NICHE DIFFERENTIATION, RARITY, AND COMMONNESS IN THE SYMPATRIC AUSTRALIAN WHITE-TAILED RATS: *UROMYS CAUDIMACULATUS* AND *UROMYS HADROURUS*

Thesis submitted by

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March 2010

Thesis submitted
for the Degree of Doctor of Philosophy
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ABSTRACT

A major problem in characterising rarity traits is that rare species are less studied than common species. Consequently, little is known about their distribution, ecology, demography, or behaviour, and their categorisation as rare may simply be a result of scarcity of data. In particular, there is a lack of comparative studies of closely-related rare and common species, an issue addressed by this thesis. My research investigated niche differentiation, rarity, and commonness in two sympatric species of rainforest rodents in the genus *Uromys*, one of which is common while the other is extremely rare, and endeavoured to provide insights into why this is so. This is an increasingly important question as continuing habitat destruction, fragmentation, and over-exploitation threaten the existence of many rare species and significantly decrease populations of what were once common species. The primary aim of the thesis is to clarify the ecological characteristics that make a species more prone to rareness and thus vulnerable to extinction. Prior to this study little was known of the ecology of the rare Pygmy White-tailed Rat *Uromys hadrourus* and, surprisingly, only basic distribution and population data was available for its sister species the common Giant White-tailed Rat *Uromys caudimaculatus*. To obtain the data necessary to facilitate an ecological comparison of the two species, a capture-mark-recapture program was conducted. Using the results from this study, niche differentiation analyses were used to compare the ecological and behavioural traits of the two *Uromys* species. The characteristics recognised in the literature as potentially predisposing a species to rarity were examined in light of the niche analyses.

Niche differentiation

There is significant niche differentiation between *Uromys caudimaculatus* and *U. hadrourus* but the two species do not appear to occupy completely independent ecological niches. There is overlap in diet with *U. hadrourus* exploiting some of the softer large-fruited seeds also utilised by *U. caudimaculatus*. However, the larger size and strong jaws of *U. caudimaculatus* enable the species to exploit hard-seeded rainforest fruits inaccessible to other rainforest rodents, including *U. hadrourus*. Both species feed on insects by tearing open decomposing logs and stumps; they also chew the bark of tree buttresses to feed on the sap weeping from the fresh edges of the scars. However, a significant part of the diet of *U. hadrourus* was obtained from aerial tree roots, a dietary resource not utilised by *U. caudimaculatus*. Aerial roots primarily occurred on the lower trunks of trees located on the densely vegetated lower slopes,

along streams and gullies, and in the wetter areas of the forest. The ability to climb is a significant niche difference between the two *Uromys* species. The scansorial ability of *U. caudimaculatus* allows it to access resources in the tree canopy (food and refuges/nesting sites) that are unavailable to the terrestrial *U. hadrourus.* However, the structure of the hind foot indicates that *U. hadrourus* was almost certainly scansorial at some stage of its evolution.

Differences in body size are also significant. *Uromys caudimaculatus* is one of the largest species in the genus with a mean body weight three times that of *U. hadrourus*, the smallest representative of the genus. The larger body size of *U. caudimaculatus* brings with it a number of ecological advantages; fewer predators and competitors and the ability to easily break into hard seeds inaccessible to other small mammals. The smaller size of *U. hadrourus* makes it more vulnerable to predation than the larger *U. caudimaculatus.* Further niche differentiation was evident in the habitat utilised by *U. caudimaculatus,* which did most of its foraging in the abundant open-understorey forest. In contrast, *U. hadrourus* was only recorded in the spatially rare and densely-vegetated forest occurring on the lower slopes, along gullies, and 1st and 2nd order streams.

Differences in behaviour may also play a part in niche differentiation with indications that *U. hadrourus* is more sedentary than *U. caudimaculatus* and that the breeding season of *U. caudimaculatus* may be longer with juveniles dispersing away from the natal area more quickly than juvenile *U. hadrourus*.

Rarity Characteristics

Of the nine ecological variables examined, three were identified as characterising natural rarity in the small mammal assemblage. These comprised habitat specificity, low dispersal ability, and specialism. While it is difficult to determine whether any one of these three characteristics is a precursor of, or makes a greater contribution to species' rarity, it is more probable that natural rarity depends on a 'flexible' amalgam of the three traits. Although possibly an important *cause* of rarity in some species, it is equally plausible that specialism may evolve as a *consequence* of rarity. It is also likely that abundance and habitat specificity are strongly regulated by energy (resource) requirements and availability, varying with individual species' ecology and life-history traits. Dispersal ability is fundamentally interrelated with both habitat specificity and specialism and there are indications that it plays an important role in the maintenance of rarity in this north Queensland assemblage of rainforest small mammals. There

were significantly negative associations between three sets of variables: (1) *Abundance - Body Size*; (2) *Habitat - Body Size*; and (3) *Specialism Index - Body Size*, indicating body size has little to do with population density, habitat specificity, or the degree of specialism in this small mammal assemblage.

Predation risk is an unknown factor in habitat specificity-dispersal-specialism characteristics of rare species, but there is ample evidence that predation can force changes in species' habitat use. Animals commonly choose among habitats that differ both in foraging return and mortality hazard, and strong predator pressure has been shown to account for low abundance and small range size of many species. Using the two *Uromy*s as examples of this model, the larger *U. caudimaculatus*, being less at risk of predation, may have chosen to forage in habitat which maximises its foraging gain; while the smaller and more vulnerable *U. hadrourus* may have forgone the benefits of increased foraging gain in favour of reducing predation levels by using less risky habitat.

ACKNOWLEDGEMENTS

Going back to university as a mature student is a brave and difficult undertaking, particularly in the sciences. The hordes of bright young faces seated in lecture theatres, all with few wrinkles and possessing a seemingly natural ownership of the learning environment, is a daunting experience. The strength or otherwise of ones self image and worth is sorely tested, particularly given the almost miraculous transition from a previously secure position of held knowledge and respect to that of a 'lowly' student with no former identity or knowledge worth knowing. Of course there are also the financial and emotional burdens of trying to study full-time while supporting your family and adapting to the absence of a predictable salary, and the persistent companionship of stress and overwork. In these latter difficulties, at least, a mature student is not alone, as this world has been the domain of university students for aeons.

I owe thanks to my wife Nicole and son Nicholas who put up with a constantly tired and sweaty husband-Dad covered in rat and leech bites; Chris Johnson and David Blair who were my supportive supervisors; Diane Bailey in JCU Administration who was always ready to assist when problems arose; and the 'Alans' of the School Stores and Purchasing Section who never tired of giving advice and service. My gratitude goes to John Winter for his support for my work and the generous way he provided me with references and other important material. Thanks also go to Steve Williams who kindly allowed me to use his predictive distribution mapping of the Australian *Uromys*. My sincere thanks also go to my two reviewers who made many comments and suggestions and in doing so helped me produce a better thesis.

This PhD project was supported by an Australian Postgraduate Research Award for three and a half years. The School of Marine and Tropical Biology of the James Cook University supported me with finance and field equipment for which they have my grateful thanks. All research procedures reported in this thesis received the approval of the James Cook University Ethics Committee (Permit No: A897_04) and were carried out under the conditions outlined in Queensland Parks and Wildlife Scientific Permits WISP04634307 and WITK04557907.

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APPENDIX 1

BOXES