important factors for larviculture. In these environmental factors, water temperature and salinity are relatively easy factors to control and effects of different water temperature and salinities on larval survival have been well studied (e.g., Howell et al. 1998). On the other hand, little attention had been paid to the water flow in rearing tanks (Backhurst and Harker 1988). Recent studies on the relationships between flow field in the rearing tanks of larviculture and survival of fish larvae has revealed that the flow field in the rearing tank has the great impact on stable production for larviculture (Kolkovski et al. 2004; Ruttanapornvareesakul et al. 2007; Sakakura et al. 2007).

Devil stinger *Inimicus japonicus* is a commercially valuable demersal fish in Japan and seedling production has been conducted in many hatcheries as a candidate species for aquaculture and stock enhancement. However, rearing results fluctuate by mass mortality during larviculture, even though eggs are from the same batch and rearing is 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 in the rearing tanks, and examined the different flow fields on the larval performance of this species. We conducted two different rearing experiments to determine the effects of different flow fields on the survival, growth and settlement of the devil stinger. First, different flow fields created by different aeration rate were investigated. Next, we examined the effects of a salinity gradient in the rearing tank on the larviculture of this species.

Materials and Methods

Materials

Two different rearing experiments (Experiment 1 and 2) were conducted at Nagasaki Prefectural Institute of Fisheries from hatching to settlement (juvenile), and growth and survival of fish were compared. Newly hatched larvae were stocked into 1 *kl* cylindrical black tank (130 cm in diameter and 70 cm in depth). Fish were reared at the same temperature (average 25 °C) and water exchange rate (100 %/day). Feeding regime was also set to the same conditions following the previous study on the ontogenetic changes in size preference of prey in this species (Olsen et al. 2003), where L-type rotifer (Nagasaki Makishima strain) of *Brachionus plicatilis* (Fu et al. 1991) were fed from mouth opening (day 1) to 5.2 mm in standard length (SL) and *Artemia franciscana* nauplii were offered thereafter. Rotifers were enriched with HUFA enriched freshwater *Chlorella vulgaris* (Super Fresh Chlorella V12, Chlorella Industry, Fukuoka, Japan) and *Artemia* was enriched with commercial product (Super Capsule A-1, Chlorella Industry, Fukuoka, Japan). The rotifer density in each experimental tank was maintained at 10 individuals/*ml*, *Artemia* density was increased according to the fish growth (0.1-6.5 individuals/*ml*), and Super Chlorella V12 was added to the experimental tanks to adjust the density to 5×10^5 cells/*ml* once daily. Water exchange rate of each tank was 100 %/day and dissolved oxygen was more than 4.83 mg/*l* in all experimental tanks throughout the experiment. Light condition was natural and maximum light intensity at the water surface was about 1000 lux for each experiment.

Experiment 1: Effects of Aeration Rate

Naturally spawned eggs of devil stinger were obtained from Okayama Prefectural Institute of Fisheries and were transported to Nagasaki Prefectural Institute of Fisheries. On

July 12, 2005, newly hatched larvae (day 0; hatching rate, 96%) were stocked into rearing tanks at a density of 12,000 larvae/tank. A total of 10 rearing tanks were used and 5 different aeration rates (0, 50, 300, 600 and 1200 *ml*/min) were set with duplicates and fish were reared until day 21.

On day 21, survived fish were counted and survival rate was calculated for each tank. Then, settled juveniles with well developed pigmentation and transparent floating larvae were discriminated, and ratio of settled juveniles (%) was calculated for each tank. Ten settled juveniles in each tank were sampled and fixed in 5 % formalin solution and then standard lengths (SL) were measured using a digital microscope (VH6300, Keyence, Japan). Remaining fish were further reared for the stock enhancement program of the devil stinger in Nagasaki Prefecture.

Experiment 2: Effects of Salinity Gradient in the Rearing Tank

Naturally spawned eggs were collected at Nagasaki Prefectural Institute of Fisheries and newly hatched larvae were introduced into experimental tanks on June 26, 2006 (hatching rate, 98%). A total of 5 rearing tanks were used in this experiment. Three tanks were aerated at 300 *ml*/min as control group at fish density of 12,000 larvae/tank. In the other 2 tanks, a salinity gradient was formed according to Yogo (2008) by pumping brackish water (22 ppt) from the surface and seawater (34 ppt) from the bottom at the same time at a flow rate of about 350 *ml*/min for each salinity water (Fig. 1). Since we had realized that larvae distribute mostly in low salinity water in the preliminary trial, we introduced 6,000 larvae into a salinity gradient tank. According to the salinity in the salinity gradient tank measured by multi ware quality meter (Model 85, YSI Inc., Ohio, U.S.A.), we defined 3 layers from the free surface of water to the bottom of the rearing tank (Fig. 1); surface (0-20 cm depth, 22.0-25.0 ppt, respectively), middle (20-50 cm, 25.0-33.0 ppt) and bottom (50-70 cm, 33.0-34.0 ppt).

Fig.1

Distribution of fish in each layer of the rearing tank was estimated at 2-5 days intervals. We counted larvae using the modified method of Masuda et al. (2001). We put an L-shape white board (10×10 cm) into the water at 10 cm intervals from the surface and projected the shade of the board over a water volume of approximately 1 *l*. We counted the number of fish in the projected water volume for 27 points and the average distribution in each layer was calculated.

On day 23, survival rate and ratio of settled juveniles (%) were calculated for each tank. SLs of 10 settled juveniles from each tank were measured with the same procedure as the Experiment 1. Remaining fish were further reared for the stock enhancement program of the devil stinger in Nagasaki Prefecture.

Statistical Analysis

In the Experiment 1, the relationship between aeration rate, and survival and growth of fish were analyzed by linear regression. In the Experiment 2, differences in survival, growth and ratio of settled juvenile between control and salinity gradient tanks were compared using Student's *t*-test. Values were considered significant at a 5% level of confidence.

Results

Experiment 1

There was a positive relationship between aeration rate and the final survival rates (n=10, r=0.7477, P<0.05; Fig. 2). Tanks with higher aeration rate (>300 *ml*/min) showed stable survival. A similar relationship was found between aeration rate and SL (range of mean SL among treatments, 8.5-9.0 mm; Fig. 2). Ratio of settled juveniles ranged 90.5-93.7 % in the aerated tanks but the ratio was relatively lower in the non-aerated tanks (85.1 %).

Fig.2

Experiment 2

In the control tank, newly hatched larvae were equally distributed in the water column, and most of the fish distributed in the surface and middle layer thereafter (Fig. 3). In the salinity gradient tank, newly hatched larvae were distributed surface layer, and after mouth opening (day 1) they distributed both in the surface and middle layer (Fig. 3). On day 21, about 50 % of fish were distributed in the bottom layer as settled juveniles. Also, fish which distributed in the surface and middle layer were mostly settled juveniles and they adhered to the mesh and pipes for drainage in the tank (Fig. 1).

Fig.3

Average survival on day 23 in the salinity gradient tank (47.3 %) was lower than the control tank (68.2 %; *t*-test, $P<0.05$), whereas growth did not differ. Ratio of settled juvenile showed a higher trend than that of the control tank (*t*-test, $P=0.06$; Table 1).

Table.1

Discussion

We confirmed that the optimal flow field for larviculture of devil stinger is formed at over 300 *ml*/min in 1 *kl* water volume. The lower survival rate of 300 *ml*/min-aerated rearing tanks in Experiment 1 than Experiment 2 is due to the different handling for fertilized eggs. Since the eggs for Experiment 1 was transferred from another institute by a parcel delivery service, this process may affect the quality of eggs even though both batches had almost the same hatching rate. Introducing salinity gradient in the rearing tank resulted in synchronized development and growth with little standard deviation (Table 1) indicating that this is a novel approach for enhancing larval performance, although average survival at settlement in the salinity gradient tank was about 20 % lower (Table 1). Our results on survival at settlement in both aerated tanks (>300 *ml*/min) and salinity gradient tanks are fairly good compared to the former studies where survival at settlement was 12.7% with 7 *kl* tanks (Kondou and Sugino 1999) and 27.9-41.0% with 27 *kl* tanks (Kusaka 2007).

Theoretical and experimental studies (MacKenzie et al. 1994; Cury and Roy 1989; Kimura et al. 2004; Mangino and Watanabe 2006) had revealed that a particular turbulence enhances larval fish ingestion rate and survival, and a dome-shaped relationship is found between turbulence levels and survival of fish larvae. In the series of studies investigating optimal flow field created by aeration for larviculture of the seven-band grouper *Epinephelus septemfasciatus*, this phenomenon was also confirmed using the same rearing tank in this study (Shiotani et al. 2003, 2005; Sakakura et al. 2007). When different aeration rate (0-1000 *ml*/min) was tested, the highest survival was achieved at the aeration rate of 200 *ml*/min and survival and feeding activity of larvae was extremely low both at 0 and 1000 *ml*/min for the seven-band grouper larvae (Shiotani et al. 2003) and this dome-shaped relationship was further utilized for the 100 *kl* mass-scale tank (Sakakura et al. 2007). In the larviculture of Pacific bluefin tuna *Thunnus orientalis*, mass mortality occurs when larvae sink and come into contact with the bottom of the rearing tank at the nighttime during the first 10 days after hatching (Masuma et al. 2011), and increasing in aeration rate during the night time enhances the survival both in 500 *l* scale (from 300 to 900 *ml*/min; Nakagawa et al. 2011) and in 50 *kl* scale (Tanaka et al. 2009). However, these were not the case in the devil stinger (Fig. 2) and it is noteworthy that survival rate became stable in the environment with stronger water flow (Sakakura et al. 2007), since devil stinger larvae with long pectoral fins (Kohno and Sota 1998) had been believed to be fragile.

Ruttanapornvareesakul et al. (2007) examined the effects of rearing-tank proportions on early survival of the devil stinger using 3 different tanks with different water surface areas and the same water volume of 100 *l*. It was reported that the survival rate of devil stinger larvae was highest in the tank with the smallest free water surface, where larval movement under the water surface is the shortest. Moreover, attaching the water surface significantly increased the physical and physiological stress of larvae (Ruttanapornvareesakul et al. 2010). Therefore, decreases in water surface tension by creating a smaller water surface area improve the survival rate of the devil stinger larvae. In this study, higher aeration rate resulted in higher survival with positive effects on growth indicating that active feeding was not interfered. The higher speed of the water current at the water surface, caused by strong aeration, may be strong enough to help free larvae from the water surface tension while decreasing the stress of larvae, and this can explain the positive relationship between aeration rate and survival of the devil stinger.

There are many studies that examined the effect of different salinities on survival in the early life stages of marine fishes (Howell et al. 1998). Some species exhibit higher survival at the lower salinity, such as orange-spotted grouper *Epinephelus coioides* (Toledo et al. 2002) and tawny puffer *Takifugu flavidus* (Zhang et al. 2010). Juvenile tiger puffer *Takifugu rubripes* shows higher growth rate at low salinity by enhanced food intake and food efficiency (Taga and Yamashita 2011). Midooka and Iida (2006) reported similar results in the devil stinger larvae where larvae showed higher survival when they were reared at 10-20 ppt seawater, and they concluded that less energy allocation of devil stinger for osmoregulation resulted in the higher survival than the full-strength of seawater. However, in this study, survival of the devil stinger in the salinity gradient tank was slightly lower than that of the control tank. This should be due to the differences in experimental settings between Midooka and Iida (2006) and this study. Former studies investigated the effects of salinity on fish by introducing fish to different salinity. On the other hand, we formed a salinity gradient in a rearing tank and let the fish choose where to stay. Consequently, larval distribution in the water column was different from the control tank especially during the first phase of the rearing trial where larval distribution at surface area is much higher than the control.

Although we introduced one-half larvae to the salinity gradient tank comparing to the control tank, aggregation at the surface layer with high density may have affected the survival of larvae in the salinity gradient tanks. Forming a salinity gradient is also quite successful in the larviculture of amphidromous fish ayu *Plecoglossus altivelis* (Yogo 2010) and Japanese flounder *Paralichthys olivaceus* at the hatchery-scale (Yogo 2005). This approach was the first trial for the devil stinger, and revealed that metamorphosis and settlement occurred synchronously during day 18 and 21 with considerable survival rate whereas the timing of settlement varied in the control tanks. Gavlik and Specker (2004) found that a decrease in rearing salinity from 30 to 20 ppt in the metamorphosing stage of summer flounder *Paralichthys dentatus* synchronized the metamorphosis and settlement. Devil stinger settle in the shallow water after the metamorphosing stage, similarly to flatfishes. Therefore, we assume that the synchronization in development of the devil stinger occurred in the salinity gradient tank considering the distribution of larvae at 22-30 ppt.

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References

Backhurst, J. R. and J. H. Harker (1988) The suspension of feed in aerated rearing tanks: The effect of tank geometry and aerator design. *Aquacult. Eng.*, **7**, 379-395.

Cury, P. and C. Roy (1989) Optimal environmental window and pelagic fish recruitment success in upwelling areas. *Can. J. Fish. Aquat. Sci.*, **46**, 670-680.

Fu, Y., K. Hirayama and Y. Natsukari (1991) Morphological differences between two types of the rotifer *Brachionus plicatilis* O. F. Müller. *J. Exp. Mar. Biol. Ecol.*, **151**, 29-41.

Gavlik, S. and J. L. Specker (2004) Metamorphosis in summer flounder: manipulation of rearing salinity to synchronize settling behavior, growth and development. *Aquaculture,* **240**, 543-559.

Howell, B. R., O. J. Day, T. Ellis and S. M. Baynes (1998) Early life stage of farmed fish. In "*Biology of Farmed Fish*" (ed. by K. D. Black and A. D. Pickering), Sheffield Academic Press, Sheffield, pp. 27-66.

Kadomura, K., S. Naruse, S. Sugihara, K. Yamaguchi and T. Oda (2007) Production of Reactive Oxygen Species (ROS) by various marine fish species during the larval stage. *Biosci. Biotechnol. Biochem.*, **71**, 2029-2033.

Kimura, S., H. Nakata, D. Margulies, J. M. Suter and S. L. Hunt (2004) Effect of oceanic turbulence on the survival of yellowfin tuna larvae. *Nippon Suisan Gakkaishi*, **70**, 175-178 (in Japanese with English abstract).

Kohno, H. and K. Sota (1998) Ontogenetic intervals based on the development of swimming- and feeding-related characters in larvae and juveniles of the lumpfish, *Inimicus japonicus*. *Aquacult. Sci.* **46**, 333-342 (in Japanese with English abstract).

Kolkovski, S., J. Curnow and J. King (2004) Intensive rearing system for fish larvae research I. Marine fish larval rearing system. *Aquacult. Eng.*, **31**, 295-308.

Kondou, M. and H. Sugino (1999) Rearing experiment on mass production of devil stinger *Inimicus japonicus* using large tank. *Bull. Fish. Exp. Station, Okayama Pref.*, **14**, 53-56. (in Japanese)

Kusaka, K. (2007) Effect of aeration with poromeric pipes on growth and survival of devil stinger *Inimicus japonicus* larvae on mass seed production. *Bull. Fish. Exp. Station, Okayama Pref.*, **22**, 18-21. (in Japanese)

MacKenzie, B. R., T. J. Miller, S. Cyr and W. C. Legget (1994) Evidence for a dome-shaped relationship between turbulence and larval fish ingestion rates. *Limnol. Oceanogr.*, **39**, 1790-1799.

Mangino, A. and W. O. Watanabe (2006) Combined effects of turbulence and salinity on growth, survival, and whole-body osmolality of larval southern flounder. *J. World Aquacult. Soc.*, **37**, 407-420.

Masuda, R., D. A. Ziemann and A. C. Ostrowski (2001) Patchiness formation and development of schooling behavior in pacific threadfin *Polydactylus sexfilis* reared with different dietary highly unsaturated fatty acid contents. *J. World Aquacult. Soc.*, **32**, 309-316.

Masuma, S., T. Takebe and Y. Sakakura (2011) A review of the broodstock management and larviculture of the Pacific northern bluefin tuna in Japan. *Aquaculture*, **315**, 2-8.

Midooka, A. and Y. Iida (2006) Trials to reduce mortality using low-salinity treatment in rearing of larval devil stinger. *Bull. Hiroshima Prefectural Fish. Ocean Technol. Center,* **1**, 41-42 (in Japanese).

Nakagawa, Y., M. Kurata, Y. Sawada, W. Sakamoto and S. Miyashita (2011) Enhancement of survival rate of Pacific bluefin tuna (*Thunnus orientalis*) larvae by aeration control in rearing tank. *Aquat. Living Resour.*, **24**, 403–410.

Olsen, A. I., A. Hagiwara and Y. Sakakura (2003) Size preferences of marine fish larvae among cultivated live feed. *Eur. Aquacult. Soc. Spec. Publ.*, **33**, 278-279.

Ruttanapornvareesakul, Y., Y. Sakakura and A. Hagiwara (2007) Effect of tank proportions on survival of seven-band grouper *Epinephelus septemfasciatus* (Thunberg) and devil stinger *Inimicus japonicus* (Cuvier) larvae. *Aquacult. Res.*, **38**, 193-200.

Ruttanapornvareesakul, Y., Y. Sakakura and A. Hagiwara (2010) Screening of enzyme activity for assessing the condition of larvae in the seven-band grouper *Epinephelus septemfasciatus* and devil stinger *Inimicus japonicus*. *Fish. Sci.*, **76**, 295-304.

Sakakura, Y., S. Shiotani, H. Chuda and A. Hagiwara (2007) Flow field control for larviculture of the seven-band grouper *Epinephelus septemfasciatus*. *Aquaculture*, **268**, 209-215.

Shiotani, S., A. Akazawa, Y. Sakakura, H. Chuda, T. Arakawa and A. Hagiwara (2003) Measurements of flow field in rearing tank of marine fish larvae: A case study of the seven band grouper *Epinephelus septemfasciatus*. *Fish. Eng.*, **39**, 205-212 (in Japanese with English abstract).

Shiotani, S., A. Hagiwara, Y. Sakakura and H. Chuda (2005) Estimation of flow in a rearing tank of marine fish larvae by simplified numerical computation-a case of two-dimensional flow. *Aquacult. Eng.*, **32**, 465-481.

Taga, M. and Y. Yamashita (2011) Effectiveness and relating factors of low salinity on growth of larval and juvenile tiger puffer *Takifugu rubripes*. *Aquacult. Sci.*, **59**, 225-233.

Tanaka, Y., K. Kumon, A. Nishi, T. Eba, H. Nikaido and S. Shiozawa (2009) Status of the sinking of hatchery-reared larval Pacific bluefin tuna on the bottom of the mass culture tank with different aeration design. *Aquacult. Sci*. **57**, 587–593.

Toledo, J. D., N. B. Caberoy, G. F. Quinitio, C. H. Choresca and H. Nakagawa (2002) Effects of salinity, aeration and light intensity on oil globule absorption, feeding incidence, growth and survival of early-stage grouper *Epinephelus coioides* larvae. *Fish. Sci.*, **68**, 478-483.

Yogo, S. (2005) How the larviculture should be performed – view point from the fish side –. *YUTAKANAUMI*, **5**, 35-36 (in Japanese).

Yogo, S. (2008) Management methods of artificial seedlings. Japanese Patent 4091965, 2008.

Yogo, S. (2010) Production of ayu larvae having wild nature of fish for stock enhancement. *Nippon Suisan Gakkaishi*, **76**, 417-418.

Zhang G., Y. Shi, Y. Zhu, J. Liu and W. Zang (2010) Effects of salinity on embryos and larvae of tawny puffer *Takifugu flavidus*. *Aquaculture*, **302**, 71-75.

通気量と塩分勾配がオニオコゼ仔稚魚の生残と成長に与える影響

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異なる通気量と塩分勾配がオニオコゼ仔魚飼育に与える影響を調べた。容量 1 *kl* の円形水槽で 2 つの飼育実験を孵化仔魚（0 日齢）より着底まで実施した。実験 1 では 5 つの異なる通気量（0-1200 *ml*/min）で 21 日齢までの飼育を行った。その結果，最終日の生残と通気量の間に有意な正の相関が検出され，300 *ml*/min 以上の通気量で生残が安定した。実験 2 では飼育水槽に水面から 22 ppt の汽水，底面から 34 ppt の海水をそれぞれ連続注入することで塩分勾配を形成させ，対照に 34 ppt 海水に 300 *ml*/min の通気を施す水槽を設け，23 日齢まで飼育した。その結果，塩分勾配水槽で飼育した魚の成長と着底が同調したが，飼育終了時の生残（47.3 %）は対照のそれ（68.2 %）より低い傾向があった。1 *kl* 規模でのオニオコゼの仔魚飼育には 300 *ml*/min 以上の強い通気による水流が必要であることが明らかになり，さらに塩分勾配の飼育水槽への導入により種苗生産に新たな可能性を見いだした。

Table 1. Comparison of survival, growth and development of the devil stinger between control (aeration rate 300 *ml*/min) and salinity gradient (22-34 ppt) tank on 23 days after hatching

	Control	Salinity gradient
n	3	2
Survival (%)	68.2 ± 6.0*	47.3 ± 0.9
Standard length (mm)	8.28 ± 0.33	8.96 ± 0.13
Settled juvenile (%)	75.3 ± 10.2	93.3 ± 0.6

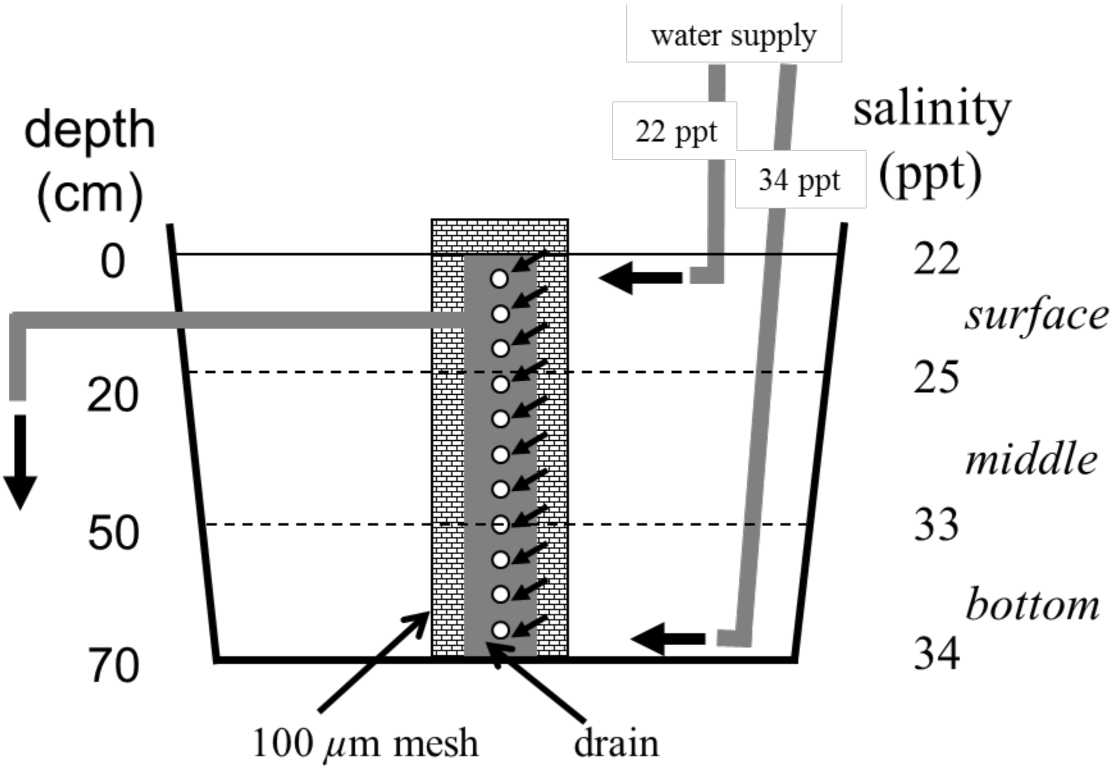
Results are mean values ± SD. An asterisk indicates significant difference between treatments (*t*-test, $P<0.05$).

Fig. 1. Schematic drawing of salinity gradient tank.

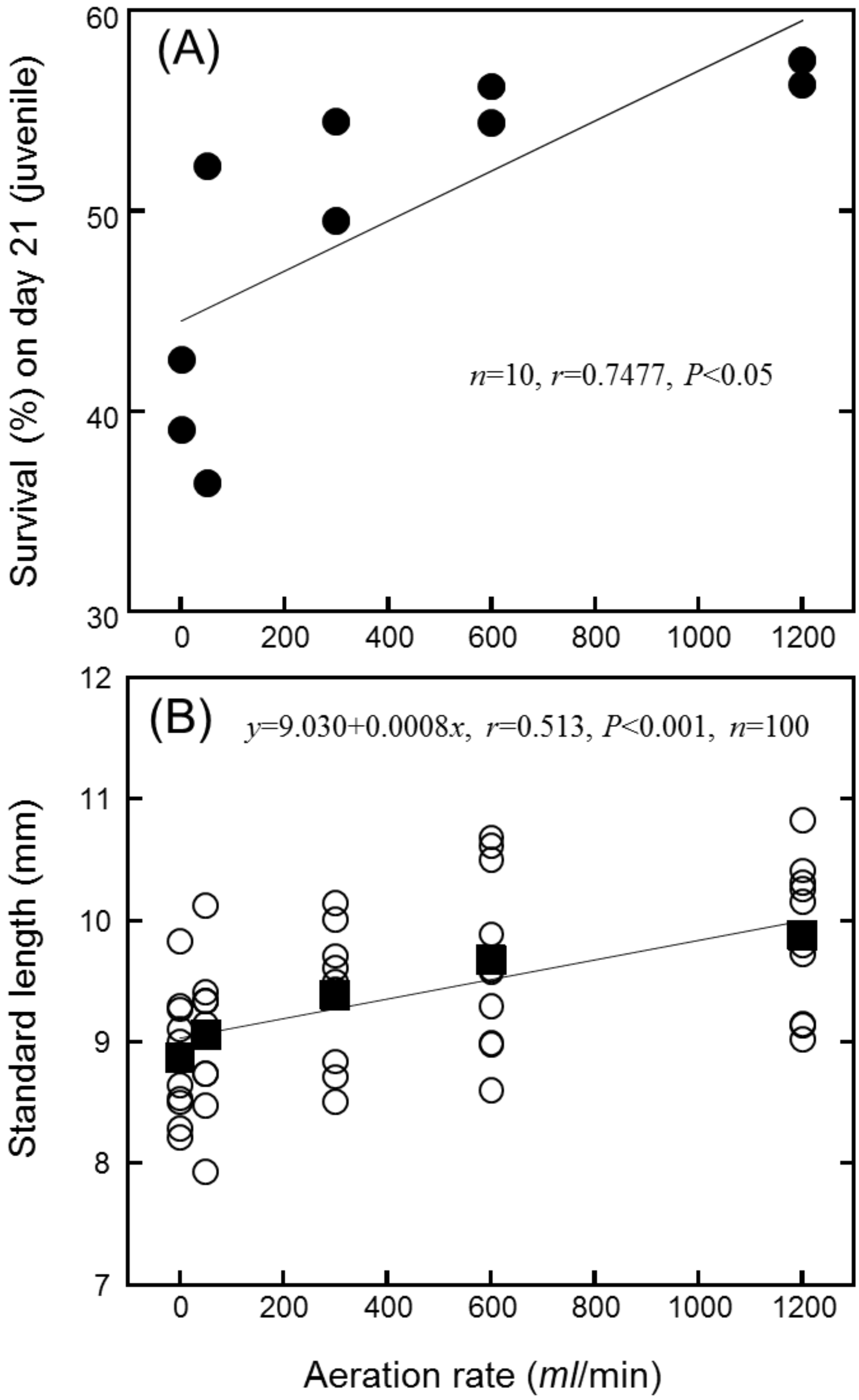
Fig. 2. Effects of aeration rate on (A) the survival and (B) growth (open circle, individual data; closed square, average) in the devil stinger reared in a 1 *kl* round tank at 21 days after hatching.

Fig. 3. Changes in estimated fish distribution in a 1 *kl* round tank reared at (A) aeration rate of 300 *ml*/min and (B) salinity gradient. Open column denotes surface, shaded column for middle, and closed column for bottom layer of the experimental tank, respectively (see Fig. 1 for the details of depth and salinity at each layer).

Sakakura et al. Figure 1　希望縮尺５３％



Sakakura et al. Figure 2　希望縮尺７０％



Sakakura et al. Figure 3　希望縮尺５５％