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CHANGES IN THE VISUAL SYSTEM OF TELEOST FISHES DURING GROWTH AND SETTLEMENT: AN ECOLOGICAL PERSPECTIVE

Thesis submitted by

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for the degree of Doctor of Philosophy in

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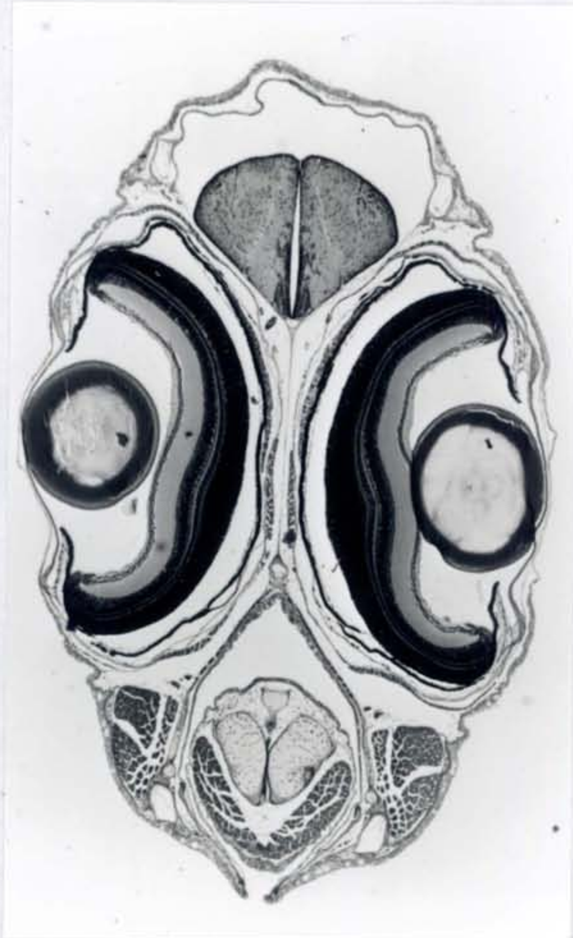

Transverse section through the head of a newly-settled fish, the labrid *Stethojulis strigiventer*, standard length 5.7 mm.

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ABSTRACT

Nearly all tropical teleost fishes have a pelagic larval phase. Species that settle to a demersal reef-associated mode of life experience dramatic changes in habitat and light environment at this time. In many cases, behaviour associated with feeding, predator avoidance and diel activity also changes. These changes are often rapid, overnight, events. The growth of the eye and extent to which the visual system of larval fishes alters during settlement was investigated in fish with ecologically differing adult lifestyles.

The ocular morphology of 18 species of tropical teleosts caught from a variety of locations across the northern Great Barrier Reef, Australia, was examined prior to and following settlement. Detailed retinal cell counts of 6 species with differing post-settlement lifestyles were carried out on fish covering a range of developmental stages. These were: the reef fish *Stethojulis strigiventer* (Family Labridae), a microcarnivore; *Pomacentrus moluccensis* and *Pomacentrus bankanensis* (Family Pomacentridae), a planktivore and herbivore respectively; *Apogon doederleini* (Family Apogonidae), a nocturnal planktivore; the inter-reef fish *Upeneus tragula* (Family Mullidae), a benthic carnivore; and the inshore planktivore *Ambassis vachelli* (Family Ambassidae). A microspectrophotometric investigation of the visual pigment compliment of *Upeneus tragula* was carried out over the settlement period. In addition microspectrophometric measurements obtained from the adults of four additional tropical teleosts are presented.

Fish that settled at small and intermediate sizes showed changes in retinal cell densities prior to settlement which appeared to be in anticipation of the post-settlement lifestyle. *Upeneus tragula*, a species that remained pelagic for an extended period was found to maintain adaptations for a pelagic lifestyle in both structural and visual pigment compliment. At settlement the retina of this species under went rapid changes in structure as a double layer of cones in the dorsal retina amalgamated to form a single layer. The loss of long-wavelength sensitivity also occurred at this time.

The theoretical ability of an eye to resolve fine detail improved rapidly as eye size increased. Mechanisms for increasing sensitivity in nocturnal species were found. These included an increase in rod densities and a lowering of Matthiessen's ratio. The ocular features found in the variety of fish examined were considered in relation to the light environment and behaviours of the fish at respective phases of their life history.

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I was first introduced to the world of animal vision by John Lythgoe and it was he who encouraged me to come to Australia and undertake this work. His influence has always been present. Sadly, I am prevented from expressing my gratitude. To his memory I humbly dedicate this thesis.

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DECLARATION

I declare that this thesis is my own work and has not been submitted in any form for another degree or diploma at any university or other institution of tertiary education. Information derived from the published or unpublished work of others has been acknowledged in the text and a list of references is given.

Julia Shand
27th March 1994