

A mighty revealing mouse

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Ten years ago, when Prof. Neville Pillay first started investigating the semi-desert-dwelling African striped mouse or *Rhabdomys* in the Goegap Nature Reserve near Springbok, Northern Cape, he never anticipated how important and groundbreaking this research would be. Since then this mouse is emerging as a critical species behaviour indicator in this era of climate change.

“The striped mouse exhibits particularly interesting sociality and social flexibility that may be important indicators as to how species can cope with unpredictable and rapid environmental change,” explains Pillay, the former Chair of Biological Sciences in the School of Animal, Plant and

Environmental Sciences (APES) and an animal behaviourist who specialises in mammal behavior.

Collaborating with four masters students, four doctorate students and one postdoctoral associate, his team's intensive research has generated enormous international interest to the extent that the striped mouse is widely recognised today as the best model to test social flexibility and stereotypical or abnormal behavior.

Their work has been published in several major journals, including the *Journal of Animal Ecology* (cover story), *American Naturalist* and *Behavior* (cover story).

The striped mouse research is based at the field station in the Goegap [Nature Reserve](#) and is co-funded by Wits and the University of Zürich. Pillay collaborates with Dr. Carsten Schradin from the University of Zürich on this project. Schradin is a former postdoctoral student of Pillay's.

At Goegap they are researching several colonies of striped mice in two major field sites. They have collared four individuals per colony to radio-track them and they have marked all the others by numbering them on their sides with hair-dye which does not harm them in any way.

They naturally have to catch the mice to do this, and they have found peanut butter and bran flakes to be the most successful lures. The Goegap striped mouse has an average lifespan of one year and is reproductively mature at two months.

Key biological questions

The striped mouse's sociality and social flexibility ranks amongst several fascinating behavioural manifestations that have enabled Pillay to ask

key biological questions, which ultimately address issues of biodiversity.

Pillay has used the striped mouse to test questions in three areas:

Evolutionary change

“Our studies on long-term evolutionary change show that the striped mouse is an opportunist that can successfully exploit a range of environments,” he explains. “There is also marked divergence in mating behaviour and the olfactory signals used for assessing potential mates between different types of striped mice, which is linked to speciation of the group in southern Africa.”

Sociality and social flexibility

The team’s studies on the sociality and social flexibility have generated a range of extraordinary findings.

“One amazing behavioural finding that really caught our attention initially is that it is the only small mammal in Africa to show paternal care where the fathers look after the young to the same degree as the mother, apart from producing milk,” says Pillay.

The mothers will forage more than the fathers and the fathers will return sooner to look after the young.

“We have also been able to show that the young raised without fathers show poor physical growth and impaired behavioural development.”

Dr. Tasmin Rymer, one of Pillay’s doctoral students who is now working for him as a research assistant, is looking at whether paternal care is inherited by the sons.

“The striped mouse is very good at surprising us, and this time round, we discovered that the sons pick up their paternal care from their mothers – and are even more paternal where the father is absent,” Pillay explains.

This was discovered in laboratory research, which can be manipulated to include or exclude the father. Similarly, research has shown that female striped mice pick up their maternal care from their fathers, and research published in 2011 shows that daughters genetically inherit their maternal abilities from their fathers.

This and other groundbreaking discoveries led to intensive research in 2010 into the behavioural adaptation and opportunism of striped mouse families and groups, which showed the following:

Living in groups versus living alone

When conditions are unfavourable at Goegap, in other words, food and water are scarce, which is common in this rain-stressed region, the offspring of the striped mice at Goegap remain in the group and become ‘helpers’ to look after the next generation of babies.

One of the reasons for this is that good territories are at a premium, as opposed to other habitats such as the highveld grasslands where good territories are plentiful and where striped field mice are customarily solitary.

“We have further researched how the Goegap striped mouse copes with environmental change in its own environment,” he continues. “At Goegap conditions vary between short periods of rain with favourable conditions and long, harsh, dry periods with unfavourable conditions. We found that their sociality or social-group structure changes according to conditions and that when conditions at Goegap are favourable they prefer to be solitary.”

This goes against theory, which suggests that animals favour group living. Their preference for living alone is largely attributed to reproductive competition as individuals in a group compete with each other to reproduce.

One of Pillay's postdoctoral students, Dr. Davina Hill, is looking at alternative female reproductive strategies. She is studying the trigger mechanisms that bring about the female striped mouse's decision to move from living in the group to living alone. She has picked up a change in progesterone in the females that live alone.

Male behavioral change

Led by the females, the males must change their tactics to respond to the females' behavioral changes. Instead of staying in the group and associating with the females in the group and showing paternal care, the males, particularly the younger males, become roamers and solicit as many females as possible to mate with them and do not show paternal care.

Pillay and his team were the first to show this happens in any animal, which was only predicted by theoretical models previously. What is interesting is that a dominant male with a whole group of females in his 'care' has lower testosterone than the roamers.

“We call it the ‘bungee-jumping’ strategy because they engage in risky behavior, sneaking into dominant males' territory to mate with their females. In striped mice the dominant male does not kill off the roaming males' offspring,” explains Pillay.

Flexible behavioral strategies

Pillay's group has shown that these flexible behavioural strategies are coupled with hormonal changes and perhaps even brain function, but not genetic changes.

The field research combined with the laboratory research was another significant marker of the striped mouse's remarkable ability to adapt and demonstrated that its sociality is facultative, and can change.

“It shows how responsive these animals are to unpredictable environmental and [climate change](#). We have opened the door for this kind of work and would like to replicate it in the grassland regions.”

Stereotypical or abnormal behavior

“Finally, my research of stereotypical behavior (abnormal behavior) in captive striped mice has highlighted the potent effects that captivity imposes on animals in captivity,” says Pillay.

Stereotypical behavior is defined as ‘repetitive behavior with no function’, which does not happen in the wild. Pacing is a typical form of stereotypy. Stereotypical behavior in striped mice is accompanied by potential changes in brain function without underlying stress hormone responses, and can be habit forming.

“Our major finding here is that, contrary to expectation, stereotypic animals have enhanced reproductive output, which goes against the theory that stressed animals in captivity have lower reproductive levels. One rationale for this is that pacing is exercise-based, where the female is losing body weight to reproduce better.”

A paper on this, which included the work of another of Pillay's students, Megan Jones, was published in 2010 in *Applied Animal Behaviour Science*. Pillay and his team believe this has implications for all animals

in captivity.

Bold or shy

Sneha Joshi, who started her doctorate degree in 2010, is looking at another aspect of stereotypical behavior – whether striped mice with different personality types (namely bold or shy) are more or less prone to stereotypical behavior. The data to date show that the bolder animals are more likely to display stereotypy and that stereotypical behaviour is genetically transmitted.

Pillay will discuss all this and other research on the striped mouse at the International Conference on the African Small Mammals Symposium in Swaziland in July 2011 and other conferences and symposia in Europe.

Provided by Wits University

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