Age specific patterns of growth and reproduction in tropical herbivorous fishes

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ABSTRACT

Research of growth and reproduction was undertaken for scarids and acanthurids in coral reefs around Lizard Island, the Northern Great Barrier Reef, Australia. The study species were mainly the scarids *Scarus rivulatus* and *Scarus schlegeli*, and the acanthurids *Ctenochaetus binotatus* and *Ctenochaetus striatus*. The study focussed on the establishment of validated aging information for both scarids and acanthurids, and the age-specific patterns of reproduction of scarids.

Age and growth parameters were determined by enumerating growth increments within otolith microstructure for each species. Various mounting and grinding/polishing techniques were employed to reveal both fine lapillus growth rings in juveniles and sagitta growth bands in adults. Daily periodicity in otolith increments was demonstrated in 55 juvenile individuals in four of the main study species: *S.rivulatus* (20), *S.schlegeli* (21), *C.binotatus* (12) and *C.striatus* (2), and 28 individuals of other species within the two families. Ring periodicity was determined by staining the otoliths *in situ* with tetracycline, and maintaining the individuals in captivity to compare the rings laid down with the number of elapsed days. Double staining techniques were also employed to determine the rings laid down between stainings.

Annual periodicity in otolith bands was demonstrated by tag-recapture experiments in the both the aquarium and the field, and by otolith marginal increment analyses for the four study species. All recaptured specimens, including four *S.schlegeli* and four *C.striatus*, showed annual otolith bands. The otolith marginal development on regular samples over the year for *S.rivulatus* and *S.schlegeli* also

indicated that a single otolith band was formed during December to May.

By enumerating otolith increments and bands, age of the field captured individuals of each study species was estimated. The age of scarids ranged up to 8 years with the majority being younger than 5 years. The growth rate was increasing with age in days during the juvenile phase, and gradually decreased after that. The acanthurids lived for relatively long period in excess of 16 years, and the growth rate decreased with age after settlement. In addition, the age of settlement was estimated to be from 28 to 47 days for scarids and from 47 to 74 days for acanthurids.

Reproductive biology of scarids was studied by seasonal examination of gonads. The gonads were examined histologically to determine the sexual identity and maturity state of individuals. By using validated aging information, the dynamics of sexual transition was observed.

Mature gonads of the two species were found throughout the year. However, a pronounced spawning peak occurred between May and September in *S.schlegeli* while a relatively less pronounced spawning peak took place from September to January in *S.rivulatus*. These patterns were indicated by seasonal development of gonadosomatic index, seasonal distribution of mature gonads, oocyte length, and the proportion of mature stage oocytes within the gonads. The proportion of mature stage oocytes within mature ovaries of two species also suggested that these species were serial spawners. Enumerating mature oocytes within the subsamples of 20 individuals in each species showed positive relationships between fecundity and body length or age.

Both females and primary males of the two species reached sexual maturity at 2 years. Females started to change sex at 3 years, and the sexual transition of the population lasted for approximately another 3 years. Similarly, the primary males started changing color phase at 3 years. Growth rates appeared to be different between the initial phase and the terminal phase individuals, and the terminal phase individuals had a higher growth rate than that of the initial phase individuals of the same age.

The proportional liver weight in *S.rivulatus* and *S.schlegeli* changed over time, and this reflected the compositional states. Larger livers had high levels of lipids, which fact was indicated by the colour and lipid droplets. High proportional liver weight occurred immediately before spawning for both species, suggesting that the liver is an important energy storage organ providing lipids for the gonadal development. For the two species of scarids studied in similar microhabitats and similar physical environments both showed seasonal patterns of liver weight and gonadal development, but it varied in timing and magnitude.

This study suggests that scarids, which have relatively fast growth rates and short lifespans, are more suitable candidates for intensive fisheries than the low-growth and long-lifespan acanthurids. However, as the population dynamics of scarids is complicated by the protogynous hermaphroditism, comprehensive management is required in scarid fisheries.

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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.

D.C. Lou
30 June 1992

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