Short Paper

Auditory Capability of the Lateral Line Canal
in the Masu SalmonTakahito Kojima,^{*1} Kazumasa Ikuta,^{**2}Akifumi Ito,^{*1} Kazumasa Yoza,^{*1}and Hideo Soeda^{*1}

(Received July 9, 1992)

In our previous paper,¹⁾ we obtained an auditory threshold for masu salmon *Oncorhynchus masou* which exhibited a W-shaped threshold curve; because of its less sensitive range of 300–500 Hz, then we assumed that masu salmon perceives sound at frequencies lower than 200 Hz through the lateral line canal from its known ability to sense relatively lower frequency sound. The present study was conducted in order to clarify the lateral line canal sensitivity range of masu salmon. We measured the auditory threshold for the fish in which the lateral line canals were transected, and compared this with that of intact fish.

Forty-five 2-year old masu salmon (21.7 ± 2.0 cm fork length, 148.1 ± 46.2 g body weight, mean $\pm$ S.D.) reared at the National Research Institute of Aquaculture, Nikko Branch, were used for the present study. For transection of the lateral line canals, fish were anesthetized with 0.004% MS-222 and an operation was performed according to Kawamura *et al.*^{2,3)} and Malyukina.⁴⁾ The gill cover was opened and the trunk lateral line nerve and mandibular canal nerve were cut near their entry into the skull using a small hook. The nerve of the supraorbital canal and infraorbital canal located inside the eye socket were also cut. After the operation, electrodes (a pair of vinyl-coated wires partially peeled to improve electrical conductivity) were inserted near the heart to record electrocardiograms. Experimental fish were set in a plastic net cage and immersed in the center of a glass watertank ($30 \times 35 \times 60$ cm). Two loudspeakers were set beside this tank for sound emission. After the fish had been rested in running water for 1 h or more, conditioning was performed by applying an electric shock (0.2 s, 5 V DC) following the signal sound (1 s, 140 dB, 0 dB re 1μ Pa). The stimulation for each individual was repeated 7 times at 5 min intervals. Frequencies of signal sounds used were 50, 70, 100, 200, 300, 500, 700, 1000, and 1500 Hz. Five fish were conditioned for each frequency. After conditioning, fish were rested for more than 12 h. Auditory responses to the sound stimuli were determined as positive when heartbeat intervals were significantly extended.

The mean auditory thresholds at each frequency for masu salmon with denervated lateral line canals are shown in comparison with those of intact fish¹⁾ in Fig. 1. Thresholds were not affected by background noise except at 50 Hz because differences between thresholds and noise spectra were longer than 20 dB. The mean thresholds of denervated fish at 100 and 200 Hz (105.0, 110.2 dB) were significantly higher ($p < 0.05$; Student's *t*-test) than intact fish (89.3,

Fig. 1. Auditory thresholds (0 dB re 1μ Pa) for each frequency in the masu salmon.

The solid line and broken line indicate lateral line canal denervated and intact fish, respectively. Vertical bars indicate the standard deviation.

81.2 dB), respectively. This result suggests that fish denervated at their lateral line canals are less sensitive to sounds of 100–200 Hz than intact fish.

Therefore, it was suggested that masu salmon hear sound in the range of 100–200 Hz mainly through the lateral line canal, and that ranges above 200 Hz are perceived by the inner ear. This study also demonstrated that the optimal frequencies for the lateral line canal and the inner ear in masu salmon were apparently 200 and 700 Hz, respectively.

We wish to express our gratitude to Dr. K. Fukushima, Dr. N. Okumoto, and the staff of the National Research Institute of Aquaculture, Nikko Branch, for their helpful suggestions and cooperation. Thanks are also due to Mr. M. Shibano, Mr. H. Shimada, and Mr. S. Yazaki for their assistance.

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