Short Paper

Changes in the Retinal Photosensitivity of Flounder *Paralichthys olivaceus* During Metamorphosis

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The flounder, *Paralichthys olivaceus* larvae shift their habitat from pelagic to benthic during metamorphosis. In their histological study, Kawamura and Ishida¹⁾ reported that the flounder larvae have only single cones in the early stages and rods and twin cones develop just before they change their habitat. Since rods and twin cones are more sensitive to light than single cones, such changes in the retina are considered to be a pre-adaptation of the eye to the change in photic environment.

In this study, the author electrophysiologically investigated whether or not a change in visual function occurs during metamorphosis, when morphological change occurs in the retina, by recording ERGs (Electroretinograms) from the eyes of the flounder larvae and juveniles at various developmental stages.

The flounder larvae and juveniles at stages C, D, E, F, G and I (classification according to Minami²⁾), 6–35 mm in total length used in this study were hatched from fertilized eggs naturally spawned in a tank. After anesthetization by MS222 (1/20,000), the fish was placed on the indifferent electrode (Ag-AgCl plate 15 mm × 20 mm) and kept anesthetized by perfusing the gills through the mouth with MS222 solution (1/40,000–1/20,000) at the rate of 0.5–4 ml/min throughout the experiment. A stainless steel insect pin insulated with lacquer except for the tip (ϕ 100 μ m) as the active electrode was placed on the cornea surface of the left (nonmigratory) eye. Electrical potentials were amplified by preamplifier (NIHON KOHDEN AB-621G) and recorded on an FM tape recorder (TEAC R-61). The system of photostimulation was the same as described previously.³⁾ The stimulus intensities were logarithmically diminished six steps by ND filters from 4800 lx and the stimulus durations were all 250 msec.

Typical ERGs from dark-adapted eyes of larvae and juveniles (stage D, F and I) are shown in Fig. 1. In the response to light, only b-waves (positive potential) was observed after a latency but a-waves did not appear. With increasing light intensity the latency became shorter and the amplitude of the b-waves increased. The threshold intensity of the b-waves became lower with growth. The threshold intensity of the juvenile after metamorphosis (stage I) was about 1/100 lower than that of the larvae at stage D and the amplitude of the b-waves at the same intensity increased 2.8–6.3 times larger. Applying Naka-Rushton's hyperbolic equation, $V/V_{\max} = I^n / (I^n + \sigma^n)$,⁴⁾ (where I : relative intensity to 4800 lx, V : amplitude of the b-waves, σ : the stimulus intensity which evokes the response of $V_{\max}/2$, n : constant which represents the slope of each curve), the values of both n and σ remarkably decreased at stage F, just before the settlement (Fig. 2). Decrease in the values of n and σ means that relative response to weak light increases. Actually, the values of n and σ of benthic or nocturnal

Fig. 1. ERGs recorded *in situ* from dark-adapted eyes of flounder larvae at stage D, F, and I (classification according to Minami²⁾). Stimulus durations are shown below the records. Relative intensities of stimulus light to 4800 lx in logarithm are shown on the left side. Vertical calibration: 200 μ v. Horizontal calibration: 250 ms.

Fig. 2. Changes of n (closed circle) and σ (open circle) values in the equation, $V/V_{\max} = I^n / (I^n + \sigma^n)$, with growth.

fish are smaller than those of pelagic or diurnal fish.³⁾ Therefore, present results indicate that the change in photosensitivity of the flounder larva suitable for the dimmer light environment occurs at stage F, just before the settlement. In addition, this stage coincides with the stage when the rod develops in the retina.¹⁾

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References

- 1) G. Kawamura and K. Ishida: *Nippon Suisan Gakkaishi*, **51**, 155–165 (1985).
- 2) T. Minami: *Nippon Suisan Gakkaishi*, **48**, 1581–1588 (1982).
- 3) S. Kitamura: *Bull. Natl. Res. Inst. Aquaculture*, **12**, 53–60 (1987).
- 4) R. A. Normann and F. S. Werblin: *J. Gen. Physiol.*, **63**, 37–61 (1974).

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