

Unearthing the secrets of sandgropers

The bizarre look and traits of the sandgropener captured the attention of Western Australian Museum Curator of Insects Terry Houston long ago. But what began as a casual interest has blossomed into a long-time fascination with these strange life forms.

by Terry Houston

Enigmatic', 'bizarre' and 'elusive' are commonly used terms for a small group of soil-dwelling creatures known as sandgroper. Some Western Australians (also known colloquially as 'sandgroper') still doubt that such creatures exist and suspect that they are as mythical as the bunyip.

For years, I lamented the dearth of information on the life histories and habits of these fascinating insects, particularly when faced with public inquiries such as "I've just dug up this weird creature that looks like a beetle at the front end and a witchetty grub at the rear, and it appears to have a pair of big ears. Do you know what it would be?" I could inform the inquirer that the creature was a sandgroper and the 'ears' were the highly modified first pair of

legs but I was stumped when it came to the inevitable next question: "What do they do?" Sandgroper first came to the attention of science in 1832 with the description of the first species (actually from Melville Island in the Northern Territory) but the succeeding 170 years saw only a few scattered anecdotal observations on their habits appear in scientific literature.

During fieldwork on the sandplains north of Perth, I frequently saw signs of sandgroper activity in the form of long, raised lines snaking across bare ground, often for tens of metres, where the insects had burrowed just beneath the sand surface. I used to think, "surely some entomologist's curiosity will be sufficiently piqued one day that he or she will get busy with a spade and reveal to us all what sandgroper are up to down there". In the end, it was my curiosity that was sufficiently piqued.

Sandgroper hunt

City folk may doubt the existence of sandgroper but not so the cereal farmers of WA's mid and northern Wheatbelt. In that region, farmers consider the insects to be serious

pests to their crops and some regard them as virtual underground locusts. The allusion to locusts is fitting in one sense—sandgroper, which can reach lengths of 35 to 88 millimetres depending on their species, are descendants of grasshoppers and share many anatomical features with them. Before the 1930s, though, they had been regarded as degenerate mole crickets.

When I set out in 2002 to try to learn something of sandgroper biology, my first challenge was to find specimens. The insects are rarely seen and difficult to find in natural environments but I hoped that their habit of burrowing near the surface would reveal them. During the cooler, wetter months from May to September fresh surface trails appear a day or two after heavy rain when the soil surface is damp. By setting out intercept traps, I hoped to secure fresh specimens for dissection. But my pitfall and gutter traps never yielded a single sandgroper. Were these insects too smart to be caught this way?

Then came a stroke of luck. Driving along a farm road late one afternoon

Previous page

Koch's sandgroper (*Cylindroaustralia kochii*).

Photo - Jiri Lochman

Below An adult female Koch's sandgroper. This species occurs from Perth to North-West Cape.

Photo - Terry Houston



Right Sandgropers' mid and hind legs recess into the sides of the abdomen when burrowing.

Photo – Jiri Lochman

Centre right An adult male Tindale's sandgrop (*Cylindraustralia tindalei*) exposed in its near-surface gallery by scraping away the surface sand.

Below right Agricultural land can support large populations of sandgropers.

Photos – Terry Houston

following earlier showers, I came across several fresh trails extending partway across the bare, sandy surface. The compacted surface was slowing the insects' progress and, by simply scraping away the surface sand with a trowel, I found an open gallery beneath each trail within which was an adult male. This led to a simple but productive technique—driving back and forth over the same stretch of road after rain and looking for fresh trails. The only hitch was that all the specimens I obtained in this way (about 30) were males.

By keeping some of these specimens alive in soil in glass containers, I was able to observe how they burrowed. Unlike other burrowing insects that throw out soil to create a tunnel, sandgropers simply part and compress the soil with breast-stroke-like movements of their fore legs. They shuffle forwards on their tiny mid and hind legs and leave an open gallery behind themselves as they progress. If at any time they encounter an obstacle or perceive a threat, they back up along their galleries before striking off in a different direction. Compression burrowing takes some real 'grunt', especially in the more compact and less yielding sub-soil. Hold a sandgrop in your fingers and you soon become aware of the power of the fore legs. That power is generated by muscles packing the enlarged first section of the body, the prothorax.

To build a picture of sandgrop biology, I needed to obtain both sexes and desired good samples of the population year round. Thankfully, this was made possible by a number of interested farmers who invited me to their properties with the promise of all the sandgropers I could want.



Sandgropers at a glance

Sandgropers are classified along with grasshoppers and crickets in the order Orthoptera. Long regarded as degenerate mole crickets, sandgropers are now known to be more closely related to the diurnal grasshoppers and are placed in their own family, the Cylindrachetidae. They are highly adapted for burrowing, being wingless in all stages, having reduced legs and only vestigial eyes. They grow gradually (without metamorphosis), the immature stages (nymphs) resembling adults in form. Contrary to popular belief, sandgropers are not exclusively Western Australian. Fourteen Australian species have so far been formally recognised in two genera, *Cylindracheta* with one species and *Cylindraustralia* with 13. These species are distributed across the Australian continent except for the south-eastern corner and Tasmania. A third genus with one species is known from South America. One species of *Cylindraustralia* has been described from New Guinea but the record needs verification.

On one farm near Dandaragan, for example, I was able to find specimens easily at any time simply by digging a hole sufficiently large and deep in a pasture paddock. Virtually all native vegetation had long since been cleared from this farm, so it was clear that the sandgropers had adapted to the agricultural environment. Excavating

to a depth of two metres, I obtained approximately 100 sandgropers per square metre of surface. This was indeed a population of locust proportions.

Sandgroper cuisine

What did all these sandgropers eat? The answer came from dissecting 162 specimens and examining their

gut contents under a microscope. This revealed a varied diet. Plant material predominated in gut contents and comprised root, leaf, flower and seed tissue. How did the insects obtain above-ground parts of plants? Very likely by browsing on surface litter and nibbling at prostrate plants. Among the various sorts of seeds consumed, those of the weed 'double-gee' appeared to be especially favoured (surprising in view of the tough, spiny fruits that enclose them). Fungi formed another component of the diet. But sandgropers are certainly not vegans—they proved to have quite a taste for flesh with insects of many kinds and even the occasional spider and mite turning up in gut samples.

Tindale's sandgroper (*Cylindraustralia tindalei*) seems to have a fondness for termite workers and some individuals had stuffed themselves on these soil-dwellers. One of the most surprising prey items was a native bee (obtained when the sandgroper burrowed through an aggregation of ground nests). Cannibalism was rife in dense populations of Koch's sandgroper (*C. kochii*) with larger specimens preying on smaller ones. So, to some degree, the dense populations would be self-limiting.

Sandgropers have fat bodies that surround their gut and other organs. Doubtless, this serves as a food reserve, sustaining the insects during times of food scarcity.

Reproductive traits

The eggs of sandgropers and the method of depositing them proved to be quite intriguing. Unlike grasshoppers, which lay their eggs in batches (or 'pods'), sandgropers invest a good deal of effort in each egg, laying them individually, each in its own chamber at depths of 40 to 190 centimetres. Koch's sandgroper, which attains a body length of six centimetres or so, produces eggs some 7.5 millimetres in length and



Left Terry Houston at work near Dandaragan. Digging by hand proved to be the best way of obtaining specimens which were found from near the surface to depths of almost two metres.

Photo – Terry Houston

Right A freshly laid egg suspended in its chamber. A drop of water clings to the egg and mould grows on the cell floor.

Below right Red eggs like this one were found occasionally (many others were white marbled with pink).

Below far right Eggs found in summer had opaque shells. The eggs have pedicels and attachment discs with adhering sand grains.

Photos – Terry Houston

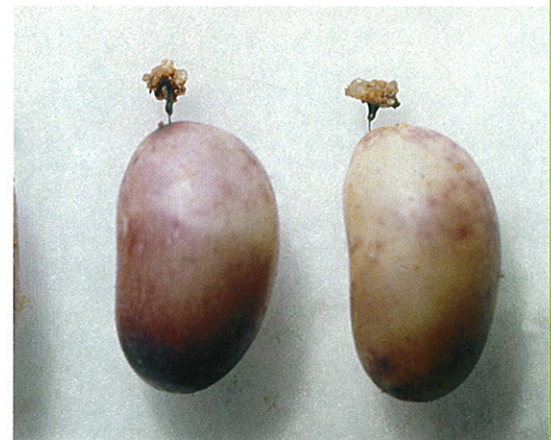


suspends them on short, flexible stalks (pedicels) from the ceiling of the egg chamber. The process involved has not been observed but must involve some clever manoeuvres.

Presumably the female begins by excavating a blind horizontal gallery, the end of which will become the egg chamber. By some means unknown, she must then reverse her direction so that she has her abdomen in the blind end of the gallery, and to deposit an egg on the ceiling would seem to necessitate her lying on her back. Oviposition complete, she must then withdraw, reverse direction again, and proceed to back-fill the access burrow with earth, leaving the egg in a 20-millimetre-long air space. As females were found to carry only a few ripe eggs at a time, their rate of reproduction appears to be rather low. What has not been established, however, is how long females go on laying.

The life cycle of the sandgropser is now better known and indications are that its duration is impressively long, perhaps several years. The egg hatches to a non-feeding 'larva' that moults within hours to the first nymphal stage, a miniature of the adult. After feeding on its eggshell, the little nymph burrows out of its brood cell and begins a life of independence. As the nymph feeds and grows, it moults five times before reaching adulthood.

In four samples of the population taken at different times of the year, eggs, nymphs of various sizes and adults were present, but small nymphs predominated. At first this was suggestive of year-round breeding but later, when it became apparent that eggs are laid only during the



winter rainfall months and remain dormant until hatching en masse in mid-summer, it became clear that this idea had to be wrong. The new recruits to the population in summer could be expected to feed, grow and soon moult to second stage nymphs. However, the abundance of first stage nymphs at all times of the year leads to only one conclusion—they must live for at least 12 months, overlapping with the next generation. If each of the five nymphal stages develops this slowly, the life cycle would extend over at least five years. Further work is required to see if this is true.

Underground homes

Why have the sandgropers evolved their subterranean lifestyle? Possibly one of the greatest benefits of living under the soil is the avoidance of vertebrate and invertebrate predators and parasitic (more correctly parasitoid) insects. Certainly, my study revealed no evidence of sandgropers having any kind of insect parasitoid at any stage of their life cycle, a most uncommon situation. The insects do produce a pungent and possibly defensive odour from

glands on the abdomen, yet they are clearly very palatable to ravens and the occasional hawk that swoop in behind farm ploughs to gorge themselves on the hapless specimens turned out onto the surface. Another benefit may be the avoidance of desiccation through the summer months when the insects are able to retreat to the cool, moist depths of the soil.

While much is still to be learnt about these bizarre creatures, at least now we have some information to provide when people ask "what are sandgropers" and "what exactly do they do?"

Terry Houston is Curator of Insects at the Western Australian Museum. He is especially interested in Western Australian insects including sandgropers, mole crickets, spoon-winged lacewings and truffle beetles. He can be contacted by email (Terry.Houston@museum.wa.gov.au).

- 48 Uncovering turtle antics
Monitoring Kimberley flatback turtles provides new insights into this threatened species.
- 55 Controversial cats
Scientists debate the role of cats in the decline of our native mammals.

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- 3 Contributors and Editor's letter
- 9 Bookmarks
Pilbara Western Australia
Western Weeds – A guide to the weeds of Western Australia
Rock Art of the Kimberley
- 30 Feature park
Marmion Marine Park
- 47 Endangered
Rottnest Island pine community
- 62 Urban Antics
Hot babes

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Executive Editor Kaye Verboon.

Editors Samille Mitchell, Rhianna King, Carolyn Thomson-Dans.

Scientific/technical advice
Kevin Kenneally, Paul Jones, Keith Morris.

Design and production Maria Duthie, Tiffany Taylor, Gooitzen van der Meer.

Illustration Gooitzen van der Meer.

Cartography Promaco Geodraft.

Marketing Cathy Birch
Phone (08) 9334 0296 Fax (08) 9334 0432.

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48



25



44



55