

**TESTIS SIZE, SPERM PLEIOMORPHISM AND EXTRA-TESTICULAR
SPERM MATURATION IN THE SPINIFEX HOPPING MOUSE,
*NOTOMYS ALEXIS***

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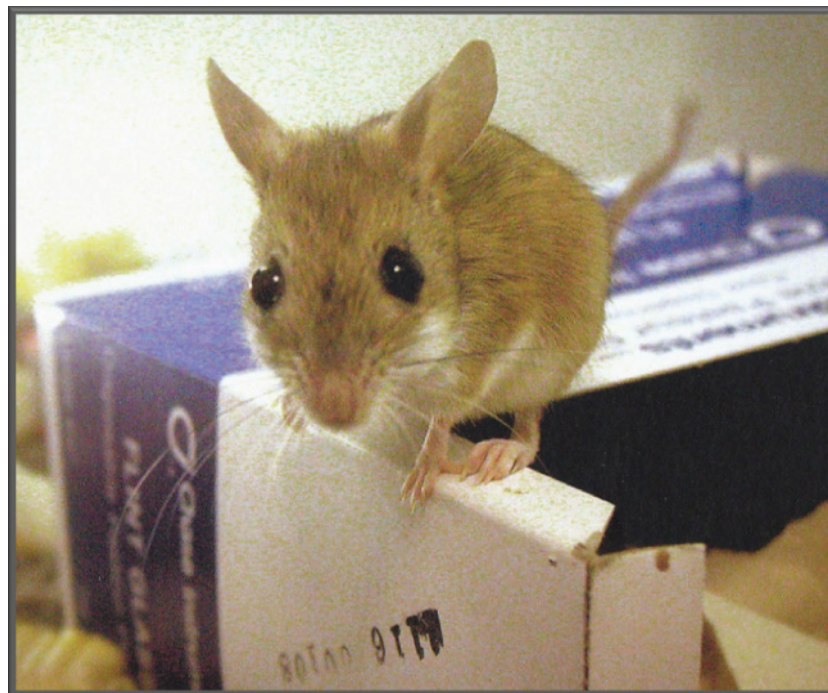
Table of Contents

1	Declaration	iv
2	Acknowledgements	v
3	Statements of Authorship and Contribution	vi
4	Abstract	1
5	Literature Review and Research Proposal	3
5.1	Introduction.....	3
5.2	Testis.....	3
5.2.1	Intra-specific variations in testis size.....	4
5.2.2	Inter-specific variations in testis size.....	4
5.3	Sperm morphology	7
5.3.1	General organization of the sperm head.....	7
5.3.2	General organization of the sperm tail	19
5.3.3	Plasma membrane.....	30
5.4	Inter-specific variation in sperm shape and size.....	31
5.4.1	Inter-specific variation in sperm head shape.....	31
5.4.2	Inter-specific variation in sperm length.....	35
5.5	Intra-specific variation in sperm shape and size.....	36
5.5.1	Intra-specific variation in sperm shape.....	36
5.5.2	Intra-specific variation in sperm length.....	38
5.6	Epididymal sperm maturation	38
5.6.1	Morphological changes	39
5.6.2	Biochemical changes.....	39
5.7	Sperm storage.....	41
5.8	Reproductive anatomy of the spinifex hopping mouse	43
5.9	General aims and objectives	44
6	Publications & Chapters	45

6.1	Publication 1.....	45
6.2	Publication 2.....	54
6.3	Publication 3.....	64
6.4	Chapter 1.....	71
6.5	Publication 4.....	95
7	General Discussion	102
7.1	Testis size	102
7.2	Sperm pleiomorphism	104
7.3	Implications of sperm pleiomorphism on fertilisation	107
7.4	Extratesticular sperm maturation and storage	109
7.5	Fertility potential	111
7.6	Future directions.....	111
8	Conclusion	112
9	Additional Publications	113
10	Bibliography.....	115

List of Figures

Figure 1	6
Figure 2	8
Figure 3	12
Figure 4	15
Figure 5	18
Figure 6	20
Figure 7	22
Figure 8	24
Figure 9	27
Figure 10	29
Figure 11	34



M. Bauer

1 Declaration

This work contains no material which has been accepted for the award of any other degree or diploma in any university or other tertiary institution, and to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text.

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Bauer, M., & Breed, W.G. (2008). Testis mass of the spinifex hopping mouse and its impact on fertility potential. *Journal of Zoology* **274**, 349-356.

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3 Statements of Authorship and Contribution

NOTE: Statements of authorship appear in the print copy of the thesis held in the University of Adelaide Library.

4 Abstract

The spinifex hopping mouse, *Notomys alexis*, is a small Old Endemic native murid rodent that inhabits the arid regions of Australia. Studies on captive-bred individuals have indicated that these animals have very small testes and produce spermatozoa of variable head morphology. While such phenomena in other species of mammals have generally been associated with either testis pathology, old age, inbreeding, and/or low levels of inter-male sperm competition due to a monogamous mating system, the causes of these features in the hopping mice investigated were not clear. The present study therefore investigated in more detail the testis size and sperm variation in this species. The possible functional implications of these features on extra-testicular sperm maturation, sperm motility and fertility potential were also explored.

In the present study, the testis size of wild-caught animals was determined for individuals obtained from populations that were reproductively active, as shown by the presence of pregnant females, as well as from populations that were reproductively inactive. It was found that males collected from nine different localities in the natural environment, even at times when the populations were reproductively active, invariably had small testes that comprised only about 0.1% of their body weight. This is about an order of magnitude smaller than that of most other murid rodent species of similar body mass.

The morphology of spermatozoa was also determined for wild-caught animals, as well as for captive-bred individuals of different ages (3 months to >12 months). The wild-caught hopping mice, as well as the captive-bred animals regardless of age, invariably had highly pleiomorphic sperm populations in the cauda epididymidis, with a similar range, and abundance, of the different morphologies occurring. A detailed study of the sperm morphology showed that some of the variation in sperm head shape was associated with differences in the nuclear shape as well as in the extent of folding of the acrosome. In addition to the intra-individual variation in sperm head morphology, the length of the sperm tail, including that of the midpiece, was also found to vary both within, and between, individuals. Furthermore, this variability in sperm midpiece and total tail length was found to be far more extensive than that in a closely related species, the fawn hopping mouse,

which has consistent sperm head morphology. Further work was, however, unable to show an association between the length of the sperm midpiece and differences in sperm motility.

Finally the impact of having small testes, low efficiency of sperm production, and small sperm stores, on the fertility potential of male hopping mice was investigated. It was found that, in spite of the small testes, males could fertilise several females within a period of a few days. This is presumably at least in part, due to rapid replenishment of sperm reserves as a result of the short epididymal sperm transit time that occurs in this species.

While the full significance of the unusual male reproductive anatomy of the spinifex hopping mouse still remains to be elucidated it is suggested that, in spite of group-living in captivity, a monogamous mating system may occur in the wild and this may in part be the reason for the evolution of the very small testis size and sperm pleiomorphism that occurs in these animals. The small testes and sperm pleiomorphism may also be part of a suite of adaptations to life in the highly unpredictable, arid environment in which these animals occur.