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Effect of Prey Density on the Swimming Behaviour of Larval Black Porgy, *Acanthopagrus schlegeli* (BLEEKER)

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Abstract

The swimming behaviour of larval black porgy, *Acanthopagrus schlegeli* (BLEEKER) was investigated, with particular attention to prey density under the laboratory conditions. Cultured rotifer, *Brachionus plicatilis*, and *Artemia* nauplii were employed as food organisms. Observations on swimming speed were made on 14, 16, 21, 22 and 26 days after hatching. No significant correlation was found between swimming speed and prey density for 14-day-old larvae. But older larvae swam very slowly just after they were fully fed, and the fish became more active together with decreasing prey density. No decrease of swimming speed occurred at a prey density of more than five rotifers/m*l* for 14, 16, 21 days old larvae.

Consequently, the swimming activity of larval black porgy are related closely with prey conditions in the tank.

Suitable prey density is essential for survival of larval fish during rearing as well as in the wild. Shortage of food may cause high mortalities in a rearing tank and may cause a decrease of natural populations. On the other hand, larval fish also have some tactics for survival under unsuitable environmental conditions. Knowledge of the feeding behaviour of larvae is prerequisite for rearing and clarifying mortality in the wild.

Larval behaviour in relation to feeding was reviewed by HUNTER (1980, 1981). But little is known about feeding behaviour in relation to prey density during rearing. In this paper, I describe the feeding behaviour of larval *Acanthopagrus schlegeli* during rearing in the laboratory.

Materials and Methods

Larval Rearing

Eggs from cage-cultured fish were collected at the Hiroshima Prefectural Fisheries Experimental Station on June 15, 1981. Eggs were transported to the Nansei Regional Fisheries

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Research Laboratory and incubated at 19°C. Hatching occurred on June 17. Larvae were reared until August 16 (60 days).
Rearing methods were similar to those described by FUKUHARA (1977). The rectangular, plastic (FRP) rearing tank measured 250×95×70 cm depth.

Mean water temperature was 23.3°C, ranging from 19.4° to 25.7°C; mean salinity was 29.8‰, ranging from 27.5 to 31.4‰, and mean illumination was 1890 lux, ranging from 540 to 5000 lux at the surface of the rearing tank in the morning (8:30-9:00).

Observing and Estimating Swimming Behaviour

Observations on swimming behaviour were made 14, 16, 21, 22, and 26 days after hatching. Devices used for observing larval swimming were the same as used for studies of *Pagrus major* (FUKUHARA and KISHIDA 1980). Swimming paths were traced for ten larvae, chosen at random, before and after feeding. It took about 20 minutes to observe ten larvae. Swimming speeds were calculated from the swimming paths using a graphic tablet (Hewlett-Packard, 9111A).

Brachionus plicatilis and *Artemia salina* were used as food organisms. Prey density was determined from three counts of one-m*l* sample.

No experiments were carried out on larvae younger than 14 days or older than 26 days because of difficulty with varying the prey density adequately. Larvae younger than 14 days were not able to reduce the prey density sufficiently during the feeding period, while larvae older than 26 days (nearly at the transition stage from post-larvae to juveniles) did not feed well because the prey was too small.

Results and Discussion

Fig. 1 shows the growth of larvae reared in the experiment. Daily growth rate in this experiment was similar to that in 1977 (FUKUHARA 1977); 0.20 mm for the former and 0.21 mm for the latter. Therefore, larval growth shown in Fig. 1 was recognized as a usual development of porgy reared in the laboratory conditions.

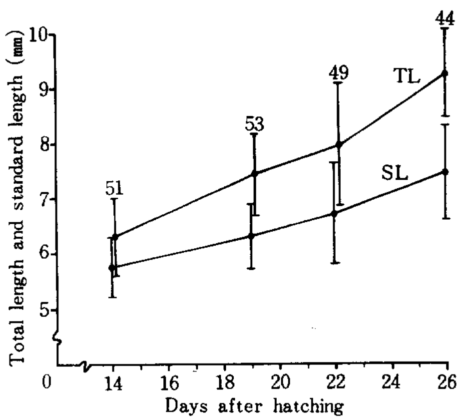

Fig. 1 *Acanthopagrus schlegeli*. Growth of larvae during rearing. Each measurement indicates averages, standard deviation and sample size.

Swimming speeds of larvae increased with decreasing prey density at each age (Fig.2). For 14-day-old in the relation was not as good as observed in the other groups. Swimming speeds ranged from 3 to 4 mm/sec. just after feeding, except for 14-day-old larvae, and then with a decrease of food density swimming speeds increased gradually to more than 10 mm/sec. which were observed before feeding. Variations in swimming speeds were less just after feeding than when prey density was low. It is assumed that larval fish overcome the shortage of food organisms by increasing searching area. FUKUHARA and KISHIDA (1980) observed the

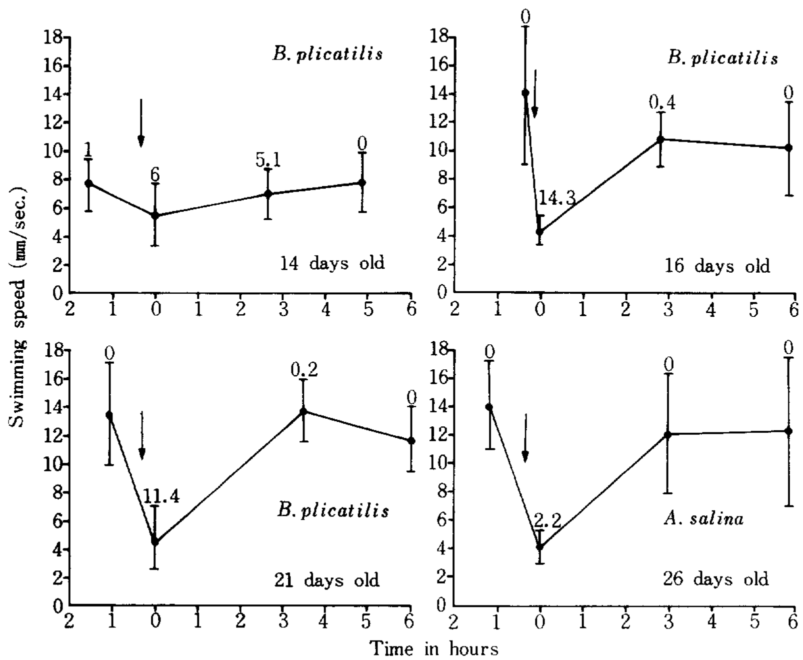

Fig. 2 *Acanthopagrus schelegeli*. Changes of swimming speed related with prey density. Arrows indicate feeding, and numbers at the times of measurement (mean ± SD) indicate prey density per m*l*.

swimming speed of red sea bream larvae at different food densities by using same device (pantagraph) described herein. According to their experiments, younger larvae showed no clear difference in swimming speed before and after feeding; however, older larvae did show such a difference. Consequently, it appears that the swimming speed of the larvae was affected by prey density and larval age.

Fig. 3 shows the relationship between swimming speed and food density. Swimming speeds greater than 10 mm/sec. were recorded, except for 14-day-old larvae, when no food organisms were present. A decrease of swimming speed was found with increasing prey density to the level of 5 rotifers /m*l*, and then no decrease was observed when prey density was greater than 5 individuals/m*l*.

Swimming speed of larval fish is important for searching for food organisms as well as for escaping from predators. At lower prey densities, larval plaice (WYATT 1972) and anchovy (HUNTER and THOMAS 1974) swam faster than that at higher ones. This tendency was more

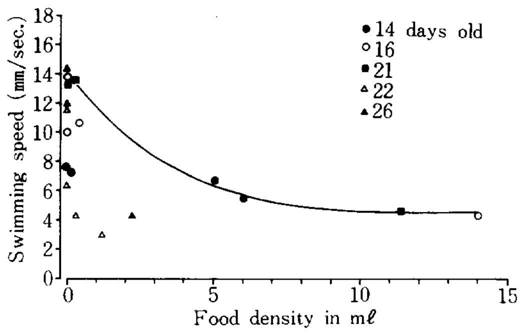

Fig. 3 *Acanthopagrus schlegeli*. Relatioship between swimming speed and prey density for larvae of various ages. Each plot shows the average of ten observations. *Brachionus plicatilis* was added from 14 to 21 days after hatching, and *Artemia salina* after 26 days. Curve was drawn freehand.

pronounced for older fish than for younger. It indicates that during rearing, younger larvae must be maintained with higher prey densities than that older ones.

In this study, no increase of swimming speed occurred at prey densities greater than 5 rotifers /m*l*. These findings suggest there is an optimum density for obtaining high survival of larvae.

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クロダイ仔魚の遊泳に及ぼす餌密度の影響

福　原　　　修

クロダイ仔魚の飼育条件下における摂餌行動と餌料密度との関係を明らかにするため，ふ化後14，16，21，22および26日の仔魚に生物餌料（シオミズツボワムシ，アルテミア幼生）を与え餌料密度と遊泳速度の変化を観察した。

ふ化後14日目の仔魚は，餌料密度と遊泳速度の間に顕著な相関はみられなかった。ふ化後14日目を除く仔魚においては，給餌前の遊泳速度は速く，摂食直後は最も遅くなった。そして仔魚の摂取による餌料の減少に伴って4㎜/sec. 前後であった速度は次第に増加し，給餌前の10～12 ㎜/sec. になった。また，14～21日目の仔魚にシオミズツボワムシを与えた場合，5個体/m*l* 以上の密度では速度の変化はみられなかった。

これらのことからクロダイ仔魚の遊泳速度と餌料密度は密接な関係を有し，餌料が不足した場合は遊泳速度の増加で索餌範囲を拡大していること，またある密度までは餌料の増加に伴い速度が遅くなると推察された。