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Sex-specific growth dynamics in protogynous hermaphrodites

Thesis submitted by

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School of Marine and Tropical Biology

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Abstract

Sexual size dimorphism is a characteristic of many animal species but the ways in which size differences between males and females originate in sex changing species is little understood. The present study investigated growth mechanisms underlying sexual size dimorphism in protogynous hermaphrodites, using tropical wrasses as a focal study group. The aims were to: 1) identify a relationship between the strength of the social organization within a group and the timing of growth divergence between sex changing and non sex-changing individuals; and 2) to identify changes in behaviour and space use associated with sex change within a group. It was predicted that where individuals were under strict social control, sexual size dimorphism would come about by a growth spurt associated with sex change. It was also predicted that in more loosely controlled social groups, prior growth history would play a greater role in the development of sexual size dimorphism.

The strength of social systems for four species of wrasse (family: Labridae) was quantified by behavioural observations and compared to growth trajectories of sex-changing and non-sex-changing females. The wrasse species used in this study were: *Coris batuensis*, *Stethojulis strigiventer*, *Halichoeres miniatus*, and *Cirrhilabrus exquisitus*. Behavioural observations were made throughout a male removal experiment to observe changes in behaviour within a group during the process of sex change. Growth patterns were estimated through analysis of otolith microstructures using daily increment width as a proxy for daily somatic growth. Comparisons were made of social systems and growth patterns both across species and within a species to determine if social influences on growth were species specific or specific to the social system.

Check marks in the otoliths at the time of sex reversal were identified in three of the four species, with the mark occurring only in male fish. A check mark was experimentally validated in *H. miniatus* as occurring within the time period of sex change. When social groups were experimentally manipulated to induce sex change by removing the male, the dominant female changed sex, completing gonadal changes in less than 44 days. An increase in otolith accretion rate, or a growth spurt, was also found in sex-changing fish and this corresponded to an increase in somatic growth rate.

The strength of the social systems of the study populations was found to influence the growth patterns of component individuals. Both across species and within species, size differences between males and females were found to be due to growth spurts around the time of sex change in social groups with strict social control. In contrast, prior growth history was found to be more important in the expression of sexual size dimorphism in groups with looser social organisation. In three of the species an initially larger increment size was found in the females that changed to male suggesting a larger otolith size at hatching in females that eventually change sex. Growth spurts were found to be important for the size dimorphism in three out of four species. Results suggest that the social system may play a major role in influencing the growth associated mechanism underlying the sexual size dimorphism in sex changing fishes, and that at times, pre-larval factors may be influencing which individuals end up becoming the dominant males in the system.