Short Paper

Density Effect on Jumping Behavior and Swimming Upstream in the Ayu Juveniles*¹

It is well known that juveniles of the ayu *Plecoglossus altivelis*, a diadromous species of salmonid fish, exhibit strong anadromous characteristics during upstream migration from the sea in spring, and jump actively when confronted with waterfalls. OFFES¹⁾ reported that different stocks of the ayu, e.g. river stock (diadromous), lake stock (land-locked) and reared fish from various hatcheries, had different behavioral characteristics regarding jumping behavior and swimming upstream and suggested that these characteristics can be used for the preestimation of the movement of fish released in the river, which is considered to be one of the most important factors influencing recapture rate during the fishing season.²⁾ The object of this study is to examine the effect of population density on behavioral characteristics such as jumping behavior and swimming upstream in the juvenile ayu.

For the jumping test, 30, 100 and 300 fish of lake stock (SL; 70 ± 2 mm) were contained separately in three wire-net baskets (bottom, 30×50 ; height, 15; water depth, 10 cm). A waterfall (23 l/min) was supplied for each basket as a stimulus for jumping behavior. The number of jumpers per unit time (usually, 1 h) was counted for 16 h and they were then replaced in their respective baskets. Water temperature ranged from 21.6–23.7°C. The experiment was conducted indoors and light intensity varied from 0–600 lx. In the experiment examining upstream swimming behavior, 30, 90 and 270 reared fish (SL; 85 ± 9 mm) were placed separately in the lower ponds (2.4 m²; water depth 10 cm) of three sets of outdoor apparatuses. The number of fish that were stimulated to swim upstream to the upper ponds (1.2 m²) by the current (72 l/min) flowing through a slope trough (length, 100 cm; width, 20 cm) was counted every day for 6 days. Fish were put back into the respective lower ponds after counting. Water temperature ranged from 15.0–

Fig. 1. Density effect on jumping behavior and swimming upstream in the ayu.

18.5°C.

The percentage of jumpers apparently increased with increase in density in the basket as shown in Fig. 1. Similarly, the percentage of fish that swam upstream also increased with increase in density in the lower pond. Thus, a density effect was observed both on jumping behavior and swimming upstream. From these results, it may be considered as follows: when the population increases in a limited space, the distance between individuals becomes less. Then the repulsive tendency between fish increases since it is a function of distance. Assuming that the repulsion acts as a drive for jumping and swimming upstream, the reaction will be enhanced even for a fixed stimulus by the increase in drive. By adopting this viewpoint, it becomes considerably easier to understand the density effect described above.

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Katsumi TSUKAMOTO,*² Kazuo UCHIDA,*² Yasuyoshi MURAKAMI,*³ Minoru ENDO,*⁴ and Takeshi KAJIHARA*²

*²Ocean Research Institute, University of Tokyo, Nakano, Tokyo 164, Japan.

*³Hiroshima Pref. Fisheries Experimental Station, Freshwater Fish Branch, Shobara, Hiroshima 727, Japan.

*⁴Oita Pref. Freshwater Fisheries Experimental Station, Ajimu, Oita 872-05, Japan.

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*² 塚本勝巳・内田和男・梶原 武：東京大学海洋研究所，東京都中野区南台 1-15-1

*³ 村上恭祥：広島県水産試験場淡水魚支場，広島県庄原市川手町

*⁴ 猿渡 実：大分県内水面漁業試験場，大分県宇佐郡安心院町庄