10.1071_ISSN0311-4546EC106p19

Plain predictions

Top: Overgrazing by livestock and eruptions of native mammals such as the Brandt's vole are contributing to the desertification of Inner Mongolia's once fertile plains.

Above: Australian and Chinese ecologists are developing a model for predicting outbreaks of Brandt's vole. This will underpin strategies for cost-effective fertility controls.

An industrious native vole and overgrazing by livestock are making a desert of Inner Mongolia's once fertile grasslands. **Wendy Pyper** outlines efforts to arrest the transformation.

Fifty years ago, sweeping vistas of waist-high grass were the trademark of Inner Mongolia. But today, stubbles of grass and weeds carpet much of the landscape, and wind erosion speeds desertification.

This transformation of China's northern-most province from productive to degraded grassland is a result of livestock overgrazing and surges of small, burrowing mammals. Among them is the disarmingly cute native mammal known as Brandt's vole.

The Brandt's vole thrives amid short, overgrazed pastures, digging enormous burrows, and storing food for the harsh Mongolian winter. A female vole can raise some 25 young in its 18-month life span.

In most years vole numbers are low enough not to cause problems, but occasionally populations erupt.

When this happens, the combination of voles and livestock depletes the palatable plants, leaving the topsoil exposed to fierce, spring winds originating in Siberia.

Dr Roger Pech and Dr Stephen Davis from CSIRO Sustainable Ecosystems are trying to discover what conditions trigger these troublesome eruptions.

Pech and Davis, both ecologists and mathematical modellers, are working

Life in the **labyrinth**

BRANDT'S VOLE (*Microtus brandti*) is considered a pest in the grasslands of China, Mongolia and Russia. In the grazed areas of Inner Mongolia in particular, its industrious burrowing activity contributes to desertification of the grasslands.

Vole burrows are complex structures, covering up to 14 square metres and consist of holes, tunnels and caches, where food is stored for winter. There are usually three or four caches per burrow, each up to 1.1 m long and 120 mm high. In the course of digging, voles can cover up to 65% of the area around their burrow system with fresh soil.

At least 13 eruptions of Brandt's vole have occurred in the past 50 years. During outbreaks, there may be more than 1300 voles and up to 5000 holes per hectare. At high numbers, the voles compete with livestock for food and can consume 15–44% of the grass.

Large numbers of voles, and rodents in general, are also associated with epidemics of Bubonic plague and other human diseases. For these reasons, scientists are trying to find effective ways of controlling the vole population in Inner Mongolia.

Top: A female vole can raise some 25 young in its 18-month life span.
Above: Vole burrows consist of holes, tunnels and caches for storing food.

Visitors to Inner Mongolia are often welcomed by a ride on a Mongolian pony. Here Stephen Davis takes time out to experience an integral part of Mongolian culture and one of the peoples' main modes of transport. As well as a pony ride, the scientists were treated to a welcoming ceremony featuring an 'extremely strong alcoholic beverage'.

with a group of Chinese rodent ecologists to develop a model for predicting vole outbreaks. The model uses 50 years of vole population data collected by Chinese ecologists, and correlates eruptions with regional rain and snowfall, and the Southern Oscillation Index (SOI).

Davis says there is evidence that moderate to dry conditions tend to favour the vole. Low precipitation usually means shorter grass, which may in turn enable voles to see and avoid predators and communicate visually with other voles. In Inner Mongolia, drier weather appears linked with consistently high and positive values of the SOI, suggesting trends in this climatic index could be used to forecast outbreaks of voles.

Pech says one of the difficulties with predicting eruptions, however, is that an outbreak doesn't always occur under the 'right' climatic conditions. This is similar to the problem of predicting when plagues of house mice will occur in the wheatbelt of south-eastern Australia.

Forecasting vole outbreaks is further complicated by the effects of livestock grazing, and possibly by diseases, such as Bubonic plague, which vole populations harbour. Pech says future predictive models may include livestock grazing, and factors that determine the growth and senescence of pasture. But at this stage insufficient data exist to include the effects of disease on vole abundance.

Oscillation and **precipitation**

THE Southern Oscillation Index (SOI) refers to the difference between the surface air pressure measured in Darwin and the surface air pressure measured in Tahiti. Over a time scale of years, it oscillates between negative and positive values.

The index is strongly associated with El Niño and La Niña events, (negative values of the SOI are correlated with El Niño and positive with La Niña), but these refer to contrasting trends in sea surface temperatures across the heart of the Pacific.

It is generally accepted that the SOI can be correlated with weather worldwide, most obviously in Australia and South America, but also in the Northern Hemisphere, including China. The SOI is used to generate predictions of rainfall probability three to six months in advance (for example, see the Long Paddock web site at <http://www.dnr.qld.gov.au/longpdk/).

Targetting fertility

Pech and Davis are also working with CSIRO reproductive and molecular biologists Dr Lyn Hinds and Dr Chris Hardy to compare the effects of various control methods on the vole population.

Brandt's vole is controlled using poison baits, which are not species specific and endanger both predators of the vole and other small, native mammals.

Hinds and Hardy have been working on a fertility control method for foxes, rabbits and mice, which acts on the animals' immune systems, and could be adapted for Brandt's vole (see Domesticus interruptus, *Ecos* 104). The sterilising vaccine, known as immuno-contraception, would be delivered in non-toxic baits to provide a new, species-specific and humane control option for voles.

Pech, Davis and their Chinese colleagues used data from a three-year study of vole survival and fecundity to compare, theoretically, the effects of poisoning and fertility control. They manipulated survival rates and reproduction rates to mimic the expected effect of poisoning or fertility control, and found two ways in which fertility control could match the reductions caused by poisoning.

The bait could be spread either at the end of the breeding season preceding an outbreak, or twice during the breeding season as the vole density increased towards unsustainable levels.

The first strategy would require predicting high densities of Brandt's vole 6–12 months ahead, or applying the control every season. This result highlights the need to improve eruption predictions.

Pech says the next stage of the project will be to continue working with Chinese ecologists to improve management of the whole grassland system, including improved methods of vole control and livestock grazing.

The aim is to incorporate the work into a new three to five-year project by the Chinese Academy of Sciences, dealing with desertification and grassland management in Inner Mongolia. In the wake of dust storms that swept over Beijing recently, the project has been given high priority.

This project is funded by the Australian Centre for International Agricultural Research.

Abstract: Outbreaks of Brandt's vole – a small burrowing mammal –- and overgrazing by livestock, are turning Inner Mongolia's once sweeping grasslands to desert. Ecological modelling, which correlates vole population data with environmental conditions, could help predict vole outbreaks. Research into fertility control methods for the vole could also provide a species-specific alternative to the current practice of poison baiting. It is hoped that improved methods of vole control coupled with sustainable levels of livestock grazing will halt or reverse desertification.

Keywords: Brandt's vole, grasslands, overgrazing, land degradation, ecological models, pest control, Mongolia.

Above right: At Xilinhot Field Station on the banks of the Xilin (Shining) River in Inner Mongolia, Chinese scientists study the behaviour and population dynamics of Brandt's vole in a series of enclosures. The netting protects the voles from predatory birds, while the sides of each enclosure prevent stoats and other animals entering. While visiting the site, Lyn Hinds could easily observe the voles sitting at their burrow entrances or using runways that criss-cross the enclosure.

Right: The grasslands of Inner Mongolia are used to produce sheep, cattle, horses and other livestock. Most of Inner Mongolia is pastureland, including 55% that can be used for livestock grazing.