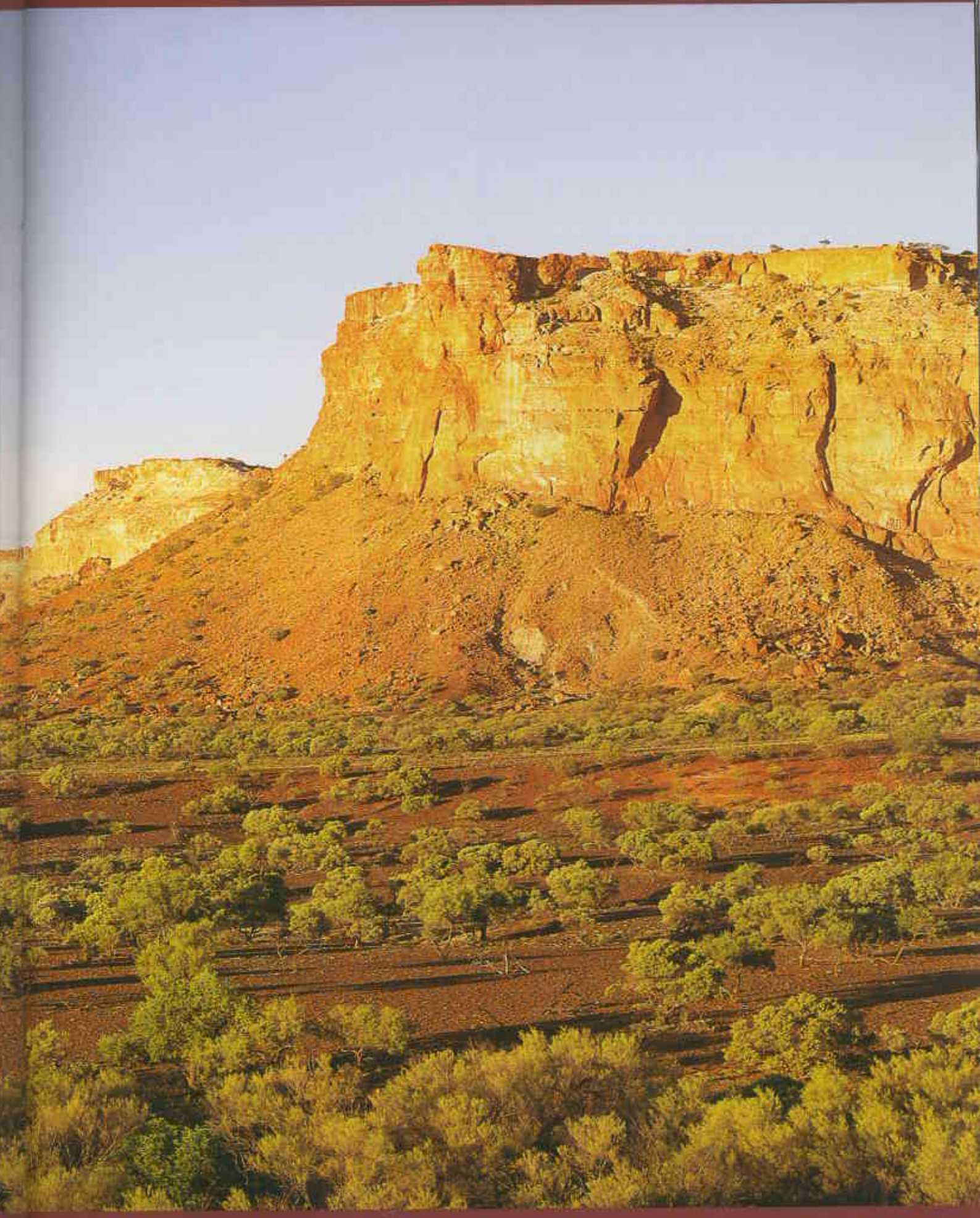
Glorious grasshoppers
of the Kennedy Range

The magnificent panoramas of the Kennedy Range can be compared with those of John Alcock's home state of Arizona, USA. In this story, John encourages us to look down at our feet to discover some fascinating creatures that roam these landscapes.

By John Alcock



As an American visitor to Kennedy Range National Park, in Western Australia's Gascoyne region, I feel right at home. The flat-topped mesas, the deep cut canyons and dry streambeds, the orange sandstone cliffs and the rock-strewn plain, with its twisted little acacias and blue-green shrubs, all remind me of places in the American south-west. Even the two wedgetail eagles floating serenely overhead could pass for the golden eagles I sometimes see in Arizona. True, we Arizonans have no answer for the trio of shaggy euros making their way among the boulders that have tumbled down the slope below the cliff in front of me. These

animals are novel and thrilling but, overall, the similarities in geology and vegetation are great enough to make me think of home when I am in the Kennedy Range.

As I wander about making mental comparisons between Western Australia and western North America, I also enjoy the small distinctive features of the Kennedy Range: a miniature mulla-mulla plant nestled next to a block of sandstone, the thin whistled *tee-titee-tee-tee* of a pied flycatcher in the midst of an aerial display, a handful of pale yellow flowers dangling from a poverty bush, and a blackish grasshopper that seems to appear out of nowhere to jump away just before I step on it. I see where the grasshopper lands and fall on my knees for a closer look before awarding the insect a master-of-camouflage medal. The insect has almost become a pebble, thanks to its refusal to move and its cuticle, which has the roughened, chocolate, lightly-flecked surface of the sunburnt stones nearby. Even the way it holds its legs, which are pressed tight to its body, contributes to its astonishing stony mimicry.

The overall effect of the pebble hopper's squat, seamless shape and colour pattern surely makes the insect all but invisible to the pied butcherbirds and grey-crowned babblers that live in the range. These, and many other birds, find edible grasshoppers irresistible, but they first have to detect them before enjoying a good meal. A grasshopper-hunting babbler would have to closely inspect a thousand pebbles for every blackish hopper discovered, not a recipe for weight gain. In the past, predators that have lost energy while hunting have left very few descendants, with the result that today's hunters rarely waste time in low payoff endeavours.

Previous page
Main Kennedy Range National Park lies about 200 kilometres inland from Carnarvon and about 60 kilometres north of Gascoyne Junction.
Inset The grasshopper *Monistria pustulifera*.
Photos – Jiri Lochman

Above left Grey-crowned babbler.
Photo – Hans and Judy Beste/Lochman Transparencies

Left This immature grasshopper, a member of the genus *Buforania*, comes as close as possible to looking and behaving like a blackish pebble.
Photo – John Alcock

The argument that grasshopper colouration often renders them inconspicuous to their predators, leads us to expect that the colour patterns of edible species will generally match the background on which they perch. Anyone willing to think small can check this expectation on a late winter or springtime walk near the Kennedy Range. Move from the plains at the base of the cliffs, where the ground is littered with black pebbles, to a sandy stream bed. Hike along what we Arizonans would call a 'wash' until you come across a stand of flannel bush (*Solanum lasiophyllum*), a common shrub here. This attractive plant possesses gorgeous purple-blue flowers and pale greenish, decidedly hairy leaves. Although most plants are grasshopper free, a few sport one or two flannel bush grasshoppers. It's not easy to spot them because these pale greenish, hairy grasshoppers like to sit motionless on the leaves of the plant, where they blend beautifully into their surroundings. So dependent is this species on its camouflage that it will often remain still, even when poked or gently prodded. The grasshopper is evidently betting that birds will fail to detect it because it looks like a flannel bush leaf, not an item on the diet of the average babbler or butcherbird.

Let's continue our walk, moving into an area of stabilised red sand dunes, which surround the attractive claypans that dot the plains to the west of the park. Here, we may stumble upon a delightful grasshopper, a species that currently lacks a proper scientific name, like many other Australian insects. This specimen is also very reluctant to move, leaping off only at the very last moment to prevent being stepped on. The standard decision to stay put makes good sense, given that this grasshopper lacks wings and so cannot fly to safety, which means it, too, must put its trust in camouflage. The tactic often works because the hopper typically chooses to sit in places with a smattering of grey acacia twigs, and other bits and pieces of dried vegetation. Among this litter, the animal's pale grey legs and flattened twig-like antennae take on a thoroughly woody appearance. Note also that its eyes do not look much like insect eyes, thanks to the sharp contrast between the paler upper and darker lower halves, an example of what biologists call 'disruptive colouration', because it disrupts the outline of an object, obscuring its identity. Disruptive eye colouration removes a cue of grasshopperness, helping the bicolour-eyed hoppers to live another day in an environment where skilful predators are constantly scanning for tip-offs to the next meal. In this respect, the grasshopper's sandpapery thorax, abdomen and hind legs also seem useful for insects that rest on a background of coarse sand. If a bird were to decide to go after these grasshoppers, it would, presumably, have to scan vast areas of sand and sort through huge quantities of twigs—again, not a recipe for weight gain.

Above Flannel bush is home to grasshoppers in the genus *Happarana* (top); the species' colouration almost perfectly matches the colour and texture of flannel bush leaves.
Photos – John Alcock

Left An undescribed species of grasshopper that offers nice examples of disruptive colouration. Note the bicoloured eye and black line on the thorax that together may break up the outline of the grasshopper, making it harder for predators to detect.
Photo – John Alcock

Below left Pied butcherbird.
Photo – Jiri Lochman

Below A grasshopper in the genus *Urnisiella* buries itself, taking its camouflaged body partly underground, so as to disappear from view.
Photo – John Alcock

Another intriguing feature of this grasshopper is that individuals come in different colours. Some are heavy on the greys, while others feature a preponderance of pale reddish browns. Sometimes a little grey male can be found mounted on a much bigger, much redder female, creating a two-tone copulating pair. (The striking size difference between the sexes of this and some other grasshoppers is at least partly a reflection of the fact that large females can produce many more eggs than smaller ones, which gives them a reproductive advantage. In contrast, small males can still produce vast quantities of minute sperm, and so males can fertilise huge numbers of eggs, despite being dwarfed by their mates.)

So what might be responsible for the colour variation in this species? Judging from other similar cases among insects, the fact that some individuals look different from others, even though they are the same species and may even be members of the same sex, is yet another indication of the evolutionary power of bird predation. Some birds are known to form a 'search image' for a particular prey item. After finding several victims of one species in fairly quick succession, the birds learn to hunt specifically for the special cues associated with this kind of prey, especially if it is highly camouflaged. I suspect that the larger insect-eating birds of the Kennedy Range employ the search image technique as a means of hunting efficiently for difficult-to-find prey (just as it helps us to have an accurate mental image of the cover of a book we wish to find in our bookshelves). If so, birds that form a search image for a grey, twig-mimicking grasshopper may tend to overlook reddish, sand-mimicking types because it is hard to keep multiple images in mind simultaneously. Of course, the reverse is true as well, so birds that happen to find several sand mimics at the outset would then tend to overlook grey twig mimics. In a species with different colour patterns, the different forms constitute different targets and so dilute their personal risk from attacks by visually hunting predators.

Thus, both the near perfection of

Right Camp Gorge.
Photo – Marie Lochman

Below right A mating pair of a yet-to-be-described species of grasshopper in which males are much smaller than the females and sometimes differently coloured.
Photo – John Alcock

camouflage and the occurrence of several colour forms in some Kennedy Range grasshoppers are almost certainly the handiwork of past generations of brutally efficient bird predators. Under pressure from these capable hunters, only the best-concealed individuals in each generation were likely to live long enough to reproduce and pass on the genes for their superior camouflage. As predators worked over each season's new crop of grasshoppers, winnowing out the less camouflaged colour patterns and leaving the better ones to reproduce, each species has been gradually reshaped in the image (or images) of its hardest-to-find types.

Previous generations of bird predators have influenced not just the external features of grasshoppers but their behaviour as well, as we have seen in the selection of resting sites by pebble-mimicking, leaf-mimicking and twig-mimicking species. Another species with behaviour that neatly complements its cryptic camouflage can also be found in the range. The grasshopper, which probably belongs to the genus *Urnisiella*, sports a classic hard-to-spot coat of grey, reddish and black patches and lines, but it is not content merely to sit still and pray when predators are about. Instead, this species sometimes launches into flight when disturbed, sailing off several metres across the red sands where it lives. After it skitters to a stop, the hopper freezes but then may very cautiously dig a little trench underneath its abdomen, using its hind legs to scrape away the sand and tiny pebbles beneath. The grasshopper then settles into the trench, and begins to drag material onto the top of its abdomen and thorax with its two elongate mid-legs, which reach out and draw the local material back to

Right The eastern face of the Kennedy Range after rain.
Photo – Marie Lochman

Below The conspicuous grasshopper *Monistria pustulifera* probably uses its colour pattern to advertise distastefulness to would-be consumers.
Photo – John Alcock

partly cover itself. Within a minute or two, the grasshopper has concealed itself to such an extent that you had better not take your eyes off the spot, even for a moment. If you do, you may never be able to find the hidden, semi-buried insect again.

Not every grasshopper in the Kennedy Range deploys take-your-breath-away tricks of the camouflage trade. In fact, some look as if they are actually going out of their way to let their enemies know where they are. And they probably are. A nearly universal rule in the world of insects is that—whereas edible species try to blend into the woodwork, seeking to extend their lives by hiding from their predators—distasteful species exhibit a high degree of conspicuousness, both in colour and behaviour. So it is that *Monistria pustulifera* sits right out in the open, flaunting its striking colour pattern, which features orange dots on a dark background. When I saw my first *M. pustulifera*, I oohed and aahed over its picturesque outfit, ignoring its less-than-attractive scientific name. When I picked it up, the grasshopper responded by exposing two bright crimson little wings, which had been hidden from view under drab wing covers. These tiny wings are completely worthless with respect to flight, but their abrupt appearance and bright colour may help to startle a naive predator, or remind an experienced one of an unhappy experience with this flightless, surely-toxic species. When specimens of a close relative of the grasshopper were experimentally offered to skinks, the skinks were quick to say 'No thanks', after learning that these brightly coloured hoppers taste dreadfully bad. I suspect that, after a single experience with *M. pustulifera*, a young butcherbird or babbler would also avoid it thereafter, having formed a durable association between its colour pattern and its bad taste.

So a walk in the Kennedy Range National Park can offer all sorts of lessons in the evolutionary results of predator-prey interactions, if you are willing to take the time to look at the grasshoppers here. Whether in Australia or Arizona, it does require a certain readjustment for most of us to look down at our feet instead of surveying the glorious panoramas in front of us, to think small instead of large. But it's worth it to discover a largely hidden world that most people overlook. After all, insects may be much smaller than euros or eagles, but they are also more common and just as entertaining in their own right. Each and every grasshopper species offers a story with chapters on colour pattern, choice of perch sites, manner of holding its hind legs, readiness to jump when disturbed, use of its wing pads, and the like. The grasshoppers of the Kennedy Range are out there, just waiting to be read, admired and enjoyed by us—but not by the local babblers and butcherbirds.

John Alcock is a professor of biology at Arizona State University in Tempe, Arizona, where he studies insect behaviour. He would like to acknowledge the help of David Rentz, who provided scientific names for the grasshoppers. John can be contacted by mail at the School of Life Sciences, Arizona State University, Tempe AZ 85287-4501, or by email (j.alcock@asu.edu).

Volume 19 Number 4 WINTER 2004

contents

Regulars

3 Contributors and Editor's letter

17 Bookmarks
Western Australia, an untamed view
Extraordinary Plants
Plants of the Kimberley Region of Western Australia

31 Endangered
Beaked eremophila

48 Feature park
Torndirrup National Park

62 Urban antics
Just hanging on. . .

Erratum

The photograph in the Autumn 2004 issue of *LANDSCOPE* (mid left, page 52) is the rare *Diuris purdiei* not *Diuris corymbosa* as stated in the caption.

The photograph in the Summer 2003-04 issue of a snail on p. 56 and p. 61 was incorrectly captioned. The photo is of the introduced predatory snail *Oxychilus* sp., which is thought to be at least partly responsible for the extinction of the Pemberton and Albany snails, and is a threat to many of our native terrestrial snails.

Publishing credits
Executive editor Caris Bailey
Editor David Gough
Assistant editor Carolyn Thomson-Dans
Contributing editors Verna Costello, Rhianna Mooney
Scientific/technical advice Kevin Kenneally, Paul Jones, Chris Simpson, Keith Morris
Design and production Tiffany Aberin, Maria Duthie, Natalie Jolakoski, Gooitzen van der Meer
Illustration Gooitzen van der Meer, Rob Fleming
Cartography Promaco Geodraft
Marketing Estelle de San Miguel
Phone (08) 9334 0296 Fax (08) 9334 0432
Subscription enquiries
Phone (08) 9334 0481 or (08) 9334 0437
Prepress Advance Press
Printing Advance Press, Western Australia
© ISSN 0815-4465

Please do not send unsolicited material, but feel free to contact the editors.

Visit NatureBase at www.naturebase.net

Published by the Department of Conservation and Land Management, 17 Dick Perry Avenue, Kensington, Western Australia.