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**Population biology, dynamics and their
implications for management of red bass:
a large, long-lived reef fish.**

Thesis submitted by

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in March 2005

**for the degree of Doctor of Philosophy
in Marine Biology
within the School of Marine Biology and Aquaculture
James Cook University**

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Abstract

The red bass, *Lutjanus bohar* (Forsskal 1775), is a large tropical reef fish that has a widespread circum-tropical distribution (Allen 1985). Preliminary research (Marriott 2002) done prior to this thesis identified that this species was potentially long-lived and slow-growing. Knowing this, the harvest of *L. bohar* by commercial fisheries is a cause for concern because populations of long-lived, slow growing species are typically more vulnerable to overfishing (e.g. Adams 1980; Musick 1999). This issue was investigated by addressing the following research objectives: (i) to investigate aspects of the population biology of *L. bohar*; (ii) to explore potential impacts of fishing on growth, size, and age structure of an exploited *L. bohar* population; and (iii) to explore the vulnerability of *L. bohar* populations to overfishing using an age-structured model and simulations.

Detailed studies of the population biology of *L. bohar* on the Great Barrier Reef provided support for the accuracy of initial estimates of age, and statistically justified a method of accepting estimates of age from repeated readings of otolith sections. The initial indication of relatively slow growth for this species was supported and the fit of the von Bertalanffy growth function (fork length-at-age) to samples from Lizard Island Region was: $L_t = 649.8 (1 - \exp \{-0.093[t+2.500]\})$, with no detectable difference in growth between sexes. Sexual maturity was found to be reached relatively late in life, compared to other reef fish, with the length at 50% maturity (L_{50}) for females observed at 428.96 mm and the age at 50% maturity (a_{50}) at 9.39 years. The L_{50} and a_{50} for males could not be resolved but were indicated to be at a much smaller size and younger age than those observed for females. Oocyte development was asynchronous and ripe

females were sampled in 8 months of the year, indicating that *L. bohar* spawned multiple times over a protracted period during each year, over a long reproductive life. Estimates of batch fecundity were also relatively high, ranging from 1.02×10^3 to 3.13×10^6 eggs, and an exponential relationship with fish weight was indicated. All of these characteristics are consistent with a theoretical *K*-selected life history strategy, and one which is typically vulnerable to overfishing.

Comparisons of size and age structures sampled from regions of different historical fishing pressure in the Seychelles, where *L. bohar* is a major component of the fishery, indicated a top-down size-selective fishing impact in the historically harvested region. Interestingly, a larger length-at-age for older age groups was also observed for this region, which was atypical of a fishing impact. Predictions made using an age-structured stock assessment model and data of its historical harvest indicated that these differences in growth were not likely due to historical differences in fishing but to other region-specific factors. The age-structured modelling also facilitated the exploration of the fished population's vulnerability to overfishing and identified the potential importance of an inferred reduced availability to harvest of older age groups to its persistence, at least in the short term.

Results from this thesis have important implications for fisheries management. My results are applicable to managing the harvest of *L. bohar* in the Seychelles and the by-catch of *L. bohar* on the Great Barrier Reef where it has recently become a “no take” species. Issues identified for *L. bohar* could also be transferred to the harvest of other exploited species with similar life history characteristics, such as the red emperor (*Lutjanus sebae*) and mangrove jack (*L. argentimaculatus*), which are targeted by

commercial and recreational line fishers on the Great Barrier Reef. This thesis also builds on developing theory concerning the impacts of fishing on species with different life history characteristics because *L. bohar* is an exploited species that is at one end of a theoretical continuum of life history strategies.

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STATEMENT ON SOURCES

DECLARATION

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