The influence of pelagic life history on the quality of tropical goatfish (family Mullidae) at settlement

by
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A thesis submitted for the degree of Doctor of Philosophy in the Department of Marine Biology at James Cook University of North Queensland, in December 1992

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ABSTRACT

High variability in the replenishment of coral reef fish populations by pelagic larvae has been extensively documented. Little is known of the mechanisms underlying this variability or the processes within the plankton that determine the growth and developmental rates of larval fish. Ultimately, these processes will not only influence numerical abundance but also the quality of the recruiting larvae. A common assumption is that fish settle to a reef with similar probabilities of survival and success. The physical condition (e.g. size, biochemical composition and muscle development) of the settling reef fish, and how that interacts with their performance (e.g swimming speed), may influence which individuals survive to join the reproductive population. This study examines how processes within the pelagic life stage influence the quality of newly settling reef fish and explores the ramifications of variable quality to the dynamics of reef fish populations.

The ecology of the pelagic life-stages of goatfish (family Mullidae) was investigated from samples collected in the Lizard Island section of the northern Great Barrier Reef (GBR) (1986 - 1991). A plankton-mesh purse seine was used to collect pelagic stage fish from around small aggregation rafts (1 x 1m). Patterns of distribution around the Lizard Island fringing reef and across the GBR lagoon were examined. Five species were caught, the most abundant being *Upeneus tragula* and *U. moluccensis*. Pelagic stage mullids were found to form large schools (1000+ individuals) that comprised of a number of species (as many as 5), each with a broad size distribution. The largest individuals of each species caught were usually competent to settle.

A distinct metamorphosis accompanied settlement to the reef. Fish changed pigmentation from their silvery pelagic colouration to a mottled cream. Over the same 6 - 12 h period, major restructuring occurred to the barbel sensory system. These are outgrowths of the gustatory system, consisting of batteries of tastebud cells, and are important for the detection and capture of prey items after settlement. Barbel length abruptly increased (up to 52 %) as did mean taste-bud size (up to 100%). Barbels were found to vary markedly in their state of development at settlement.

Age, size and body mass at settlement were examined for goatfish, *Upeneus tragula*, among five stations across the GBR lagoon, over time periods ranging from days to three years. Larval durations and fish length showed equally high levels of variability (ranges: 25 - 37d, 19 - 31 mm standard length respectively). Significant differences in age, length and weight at settlement were found at all spatial and temporal scales. Growth rates averaged over the whole larval period ranged from 0.55 - 1.0 mm/d. Similarly high levels of variability were found in the biochemical composition of newly settled *U. tragula* over ten samples collected over two summers (1990/91, 1991/92). Relationships of nine commonly used measures of fish condition with fish length were very poor. Maximum non-sustainable

swimming speed and biochemical composition were particularly poorly correlated with fish size ($r \leq 0.2$).

Two experiments examined the extent to which food availability and water temperature during the late larval stages influenced the high levels of variability in age and body characteristics of *U. tragula* at settlement. Feeding history influenced size, age, muscle development and body composition of fish at settlement. Water temperature (25 - 30 °C range) significantly influenced only age at settlement. These experiments suggested that the processes of growth and differentiation for late pelagic stage fish dissociated from one another under certain environmental conditions. Over a natural range, water temperature did not dissociate growth and developmental rates. Food availability strongly influenced the relationship between these processes and ultimately governed the age and condition of the fish at metamorphosis. Differences in the temperature regime and feeding history within the pelagic life-stage accounted for much of the variability in growth characteristics among samples.

Two preliminary experiments examined whether the size or body condition at which a fish settled biased the probability of it surviving the initially high predation pressure. Results suggest that predation by the lizardfish, *Synodus variegatus*, was random with respect to both size and biochemical composition of the newly settled goatfish, *U. tragula*. This suggests that the influence of the pelagic life history will extend well into the post-settlement stages and may ultimately influence which individuals join the reproductive population.

Acknowledgements

Many people contributed in a myriad of ways to making the last four years exciting, interesting and extremely enjoyable. Inevitably I will have forgotten someone, or, almost as bad, spelt someone's name wrong! To those I have forgotten, it wasn't on purpose, many thanks.

I am indebted to my supervisor Howard Choat for his ecological insight and enthusiasm for the project. His initial observations of goatfishes around a night light at Lizard Island spawned this project. His belief in my ability to "produce the goods" and his support in grant applications have allowed me the freedom to explore a diversity of ideas, some hair-brained. This thesis is composed of some of the ones that worked. His contribution has been more than conceptual, but rather has greatly influenced the way I approach ecology. I thank him for thoroughly reading the most important part of this thesis. Maria Milicich, Will Oxley, Julian Caley, Jenny McIlwain, Natalie Moltschaniwskyj and Emma Hutchinson spent many hours proof reading this thesis, and made useful suggestions on how to improve it. For that I am extremely grateful.

Brett Molony added an extra dimension to the project with his biochemical wizardry, appalling singing and good jokes. This project has benefited greatly from discussions with and comments from Brett, Maria Milicich, Brigid Kerrigan, Geoff Jones, Simon Thorrold and Julia Shand. Many people gave not only their muscles and enthusiasm to this project, but also aided in its conceptual development. Many thanks to all for helping me discover the weather limitations of purse-seining. Thanks to: Brigid Kerrigan, Lynda Axe, Brett Molony, Jenny McIlwain, Vicki Hall, Evi Seymour, Stephanie Seddon, Karen Tricklebank, Astrid Hülsmann, Steve Comport, Mark Meekan (for saving me from Chris Paparakas) and Anne Wakefield.

With any project there are administrative nightmares and day to day labours. Thanks to all for imparting their special sorts of expertise to the project, in particular: Leigh & Heather Winsor, Zolly Florian, Anne Sharp, Sweet-Sue Kelly, Jan Woodley and Savita Francis. This research was funded by the Australian Museum, through a Lizard Island Doctoral Research Fellowship, by two Australian Research Council minor research grants and a Merit Research Grant. Many thanks to Marianne and Lance Pearce, Lyle Vail and Anne Hoggett for their friendship and making Lizard Island such an enjoyable place to work.

Many people have maintained my sanity by their friendship and companionship; for that I am grateful. Special thanks to: Maria, Simon, Jenny, Natalie, Beatrice, Dorothee, Lexa, Mark, Kendall, Marianne, Lance, Uschi, Geoff, Lou, Hannah, Brady, Glen, Julia, Campbell, Barbara , Keith, Vicki, Julia, Phil and many more.

Finally, my heartfelt thanks to the people who have supported me both emotionally and financially over the course of this project. My mother, has been a stabilising and positive influence throughout my rather lengthy tertiary career. Lastly and most importantly, I wish to thank for her continual love and encouragement, her sense of humour, stimulating discussion and her ability to put life into perspective. This work is dedicated to her.

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