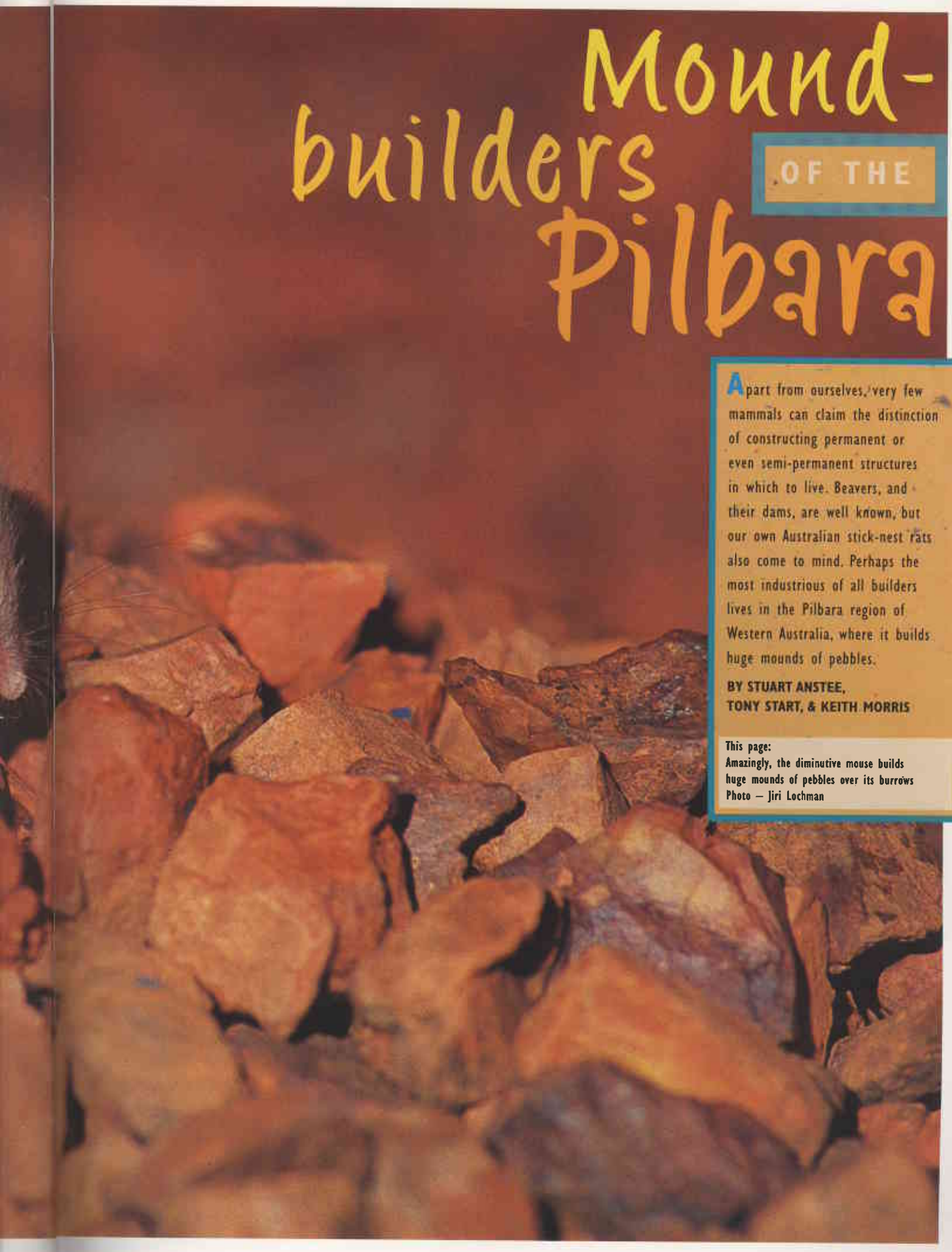
Mound-builders of the Pilbara

Apart from ourselves, very few mammals can claim the distinction of constructing permanent or even semi-permanent structures in which to live. Beavers, and their dams, are well known, but our own Australian stick-nest rats also come to mind. Perhaps the most industrious of all builders lives in the Pilbara region of Western Australia, where it builds huge mounds of pebbles.

BY STUART ANSTEE, TONY START, & KEITH MORRIS



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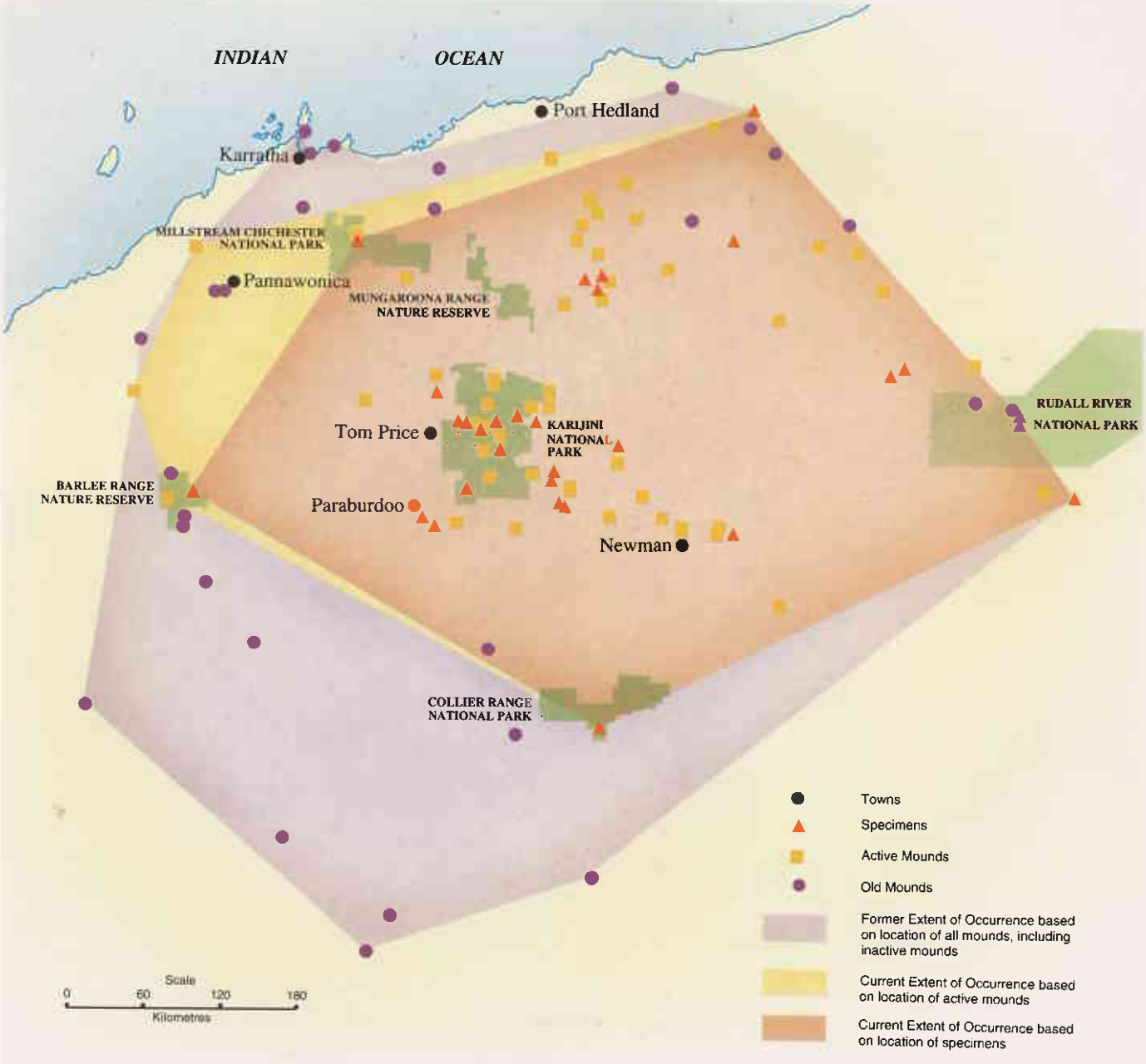
Amazingly, the diminutive mouse builds huge mounds of pebbles over its burrows
Photo – Jiri Lochman

Unknown to most Australians, the ngadji or western pebble mound mouse (*Pseudomys chapmani*) is an industrious native rodent that constructs large mounds of pebbles over its burrows. Adults, which weigh about 12 grams (smaller than most house mice), are among the smallest of Australia's rodents. Their diminutive size makes their mound-building feats amazing; some mounds are up to four metres across and half-a-metre high! The mounds are made of thousands of pebbles, each roughly the same size—one to two centimetres across and one to two grams in weight. They persist for many decades, even when the mice that built them have long disappeared.

Many years ago, naturalists working in the Pilbara, the inland Gascoyne and even the northern Murchison, knew of pebble mounds which, they assumed, were built by *Pseudomys hermannsburgensis*, a very common rodent that was usually called the sandy inland mouse, but, sometimes, the pebble-mound mouse. That assumption posed a problem because the sandy inland mouse is widely distributed across arid Australia, but it did not build pebble-mounds anywhere else. The riddle was solved in 1979 when biologists Nick Dunlop and Ian Pound, working at a proposed iron ore mine site in the south-east Pilbara, discovered that the mound-builder was really a previously unknown species. The sandy inland mouse just lived nearby.

Confusion was understandable. The two species are similar in colour, size and appearance, and live animals can only be distinguished by differences in the pads on their feet. When the riddle was solved, all the specimens identified as sandy inland mice in the Western Australian Museum were re-examined. It turned out that some were really pebble-mound mice and so, by 1980, the new species was known from four locations, all in the east or south-east Pilbara. Yet mounds, no longer inhabited by mice, were reported from as far away as the Murchison and Gascoyne.

At Mileura, in the Murchison, the artisans had been extinct since at least 1960, and other populations seemed to



have gone the same way. Many other rodents of the State's arid zone had declined or become extinct since European settlement (see 'Disappearing Mammals', *LANDSCOPE*, Spring 1990). The fate of the ngadji seemed to be no different, although no one knew why. Accordingly, in 1983, the Minister prudently declared it to be, 'Fauna that is likely to become extinct or is rare'.

The new mouse was named *Pseudomys chapmani* and given sole right to the common name 'pebble-mound mouse'—for a while. 'Western' was added to the common name when other pebble-mound-builders were discovered elsewhere in Australia. However, the preferred practice now is to use relevant Aboriginal names for our indigenous rodents. The Punjima people of the Hamersley Range, one of its strongholds, call it ngadji, the name we now use (see 'Dinkum Aussie Rats', *LANDSCOPE*, Spring 1996).

OF MICE AND MINES

How rare was the mouse? In the next decade, we learned very little more about the ngadji, although actively tended pebble-mounds were commonly being reported on stony slopes in the Pilbara. They were often on spurs at the base of hills and ridges, particularly in the Hamersley Range.

Our lack of knowledge was highlighted in the early 1990s when the charismatic rodent became a focal point in the environmental review of the proposed Marandoo iron ore project, because active pebble-mounds were common on the site. In order to achieve its goal of sustainable development, Hamersley Iron and the Department of Conservation and Land Management (CALM) developed a strategy for minimising the impact of the Marandoo project on the adjacent Karijini National Park and its biota. The need to formulate appropriate management options reinforced the need for information on the basic biology of ngadjis.

It was just as important to determine, once and for all, how rare it really is. This would require surveys to find out where nadjis had occurred and where they still live. Perhaps, too, comparing environmental factors at places where it is extinct with those where it still thrives, would provide clues to why it had vanished from some areas. For example, is there a correlation with particular habitat types, land uses or fox abundance? Those clues could lead to better management, and Hamersley Iron supported surveys to obtain the information.

Hamersley Iron has not been the only company planning projects in pebble-mound country. BHP was the other leading player and it, too, sought to minimise the impact of its operations on the mound-building mouse as well as supporting research into its biology. Close liaison between the two iron ore miners and CALM ensured an integrated approach to the problems.

Top: No wonder sandy inland mice were confused with Ngadjis; they look very similar.
Photo – Jiri Lochman

Above: Ngadjis use their mouth and front feet to manipulate the pebbles on their mounds.
Photo – Babs & Bert Wells/CALM

MOUSE ECOLOGY BY RADIO

At Marandoo, the University of Western Australia, in conjunction with Hamersley Iron, researched patterns of movement, use of mounds and demographic structures of ngadji populations. Many people had reported that ngadjis were difficult to catch, so

each mound was encircled by a low fence made of flywire. On some of the larger mounds, the diameter of the circle was more than six metres. Eight or ten Elliott traps (which catch small mammals alive and unharmed) were placed inside the fence. Trapping continued until no new mice were being caught.

The technique worked well. For example, at one site mice were captured at 12 of the 26 mounds. Several mounds yielded only one mouse, but five mounds were home to five or more. Astonishingly, 12 mice lived in one mound. (Elsewhere, as many as 25 mice have been found in a mound.) Commonly, a mound is home to an adult male, one or perhaps two or three reproductively active females and several younger ones. Thus, we learned that the ngadji is often gregarious.

Small radio transmitters, attached to tiny collars and weighing less than one gram, were used to track the movements of 14 of the largest mice.

Each transmitter emitted signals at a slightly different frequency so that the mice could be identified individually. Because the mice are so small, it was necessary to anaesthetise them before correctly fitting the collars around their necks; too tight and the mouse could choke to death, too loose and it could snag the collar, and itself, on a twig.

The ngadjis covered large distances at night, often visiting other, unoccupied mounds. Some males travelled up to a kilometre and roamed over fourteen hectares, while females used three to five hectares. They spent a lot of time moving up and down dry creek beds. (Small gutters, draining the slopes on which the mice prefer to live, are a feature of ngadji habitats. They have noticeably richer plant communities than the surrounding hummock grassland, possibly providing a greater range and abundance of food.)

The radio collars also pin-pointed which mound each mouse used as a day-time refuge. By holding the radio receiver over a mound and flicking through the different transmitter frequencies we could find out who was at home. Although the mice roamed over a considerable area each night, they would always return to the same home-mound in the morning.

There was considerable overlap of the areas used for foraging by mice from neighbouring mounds. However, neighbours were excluded from smaller core-areas around each home-mound. Thus it seems that the mice from several mounds are willing to share food resources, but the 'family' that inhabits each mound maintains its social integrity.

DISTRIBUTION TODAY

Mark Piggott carried out the survey work that Hamersley Iron supported. After consulting CALM scientists, he visited places as far-flung as Rudall River National Park in the Little Sandy Desert (see 'Rudall River National Park' in this issue), the Chichester Range near Python Pool , which is just inland from Karratha, and Collier Range National Park, some 150 kilometres south of Newman. He caught ngadjis at all these places, and others, in the inland Pilbara.

However, in the rest of the Gascoyne and in the Murchison he found no active mounds and caught no mice. Pastoralists knew of the pebble-mounds and some remembered the days when they had been lived in, at least thirty or forty years before. Even students of the

Ngadjis live communally in chambers excavated below their pebble mounds. The mounds help to insulate them from searing heat.

Above left: Early morning, before the day gets hot: Stuart Anstee checks the traps he set on a pebble mound.
Photo – Stuart Anstee

Above: Elliott traps, set inside a fence erected around a pebble mound, catch all the inhabitants safely.
Photo – Stuart Anstee

Far left: Tiny radio transmitters, attached to collars, give away the secrets of a ngadji's nocturnal movements.
Photo – Stuart Anstee

School of the Air in Carnarvon told him of several places where he could find long-disused mounds, but all the evidence supported the earlier belief that pebble-mound-builders were extinct in those regions.

Along the Pilbara coast, too, old mounds occur on many of the small ranges that interrupt the coastal plains, and on the Burrup Peninsula. There are even old mounds within a couple of hundred metres of suburban Karratha.

Ngadjis are probably extinct in most of the Gascoyne, the Murchison and along the Pilbara coast. But what of their status in the inland Pilbara and Little Sandy Desert?

The iron ore miners encountered ngadjis almost everywhere they worked on gentle upland slopes. Surveyors seeking new road alignments reported the same. CALM scientists conducting biological surveys encountered them in the Barlee Range Nature Reserve in the south-west Pilbara and the south-west edge of the Little Sandy Desert. In particular, Nick Dunlop and Charles Newland, of the Department of Minerals and Energy, recorded numerous sites where there were active mounds.

When all these locations are mapped, it becomes clear that the ngadji has vanished from the upper Murchison, most of the Gascoyne, and the Pilbara coast. However, it is thriving wherever there is suitable habitat in most of the Pilbara and the Little Sandy Desert. Put in area-terms, it is extinct in about one third of its former range, but, as that portion contains proportionately less suitable habitat than the Pilbara, it has

PEBBLE-MOUNDS

When you find your first pebble-mound you can be excused for wondering why someone dumped a wheelbarrow load of gravel, carefully screened for mixing into concrete, among the spinifex on a barren, stony hillside. However, if the mound is being actively tended by the mice, you will notice steep-sided hollows and volcano-like structures, complete with little 'craters', on the surface. Look carefully and you will see that many of the craters lead to holes, their entrances usually blocked by a few pebbles. The mice do not live in the mound, but in a maze of tunnels below it. The holes at the centres of the craters provide access to this underground home. Once you have recognised a pebble-mound, you will know others very easily.

We now know that, elsewhere in northern Australia, at least four other species of mice build pebble-mounds. They, too, live on gentle slopes in arid uplands where the soils are stony and often shallow. But why build mounds? They are very costly in energetic terms.

Related species living in the valleys or plains don't build mounds. Their nest chambers are constructed at the ends of deep burrows, where they are well insulated from the extremes of desert temperatures. Pebble-mound mice live where the shallow, stony soils would make it hard if not impossible to burrow deeply and escape the heat. Perhaps they have insulated their nest chambers by building mounds overhead.

If the mounds were made of soil, they would erode; fire is common in spinifex communities, so wood or leaves would burn, but pebbles, which are abundant anyway, make durable mounds. Moreover, they trap wind-blown sand and dust, which settles into the gaps, deep down, adding to the insulation. Building these mounds is energetically expensive, but the ngadji seem to overcome this hurdle by living gregariously in the same mounds for many generations.

probably disappeared from less than one quarter of the area it used to occupy. Furthermore, all the evidence suggests that, where it has vanished, it did so before about 1960, perhaps much earlier. Elsewhere, it seems to be stable and secure.

Does this pattern give us any clues to why? Perhaps it does. Wherever ngadjis survive, they live in uplands where spinifex grows on stony soils of gentle slopes. Scattered trees and linear thickets growing in gutters carved by summer storms complete the picture. Where they have vanished from the Murchison and Gascoyne, the country is dominated by mulga woodlands, although the stony hills on which the old mounds persist often support no more than a sparse shrubland, usually of cassias (*Senna* species).

Fire is common in the spinifex, but rare in mulga of the Gascoyne and Murchison. Furthermore, we have seen ngadji families continuing to tend their mounds after fierce fires, so it is improbable that fire has been a factor.

Stock and feral goats avoid harsh spinifex hills, but they have exacted a severe toll from the mulgalands. Perhaps this is a factor, but it cannot be the whole story, for on the small ranges along the Pilbara coast, the old mounds are built among spinifex on stony slopes.

The most intriguing correlation involves foxes. Foxes had reached the mid-west well before 1930, and the first bounty for a fox taken on the Pilbara coast, at Roebourne, was paid in 1931. Even today, foxes are common in the mulgalands of the Murchison and Gascoyne and along the Pilbara's coastal plains, where its depredations on rock-wallabies bear testimony to forays into the coastal ranges. These are exactly the areas from which ngadjis have vanished. Yet most of the rare records of foxes in the inland Pilbara are old sightings from the larger river valleys, where the alluvial soils do not provide ngadji habitat anyway.

Could it be that foxes were the main culprits and, if so, were they sometimes aided and abetted by sheep, goats or other exotic herbivores? We may never know, but one thing is clear. The ngadji is still common in its special habitat over most of its former range. While it was prudent of the Minister to declare it to be 'Fauna that is likely to become extinct or is rare', on the available information in 1983, that status is probably no longer warranted, and a comprehensive review has recommended that its conservation status be amended accordingly.

Top: Active pebble-mounds are characterised by volcano-like structures around the entrances.
Photo – Jiri Lochman

Above: The gentle, stony slope in the foreground is typical ngadji habitat in the Hamersley Range.
Photo – Babs & Bert Wells/CALM

Stuart Anstee is the Environmental Scientist for Hamersley Iron's Department of Environmental Affairs. He has been conducting research on the ngadji for two years and can be contacted on (09) 327 2164.

Tony Start has recently reviewed the status of the ngadji and Keith Morris is an expert on Australian rodents. Both are Principal Research Scientists involved (among other things) in management of threatened fauna. They work from CALM's Wildlife Research Centre at Woodvale where they can be contacted by telephone on (09) 405 5100. Tony's e-mail address is tonys@calm.wa.gov.au and Keith's e-mail address is keithm@calm.wa.gov.au

The authors extend their grateful thanks to the many people who have freely contributed their knowledge and advice on ngadji biology.

LANDSCOPE

VOLUME TWELVE NUMBER 3, AUTUMN 1997

Aquatic bugs are helping scientists to determine the health of WA's waterways. See Spineless Indicators on page 49.

CALM's new Marine Conservation Branch gets in deep (page 10) to play its vital role in safeguarding the health of WA's unique marine environment.

Called 'Karlamilyi' by desert Aborigines, Rudall River National Park (page 28) is steeped in history and bristling with wildlife.

The economic, social and conservation potential of Acacia in WA , a story of a golden future on page 16.

Fancy a walk? Join us while we look at the environment, history and building of a new Bibbulmun Track. See page 36.

FEATURES

REGULARS

COVER

The tiny pebble-mound mouse of the Pilbara (see story on page 42) is a tireless night-worker and the architect of many odd, red gravelly mounds, which look like miniture volcanoes among spinifex.

Illustration by Philippa Nikulinsky

Managing Editor: Ron Kawalilak
Editor: David Gough
Story Editors: Verna Costello, Mitzi Vance, John Hunter
Scientific/technical advice: Andrew Burbidge, Ian Abbott, Paul Jones and staff of CALM's Science & Information Division
Design and production: Maria Duthie, Sue Marais
Finished art: Maria Duthie, Sue Marais, Gooitzen van der Meer
Illustration: Gooitzen van der Meer, Ian Dickinson
Cartography: Promaco Geodraft
Marketing: Estelle de San Miguel ☎ (09) 334 0296 Fax: (09) 334 0498
Subscription enquiries: ☎ (09) 334 0481 or (09) 334 0437
Colour Separation by Prepress Services
Printed in Western Australia by Lamb Print

Visit *LANDSCOPE* Online on our award-winning Internet site *NatureBase* at http://www.calm.wa.gov.au/
Published by Dr S Shea, Executive Director
Department of Conservation and Land Management,
50 Hayman Road, Como, Western Australia