OF MICE AND MASSONIAS

The pollination of flowers by rodents was thought to be confined to the Proteaceae but recent discoveries show that the Namaqualand lily *Massonia depressa*, and most certainly others like it, are also pollinated by rodents.

by ***Steve Johnson****, School of Botany and Zoology, University of Natal, Pietermaritzburg,*
Anton Pauw *and* ***Jeremy Midgley****, Department of Botany, University of Cape Town*

Above **A flower head of *Massonia depressa* nestles between two large leaves lying flat on the sun baked surface of the Knersvlakte in Namaqualand.** Photo: A. Pauw.

The Knersvlakte is a vast expanse of flat gravelly land that stretches north from Vanrhynsdorp. During spring it is carpeted with flowers and this is the season when tour buses can be seen traversing the national road in search of the ultimate photo opportunity. We had come to the Knersvlakte during the cold months of winter, long before the veld turns into a kaleidoscope of colour. Our mission was to uncover the pollination mysteries of an unusual lily with the most unprepossessing flowers imaginable. *Massonia depressa*, the object of our attention on this trip, has greenish brown flowers at ground level, nested between a giant pair of flat green leaves. We suspected that these flowers are pollinated at night, not by insects, but by mice, which are, by and large, nocturnal animals. And so, a group of slumbering Karoo sheep were startled by the sight of three botanists picking their way among the vygies in the dead of a winter's night. It is an eerie experience to wander about the Knersvlakte after dark; colder than one might imagine and, in the absence of city lights, luminescent with stars.

More than twenty years have passed since John Rourke of Kirstenbosch and his American colleague Delbert Wiens made the sensational discovery that a group of *Protea* species is pollinated by rodents. These proteas have dull flower heads situated near ground level, quite unlike their bird-pollinated relatives which have brightly coloured conspicuous flower heads. They also have a strong yeasty odour that makes it possible for mice to find the flower heads during the night. We have long been intrigued by a small group of lilies in Namaqualand that have features reminiscent of rodent-pollinated proteas. The flowers of these lilies, like *Massonia depressa* and *Androcymbium dubium*, are dull and grow low on the ground. Could they represent an as yet undocumented case of rodent-pollination?

We had located a large flowering population of *Massonia depressa* in late July 1998 and laid out a number of rodent traps, baited with peanut butter and rolled oats. We had also been taking measurements of the nectar, which is unusually viscous and jelly-like and collects in a pool at the base of the bowl-shaped flower. We noticed that the nectar in each flower increased

towards dusk - an indication that the plants were preparing for a nocturnal visit. As evening progressed the flowers developed a strong scent that permeated the air around us. The scent is not pleasant and was likened by one of us to the smell of a damp sheep! Now we waited, shivering as the temperature plunged to near freezing point.

By midnight the first of the traps had been sprung. These traps were not lethal spring-loaded 'mouse-traps', but small tunnels into which the rodents venture but cannot exit until set free by their human captors. Inside we were surprised to discover a hairy-footed gerbil *Gerbillurus paeba*, and not a mouse as we had expected. We dabbed its fur with sticky tape to collect pollen, and most importantly, collected the droppings that had accumulated in the trap. Three more gerbils were trapped and later the microscope revealed that their droppings were packed with *Massonia* pollen. This was the proof we needed to show that they had been visiting the flowers. After visiting flowers, rodents become dusted with pollen which they lick off their fur during the grooming process. In this way pollen is ingested, but as the pollen wall is virtually impervious to digestion, it eventually ends up in the droppings.

We took one of the gerbils to our nearby campsite and placed it carefully in a darkened terrarium containing several flowering plants of *Massonia depressa*. The first reaction of the gerbil was to sniff the air and then, without hesitation, dash across to a *Massonia* plant and begin lapping nectar from the flowers. It pushed its snout in amongst the anthers and stigma of each individual flower when draining the nectar, and did not nibble or damage the flowers while doing so. The rodent's snout was soon heavily encrusted with pollen, which was liberally daubed onto the stigma of each flower that it subsequently visited. Having witnessed this exciting interaction between *Massonia* and its unlikely pollinator, we released the gerbil back at the field site and retired exhausted, but happy, at 3 am.

Although the results of this first season were promising, we wanted to obtain more data from other populations, and so in the following winter we travelled to the Niewoudtville escarpment which overlooks the Knersvlakte. We set rodent traps among giant boulders on a rocky ridge where plants of *Massonia depressa* are plentiful. Several individuals of the Namaqua rock mouse *Aethomys namaquensis* and spiny mouse *Acomys subspinosus* were found in the traps and, on examination, they too proved to have *Massonia* pollen in their fur and faeces. After being released in the early hours of one morning, a Namaqua rock mouse even brazenly lapped nectar from *Massonia* flowers just a few metres away from where we stood.

Insects hardly ever visit the flowers of *Massonia depressa*. One reason might be the jelly-like constituency of the nectar, which would make feeding difficult for insects with their narrow syringe-like mouthparts. (Rodents easily lap up the nectar with their broad tongues.) To establish with certainty whether rodents are the primary pollinators of *Massonia*, we decided to cover plants with wire mesh cages that would exclude rodents, but allow insect access to the flowers. At the end of the flowering season we returned to the site and found that almost no seeds were produced by the covered plants, while uncovered plants had produced plenty of seeds. We now felt that we had enough evidence to conclude that *Massonia depressa* is indeed adapted for pollination by rodents.

Pollination by small 'non-flying mammals' (to distinguish them from bats) we now know, occurs on several continents. Marsupials visit the flowers of various Australian shrubs including *Banksia*, which are cousins of our South African proteas. In Madagascar, lemurs have recently been implicated in the pollination of several plants including *Ravenalia*, a close relative of *Strelitzia*. Proteas were thought to be the only plants in southern Africa that rely on rodents for pollination, but now it seems that a guild of South African lilies can be added to that list. In all, we predict that about a dozen Namaqualand lily species with ground-hugging flowers are pollinated by rodents.

Further reading

Wiens, D., and J. P. Rourke. 1978. Rodent pollination in southern African *Protea* spp. *Nature* **276,** 71-73.

Johnson, S.D., Pauw, A. & Midgley, J. 2001. Rodent pollination in the African lily *Massonia depressa* (Hyacinthaceae). *American Journal of Botany* (in press).

The ground level position of *Massonia* flowers makes it easy for rodents like this hairy-footed gerbil *Gerbillurus paeba* to get to the nectar. Photo: Steve Johnson & Anton Pauw.