

Preliminary Anatomical Characterization of the Choroid Rete Mirable of the Mangrove Snapper, *Lutjanus griseus*

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The choroid rete mirable is a richly vascularized network of capillaries within the teleost eye, situated between the ophthalmic artery and the choriocapillaries [1]. The primary purpose of the choroid rete mirable is to provide blood circulation and oxygen transport throughout the eye. The teleost retina is typically avascular, and is reliant on the choriocapillaries for oxygen [2,3]. The afferent and efferent capillaries that comprise the choroid rete are arranged close to each other, in parallel fashion; this arrangement allows for efficient countercurrent exchange of gases and materials [1,3]. The choroid rete is also responsible for maintaining high oxygen pressure in the retina. This pressure is established and maintained through a Root effect, a process that leads to an increase in partial O₂ pressure (P_{O₂}) within the retina and the “off-loading” of oxygen into the retina [2,4].

Vascular corrosion casting technique was applied to a 20cm mangrove snapper (*Lutjanus griseus*), a nocturnal fish captured on reef patches off of the Nova Southeastern University Oceanographic Center in February 2010, according to standardized casting technique [5]. The specimen was euthanized with MS-222 (Tricane Methanesulfonate) and was treated with sodium heparin. Blood was flushed from the body using an isoosmotic saline through the ventral aorta via butterfly cannula, then infused with Mercor II[®] resin (Ladd Research Industries, Burlington, VT, USA) mixed with catalyst, at constant pressure until the onset of polymerization (approximately 15 minutes). The specimen was immersed in hot (60° C) water for approximately one hour to complete resin curing. Surrounding tissues and bone were removed by maceration in a 4.5M NaOH solution over several weeks. Casts of the retinal vasculature were isolated and cleaned by washing in distilled water, and air dried. Casts were photographed via light microscopy to obtain measurements of total size (FIG 1), then were mounted on aluminum stubs with silver paste and sputter coated with gold-palladium. A total of three stubs were assembled – one with a full choroid rete mirable, and two with rete halves, one interior-facing and the other exterior-facing. After allowing approximately one week for off-gassing, the stubs were subjected to scanning electron microscopy (ISI DS230, SEM Laboratory, Oceanographic Center, Nova Southeastern University) to examine, measure and photograph the arterial and venous patterns of the choroid rete mirable. A total of 56 images were captured of the three stubs produced.

For this particular specimen, the retinal vasculature of the mangrove snapper had a diameter of approximately 8mm (8000µm), and a cup depth of 7.5mm (7500µm) (FIG 2). The choroid rete mirable was approximately 4mm (4000µm) in length, between the branches of the ophthalmic artery and the choriocapillaries. The choriocapillary bed was approximately 2.8mm (2800µm) in length. The capillaries of the choroid rete had diameter of 15.91µm, while the choriocapillaries had a diameter of 227µm - 334µm. The choroid rete mirable had a complexity of approximately 22 capillaries per 0.0625mm² (62500µm²) (FIG 3).

Further examination of the choroid rete mirabile and associated vascular structures using vascular corrosion casting and SEM techniques are currently being conducted using a variety of reef fish species. These results, together with biochemical analysis of oxygen consumption in the retinal tissue, will be used to determine possible differences in eye vasculature structure and function between diurnal and nocturnal reef fish.

References

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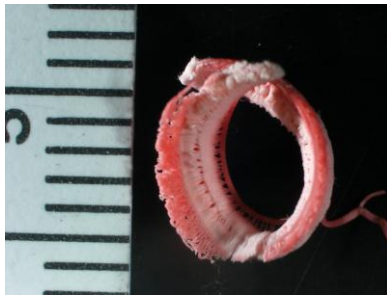


FIG 1. Corrosion cast of choroid rete mirabile of 20cm mangrove snapper (*Lutjanus griseus*).

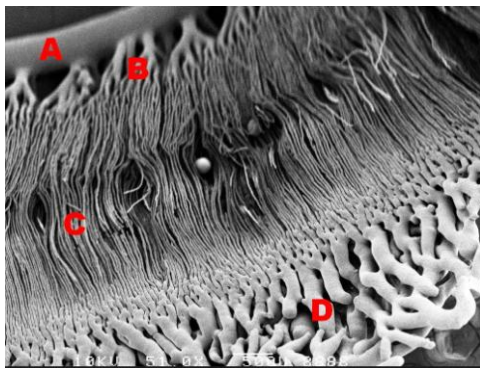


FIG 2. The retinal vasculature of a mangrove snapper (*Lutjanus griseus*) – a) ophthalmic artery, b) branches of ophthalmic artery, c) choroid rete mirabile, d) choriocapillaries.

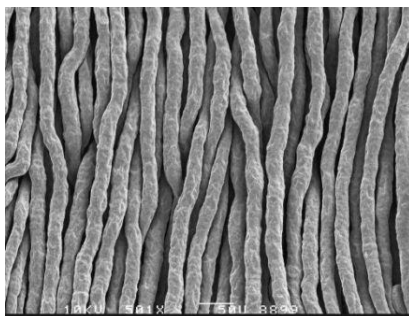


FIG 3. Afferent and efferent capillaries of the choroid rete mirabile.