A multi-scale analysis of population dynamics and sexual size dimorphism in a widely distributed coral reef fish family (Acanthuridae)

Thesis submitted by

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STATEMENT OF ACCESS

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General Abstract

There is a large amount of evidence that the demography and associated life history features of coral reef fish vary across a range of spatial scales. Many Indo-Pacific species are particular in that their geographical distribution extends over ocean basins, and there is increasing evidence that a number of coral reef fish display highly asymptotic growth trajectories. This thesis uses an age-based approach to examine the mechanisms and patterns of variation in the demography and associated life history features over broad geographical scales and in the context of asymptotic growth, exploring the nature of the trade-offs in life history traits associated with variation in growth in coral reef fish. Over 1500 individuals of three Acanthurid species, *Ctenochaetus striatus*, *Acanthurus nigricans* and *Acanthurus leucosternon*, were collected at 14 locations across the Indo-Pacific region. Three critical demographic parameters were examined: mean adult body size, growth rate and longevity, and the relationship between size, age and sex was established using the re-parameterised equation of the Von Bertalanffy Growth Function.

We found a longitudinal trend in life span, with Indian Ocean populations being shorter lived than those of the Pacific region, suggesting the presence of differences in population dynamics and recruitment patterns between ocean basins. In contrast, there was no predictable pattern in growth, which varied primarily across locations indicating a substantial effect on growth of local habitat conditions. There was a clear sex-specific structure in growth within all populations sampled. The mechanism underlying the variation in size among and within populations was a mechanism of fast initial growth, which was consistent across species, geographical scales, and across the sexes. This result indicates that adult body size is determined by the rate of

growth during the early years of post-settlement life of all individuals, regardless of the nature of sexual ontogeny, suggesting the absence of a trade-off between reproductive and somatic growth in both males and females of the study species. The magnitude of the differences in size between the sexes increased in populations where large absolute adult size was favoured, suggesting an allometric relationship between sexual size dimorphism and the rate of growth of the larger sex. The direction of sex-specific size distributions of the study species varied with adult body size of males, providing evidence that female-biased sexual size dimorphism in acanthurid species is the result of selection for small body size in males.

This study illustrates the importance of early post-settlement life history in shaping the demography and life histories in coral reef fish with a highly asymptotic form of growth, and suggests that determinate growth is associated with: 1) a large potential for flexibility in growth, 2) constraints on the nature of the mechanisms underlying variation in size across geographical scales, and between the sexes, and 3) an evolutionary life history trade-off between juvenile survival and lifetime reproductive success overriding the costs of reproductive growth of females.

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STATEMENT ON SOURCES

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.