

DUNG BE





BEETLES

by Carson Creagh



Australia's 22 million cattle and 162 million sheep produce (according to research conducted by the CSIRO Division of Animal Production) at least 54 million tonnes of dung each year, measured as dry weight — enough to cover 150 000 to 200 000 ha of otherwise productive farming land. Much of that astounding total takes weeks (or, in especially dry conditions, months) to break down, denying nutrients to the soil for extended periods, reducing the amount of land available for fodder or leading to patches of rank, unpalatable growth. Sheep dung is a minor problem, but fresh cattle dung provides a bonanza for flies.

Surprisingly, Australia has several hundred species of native dung beetles, but they are largely restricted to native bushland where they make use of the fibrous dung produced by kangaroos, wallabies, wombats and other native mammals. Pastures and paddocks seem to provide unfavourable habitats for most native dung beetles, so they play little part in disposing of the dung produced by introduced livestock such as cattle and sheep.

This was the situation until the early 1960s, when CSIRO Division of Entomology researcher Dr George Bornemissza suggested that Australia would benefit from importing dung beetles that make use of dung produced by large

herbivores — especially hoofed grazing animals from open plains. In what is perhaps the largest-scale biological control project in history, dung beetles were first introduced into Queensland to counter buffalo flies (blood-feeding pests of cattle throughout Australia's north); then later, other species were introduced into southern Australia to control bushflies. In all, between 1968 and 1982, the Division of Entomology imported 55 species of beetles from Africa, Europe and Asia: Australia



Torres, echoes across the centuries in his comment that 'so great was the number of flies it seemed as if they wanted to eat the men up...'

In south-eastern Australia, 17 species of dung beetles have become established in New South Wales, four in Victoria and four in Tasmania. Their natural rate of spread is slow in relation to the vast areas devoted to cattle-grazing, and in many cases populations still remain within a 100-kilometre radius of their initial release sites. However, in recent years farmers and scientists, with the aid of the Dairy Research and Development Corporation, have aided dispersal by collecting beetles and transporting them to new, uncolonised sites. This is not always easy. Dung-burying beetles dig tunnels beneath the pads on which

they feed and react swiftly to disturbance by disappearing into their tunnels, creating the bizarre sight of collectors tip-toeing up to dung pads so they can grab a useful supply of beetles!

Research by Dr Marina Tyndale-Biscoe, from the Division of Entomology's Canberra headquarters, over the past 4 years in south-

THEY ARE WINNING ADMIRATION IN THE FARMING COMMUNITY, AND STARTING TO HAVE A MEASURABLE IMPACT ON THE ANNOYING BUSHFLY

is a very large continent with many different climates, habitats and soils, which explains why it was necessary to introduce such a variety of dung beetles.

The promise of reducing the numbers of bushflies, if not eliminating them, is obviously appealing. The shock and distress experienced by Diego de Prado, chronicler for the 1606 expedition of Luis de

MAKE THEIR MARK

eastern Australia and Tasmania indicates that the dung beetles established in this part of the country are beginning to have an impact on bushflies. Her field experiments have shown that, in ideal conditions, dung beetles can totally suppress the survival of bushfly larvae in dung pads, while the average survival over an entire summer season is reduced about threefold.

However, Dr Tyndale-Biscoe warns that we need a wide distribution of beetles before we can expect any long-term reduction in the fly nuisance, since flies can be carried by favourable (or, depending on one's point of view, unfavourable) winds from other areas where they have bred successfully.

In the Canberra region, which now has a well-established dung beetle population, she found that fly counts fell to below nuisance levels in 1990/91 — a year of high beetle numbers — and well below fly counts made before the introduction of exotic beetles. However, during the drought year of 1991/92, beetle numbers were severely reduced and fly numbers again rose to pre-introduction levels.

In some species of dung beetles, males and females cooperate in burying dung. The males carry pieces of faecal material into tunnels below the pad and pass these to their mates, which work the dung into 'brood masses' and then lay a single egg in each.

Thousands of dung beetles have been collected from a single cattle pad, and together they can destroy the entire pad in a matter of hours. Most species introduced into Australia are between 9 and 15 mm in length; the biggest beetles, *Onitis asynotus* and *Geotrupes spiniger*, which measure up to 25 mm long, usually occur in smaller

numbers but can achieve the same end just as quickly. Such speed is bad news for bushflies, since they need moist dung for up to a week if their larvae are to develop successfully. Large numbers of beetles also disturb each other, inspiring both males and females to fly to other pads in search of egg-lay-

ing material and thus increasing the speed of their dispersal. Even if dung beetles do not totally destroy every pad, their *modus operandum* ensures that enough material is removed so that there is little left in which fly larvae can survive. *Euoniticellus fulvus*, an 8- to 12-mm long beetle introduced from central and southern Europe from 1978 to

1982, and now well established in New South Wales, Tasmania, Victoria, South Australia and Western Australia, may for example dispose of less than half of a dung pad through burial. However, the combined action of many hundreds of these small beetles also shreds and scatters the pad,

known, the grateful citizens of some parts of Western Australia may well consider adopting dung beetles as their mascots. Dr James Ridsdill-Smith and Mr John Matthiessen, of the Division of Entomology's Perth laboratories, have found an 88% reduction in the number of bushflies in the Busselton district during high summer, and a reduction of 99% in the number of flies surviving from egg to adult in dung pads.

However, the first dung beetles released in Western Australia are summer-active: in other words, they are not abundant in spring, when fly breeding is at its height, so they cannot prevent an increase in the number of flies in December.

To close that gap, Dr Ridsdill-Smith and Dr Keith Wardhaugh identified, evaluated and collected spring-active beetles in Spain from 1977 to 1988, and in 1989 imported adults of three species that appeared to offer the desired pattern of greatest activity in spring, followed by a decline in dung-burying at the beginning of the hot, dry weather of summer — about the time when the already established beetles begin their breeding cycles.

With the cooperation of Iberian Airways, Qantas and Ansett, which provided free transport for specimens, the researchers established breeding populations in a special quarantine insectary at the Australian Animal Health Laboratories, Geelong, after which surface-sterilised eggs were transported to Western Australia for rearing to adult stage and field release.

One Spanish beetle, *Bubas bison* (active during autumn as well as spring), originally released in 1983 and then, to broaden its genetic base in Australia, released again in 1989, has established



Tasmania's 'beetle bus'

Mr Doug Kershaw, a farmer at Scottsdale in north-eastern Tasmania, is so enthusiastic about the benefits of dung beetles that he has established his own 'beetle stud'. Farmers are travelling long distances to collect Mr Kershaw's thoroughbreds, and he has already sent more than a million beetles to many places in Tasmania and as far as mainland Bega, on the south coast of New South Wales. The Tasmanian Department of Primary Industries, which supports the distribution program, this year organised two buses to take more than 70 farmers from the north-west of Tasmania to Mr Kershaw's property to collect beetles for release on their own farms.

ing material and thus increasing the speed of their dispersal.

Even if dung beetles do not totally destroy every pad, their *modus operandum* ensures that enough material is removed so that there is little left in which fly larvae can survive. *Euoniticellus fulvus*, an 8- to 12-mm long beetle introduced from central and southern Europe from 1978 to

interfering with the chances of flies laying eggs and drying out what material remains. *Euoniticellus* lays 60–80 eggs during its 3-month lifetime, so the first offspring will themselves be laying before their parent dies.

While dung beetles in eastern Australia have yet to make their presence and their benefits widely

itself so well that Dr Ian Dadour of the Western Australian Department of Agriculture and his assistants have 'cropped' 25 000 beetles from 3- to 4-ha field release sites and used them to 'seed' other areas. The 'cropped' beetles clearly stem from the original releases, since there is a lag of several years between time of release and recovery of the species in the field. Scientists hope that the later releases will, within a few years, build up into equally large populations.

While *Bubas bison* is making its presence felt in such spectacular fashion, the second and, in particular, third species are taking longer to establish themselves because of their complex breeding behaviour, but CSIRO researchers working in collaboration with Dr Dadour are engaged in a program to establish all three species and to evaluate their impact. The researchers hope they will eventually close the spring window. When all three species are hard at work, their overlapping breeding cycles will mean control of dung from August to the end of November, providing effective coverage of the main bushfly breeding season.

Farmers in coastal areas of the south-west of Western Australia are delighted by the success of the spring- and summer-active beetles: the presence of up to 2000 beetles in individual dung pads during times of peak activity means a pad can disappear in as little as 3 hours, greatly reducing populations of fly larvae and intestinal parasites.

Farming costs are down, too: landholders in many areas of the south-west have not had to harrow their paddocks to remove accumulated dung since the early 1980s, thus saving themselves harrowing costs of up to \$30 per ha. Some dairy-farmers are also

convinced that a reduction in the number of annoying bushflies has meant a reduction in stress among stock, with greater productivity being the eventual benefit. In fact, says Dr Dadour, some farmers in the south-west are so keen to identify their local dung beetles that they've been known to tape 'pin-up' photographs of beetles to their tractors!

But it is Western Australia's tourism industry that could be the biggest winner. The State's spectacular spring wildflower blooming attracts tens of thousands of visitors each year. It is unfortunate that dung beetles are as yet poorly established in the drier, inland areas where wildflowers are most abundant, though researchers hope to see eventually a declining number of bushflies to annoy visitors — no small consideration, given that the State earns at least \$1.7 billion each year from tourism.

Of course, dung beetles do much more than help the tourism industry. Their activities aerate the soil; reduce erosion; recycle nutrients; enhance water and root penetration; reduce the amount of dung available and hence the number of fly breeding sites; reduce numbers of gastro-intestinal parasites that breed in dung; reduce the transmission of diseases such as trachoma in humans and the related condition, pink-eye, in cattle; and reduce the need for drenching and harrowing, as well as the frequency of stock stress.

This impressive range of benefits provides some indication of why dung beetles, so revered in ancient Egypt, are attracting a new generation of admirers. Dr Dadour is extending community involvement in, and awareness of, the CSIRO-Western Australian Department of Agriculture collaboration by involving 300 primary and secondary schools

in south-western Western Australia in a project called BIOSCAN (supported by the Department of Industry, Technology and Commerce and the Western Australian Ministry of Education) that is designed to survey populations of both dung beetles and bushflies, and to spread the beetles themselves along with the good news.

More about the topic

Dung beetles dig in. *Rural Research* No. 98, 1978, 13–20.

Bushflies — native dung beetles lead the assault. *Rural Research* No. 98, 1978, 29–30.

Dung beetles get a little help from their friends. J. Seymour. *Ecos* No. 26, 1980, 20–5.

The boom and bust of the bushfly. R. Beckmann. *Ecos* No. 53, 1987, 8–11.

'Common Dung Beetles in Pastures of South-eastern Australia'. M. Tyndale-Biscoe (CSIRO Division of Entomology: Canberra 1990).

