Mutz, Stephanie J. (2006) ***Comparative growth dynamics of Acanthurid fishes.***
Masters (Research) thesis, James Cook University.

COMPARATIVE GROWTH DYNAMICS OF ACANTHURID FISHES

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in March 2006

for the degree of Masters of Science in Marine Biology
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Abstract

Considerable variation exists in the demographic characteristics of coral reef fishes. Growth trajectories of size, growth and longevity of four species of the wide-spread coral reef family, Acanthuridae, were investigated. Growth data were obtained from growth increments in sagittal otoliths. Three species of these were studied in the tropical Atlantic, and one in the tropical South Pacific. The focus of the study is the variability of the demographic parameters at both large and small spatial scales. Large scales studies were conducted along both latitudinal and longitudinal gradients. Latitude has a direct influence on sea temperature, and this affects the growth and demography of teleosts. Longitudinal effects are not as well studied, and comparing the demographic characteristics of teleosts along a longitudinal gradient is the first of this type of study. Longitudinal comparisons of longevity and growth allow us to analyse the variability of life history characteristics of organisms at different localities across an ocean without having to consider the effects of sea temperature. In order to completely understand the mechanisms behind large scale variability in demography, a small regional scale study can aid in pinpointing possible factors that can discern these differences within a small region. A local scale study was conducted at Bermuda with study habitats 10's of kilometres apart.

Analysis of size at age data revealed that these acanthurids exhibit fast initial growth, until age 4, after which is substantially reduced generating a characteristic “square” growth curve. This indicates evidence that size and age of some reef fishes may be decoupled. All species at every study site follow similar growth patterns within the first four years of life. Acanthurids, including the species in this study, generally reach maximum size within the first 10% of their life span, irrespective of their maximum size and longevity. Nevertheless it must be noted that as most populations reach asymptotic size, there are exceptions for three species (*A. coeruleus, A. chirurgus* and *A. lineatus*) at two locations (Isla de Margarita and Marquesas). In these populations growth was reduced at older ages, but did not reach asymptote. Upwelling events and nutrient blooms may be responsible for these non-asymptotic growth trajectories, providing sufficient resources to allow growth to occur more prominently.

The species in this study exhibit a wide range of sizes, although maximum sizes and longevities were not correlated. This study found that populations of the longest lived acanthurids do not necessarily reach the largest body sizes contradicting previous age and body size correlation studies of acanthurids, and indeed ectotherms in general.

In the tropical Atlantic Ocean, the demography of *Acanthurus bahianus, A. coeruleus* and *A. chirurgus* was assessed at 12 locations on a large (56^o) latitudinal scale. Mean sea temperature (MST) negatively correlated with longevity, absolute body size, and instantaneous growth (size-at-age at ages 1, 2.5 and 4) over a large latitudinal gradient. Decreasing growth with increasing temperature is a trend which is opposite to many previous demographic studies of ectotherms, and more specifically, teleosts. Populations of all Atlantic species in this study from cooler (i.e. lower MST) environments are longest lived, but not necessarily largest in size (i.e. Bermuda), while populations of all species in warmer waters consistently exhibited small size and short lifespan (i.e. Belize), indicating MST may not be the only factor driving these growth patterns. Mass island effects can also influence growth, as populations from the isolated oceanic islands have the longest lifespans and larger body sizes.

To assess the potential influences of other environmental and fishing impacts, a study was conducted along a longitudinal scale at constant sea temperature. The demography of *A. lineatus* was estimated at five localities spanning 75^o longitude across the South Pacific Ocean. The variation in body size and instantaneous growth among sites was equivocal. A negative relationship was found between longevity and longitude from the west to east end of the Pacific Ocean, however within Oceania, the difference was not so great. This is in accordance with previous studies demonstrating exceptionally long life spans of coral reef fishes on the Great Barrier Reef.

Comparisons of the demographic patterns of *A. coeruleus* and *A. chirurgus* between the lagoonal and outer reefs of Bermuda allowed me to assess any variability in the life history characteristics on a small regional scale. Juveniles of *A. chirurgus* settled onto the lagoonal reefs and migrated to the outer reef as adults, while both juveniles and adults of *A. coeruleus* inhabited the outer reef. These differences in spatial distribution on a local scale may give us a better indication of the environmental effects on the general demographic patterns found at larger spatial scales.

Acknowledgments

Most importantly I would like to give a very special acknowledgment to my supervisor Professor J. Howard Choat who has extended to me his knowledge, insights and support more than I could ever imagine. I would also like to thank Dr. Craig Syms for his encouragement and assistance with statistical analysis. Furthermore, to Will Robbins, whose help in every aspect was imperative to completing this study; especially with the required fieldtrips. Much gratitude goes to Michael Berumen for his sound advice and assistance in the field. Thanks to Dr. Ross Robertson for organising the collections of samples, and giving pertinent insight into the extent of the environmental and temporal mechanisms occurring in the Atlantic region.

I would like to thank the incredible staff of the Richard. B. Gump South Pacific Research Station in Moorea, French Polynesia; in particularly Dr. Neil Davies, Tony, Jacques and Irma You Sing, Val Brotherson and Frank Murphy who made the fieldwork all the more efficient and successful. I further thank the Gump Station for financial support.

Last but certainly far from least I am grateful for my friends and colleagues for their extensive discussions and undeniable encouragement and understanding along the way: Michael Berumen, Thea Brolünd, Andy Brooks, Karin Büchler, Rob Burriston, Martial Depczynski, Maria Dornelas, Monica Gagliano, Lindsay Harrington, Matt Kay, Liz Laman Trip, Jen Lape, Jenny MacGregor, Katy Miller, Phil Munday, Kamal Ranatunga, Will Robbins, Ben Ruttenberg, Barbara Walker and Stefan Walker. Most importantly I would like to thank my parents; for what luck to be born out of love and to live in an atmosphere full of warmth and interest.

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