Short Paper

The Habit of Cutlassfish as Inferred from the Retina

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(Received July 7, 1987)

An animal's habit is well reflected in its eyes, and differences in number and size of various retinal structures in fishes, when considered along with various other features, are assumed to suggest certain functional differences.¹⁻⁶⁾

The rainbowfish *Halichoeres poecilopterus* which spends most of its time lying quietly in the sand with only the eyes exposed possesses an area in which the density of the retinal elements is increased at both the dorso-temporal and bottom parts of the retina, which is adapted to form vision during both horizontal locomotion and lying in the sand.⁴⁾ The piscivorous cutlassfish *Trichiurus lepturus* swim horizontally as many other fishes do, but is often found vertically suspended with head up in rocky shore waters as well as in aquaria. The retina of this fish is therefore expected to be adaptive to vision during vertical suspension as well as during horizontal locomotion.

To study vision in the cutlassfish, particularly for when it is suspended vertically, the retina was examined histologically following Kawamura and Tamura.⁴⁾ The eyes of an adult 91 cm in total length were fixed in Bouin's solution for two days and transferred into 70% ethanol. The retina was divided into 33 parts, and after routine dioxan-paraffin embedding, tangential and cross sections (6 μ m) were made, and the numbers of cones in 0.01 mm² of each part were counted.

As reported by Ali and Anctil⁷⁾ for the cutlassfish in the Atlantic, the retina is characterized by the presence of epithelial cells with pigmented short processes, and a thick visual cell layer composed of numerous slender rods and relatively large single cones but no twin cones.

From the present study, the highest cone density, 701 cones in 0.01 mm², was found slightly below the temporal retina. From the highest cone density and the lens diameter (5.7 mm), the minimum separable angle of the retina is calculated as 4.5 min of arc, which means a comparatively better visual acuity among marine fishes. The cone density topography shows an area lateralis slightly below the temporal part (Fig. 1A), which implies that the visual axis is nasalward but slightly upward (Fig. 1B). The nasalward visual axis is common in fishes which sight and attack prey passing in front of the snout, while the upper-fore visual axis is found among the Scombridae which do the same from below.⁸⁾ Thus, the eyes of the cutlassfish seem to be adapted for horizontal locomotion but not for vertical suspension.

Fig. 1. Cone density topography of the retina (A) and the visual axis (B) of the cutlassfish *Trichiurus lepturus*. Figures in the topography show the number of single cones in 0.01 mm²; arrow indicates the visual axis.

The result of the present histological examination of the retina leads one to question why the cutlassfish remains in suspension with head up. The vertical posture may be explained simply by the position of the gas bladder which provides neutral buoyancy. The gas bladder is located far ahead from the geometrical mid-point of the fish body, and the larger moment of force acting downward on the rear causes a pitch which may be balanced when the fish is suspended vertically with head up.

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