Biology, ecology and trophic interactions of elasmobranchs and other fishes in riverine waters of Northern Australia

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This thesis is presented for the Doctor of Philosophy

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DECLARATION

I declare that this thesis is my own account of my research and contains as its main content work which has not previously been submitted for a degree at any tertiary education institution

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Abstract

In light of the extirpation of a number of elasmobranch species commonly encountered in fresh and estuarine waters elsewhere in the world, 39 river systems were sampled throughout northern Australia to determine the species present. A total of 502 elasmobranchs representing 36 species, in addition to 1531 teleosts representing 46 species, were captured. In regard to elasmobranch species known to frequent riverine habitats, the bull shark *Carcharhinus leucas* was captured in the highest number, followed by the freshwater sawfish *Pristis microdon*, the freshwater whipray *Himantura chaophraya* and the dwarf sawfish *Pristis clavata*. Although these species were generally captured in low numbers, all were widely distributed throughout the region. Furthermore, the waters of King Sound, Western Australia, and the rivers entering it, i.e. the Fitzroy, May and Robinson rivers, were found to contain far higher numbers of *P. microdon* and *P. clavata* than any of the other rivers sampled, as well as the northern river shark *Glyphis* sp. C, and which subsequently provided an ideal locality to study the biology of these species.

The Fitzroy River was shown to act as a nursery for *P. microdon* and *P. clavata*, where immature individuals remain for a maximum of four or five years before migrating to marine waters. Investigations of the rostra and rostral tooth morphology of *P. microdon* indicated their usefulness as a diagnostic tool in differentiating this species from other members of the genus, including *P. clavata*, and for differentiating between the sexes, i.e. female *P. microdon* generally possess 17-21 teeth cf. 19-23 teeth in males. However, no significant difference in the number of rostral teeth was found between female and male *P. clavata*, with both sexes possessing an average of 42. Furthermore, the facts that *P. clavata* was captured up to 2332 mm in total length and all of the individuals were immature, indicates that the description of this species as a ‘dwarf’ sawfish is erroneous.

The use of rivers of northern Australia as nurseries was also apparent for *C. leucas*, with none of the 111 individuals dissected (ranging in length from 681 to 1365 mm TL) being mature. Furthermore, this species appeared to remain within the rivers for approximately four years. Stomach content analysis and field observations confirmed
an opportunistic, and often aggressive, feeding nature, and thus the species may pose some risk to bathers utilising inland waters far upstream (i.e. over 300 km).

Morphometrics and radiographs of 10 *Glyphis* sp. C captured from the macrotidal waters of King Sound (the first capture of this species in Western Australia) indicated that these specimens possessed both a wider range in total vertebral count (i.e. 140-151 cf. 147-148) and number of diplospondylous caudal centra (i.e. 64-70 cf. 65-68) than that previously reported and lent support for its synonymisation with *Glyphis gangeticus*. Radiographs also revealed the spinal deformation and fusing of vertebrae in three of the ten individuals, which may be attributable to a genetic abnormality indicative of inbreeding within a small gene pool.

Analyses of stomach content and stable carbon (δ\textsuperscript{13}C) and nitrogen (δ\textsuperscript{15}N) isotope ratios of fishes occurring in the Fitzroy River indicated that the diets of a majority of the species present are broad, and greatly influenced by the seasonal availability of different prey types. While stomach content analysis suggested that aquatic insects, and to a lesser extent filamentous algae, represent vitally important food sources for many of the species present, stable isotope analysis strongly suggested that this latter food source may not be an important direct energy source, and that prey types which persist throughout the year (e.g. fish, molluscs and *Macrobrachium rosenbergii*) may in fact be more important sources of the energy than dietary data revealed. Dietary overlap was found to be the highest during the wet season when prey availability was high, decreased in the early dry season as fishes became more specialised in their feeding, before increasing again in the late wet when food became very limited. These analyses also supported the views that juvenile fishes may target high energy food items to attain higher growth rates and a large size rapidly, in order to achieve competitive feeding advantages and reduce the risk of predation, and that many species will maximise their energy intake in response to changes in resource availability.
Acknowledgements

The opportunity to study fascinating species and explore some of the most remote rivers of northern Australia was a true privilege. Before departing on the initial survey I was convinced that six months in the bush chasing sharks and rays would satisfy all my boyhood dreams of adventure and exploration, but in reality all it has done is made me dream for more.

This research was only achieved through the support of a great number of people. Particular thanks must go to Andrew Rowland, Dr Howard Gill and Dr David Morgan for their help in every facet of this thesis, during field trips, for their expertise as scientists, their passion for fish biology and ecology and their good humour as mates. Thank you also to other members of the Centre for Fish and Fisheries Research and Murdoch University, including Dr Steve Beatty, Dr William White, Michael Taylor and Matthew Pember, and to Dr Eric Paling for his supervision, guidance and support. Thanks also to Drs Peter Last and John Stevens for presenting the opportunity to conduct the initial surveys, and Stirling Peverell for his coordination of the Queensland survey team. The support of staff at the Museum and Art Galleries of the Northern Territory, in particular Dr Helen Larson, Dr Barry Russell and Steven Gregg, was also crucial to the success of sampling in the Northern Territory.

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