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New dung beetles at work in Western Australia

Onthophagus ferrox, the main native species of dung beetle in the south west

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Two kinds of dung beetles are active in the agricultural areas of Western Australia. In one group are the native beetles which are mainly active in winter, and in the other group are beetles introduced from overseas. The introduced beetles are mainly active in summer and have already produced some spectacular results.

The CSIRO has been introducing dung beetles into Australia because native species are inefficient at breaking up the large dung pads of cattle throughout the year. The aim is to introduce species which work when the native beetles are not active, mainly in the summer months. This will improve the year-round recycling of nutrients in dung pads, help pasture growth, and remove the breeding site of the bush fly (and in tropical Australia, the buffalo fly).

Activity of dung beetles can also greatly reduce the number of cattle intestinal worms that reach the pasture from dung pads.

Onthophagus binodis, the most common introduced species successfully established in the south west

Onitis alexis, an introduced beetle common in the Geraldton area
The area covered by dung pads is significant in itself. Each cow drops an average of 12 dung pads each day, and this could cover 5 to 10 per cent of a paddock in a year if not disposed of.

Furthermore, unless they are ravenous, cattle avoid the zone of tall rank pasture immediately surrounding a pad.

Species
The most common of the local native species is a shiny black beetle *Onthophagus ferox* about 1.5 cm long with three spines on the thorax. This beetle is particularly active in winter and spring. It is a night flier and can sometimes be seen swarming around lights. These beetles are slow workers and are usually too few to bury an entire pad.

Most of the introduced beetles have come from Africa. Of these, *Onthophagus binodis* is abundant mainly around Albany and Bunbury. It is about 1 cm long, a dull black, and with a hump rather than spines on the thorax. *Onthophagus binodis* is active through the summer, when large numbers of beetles may be seen in a single dung pad. It is active in daylight and flies with a noticeable buzzing sound to fresh dung. The pad is often completely destroyed by the beetles' activity.

Another species, *Onitis alexis* is well established in the Geraldton area, as far south as Eneabba. It is about 1.6 cm long, a dull greeny-brown and with no hump or spines. The adult beetles fly only at dusk, and the species is particularly active in early summer.

In warmer areas, *Euoniticellus intermedius,* an African species, has been successful. It is well established in the north, and has been found around Carnegie and Mount Augustus. It is also established near Dandaragan. This species is small, about 0.8 cm long, and pale brown.

In tropical Australia, the species introduced from Africa, *Onthophagus gazella* has made spectacular progress since its first release in April 1967, and occurs north of a line through Broome, Daly Waters and Maryborough. Soon after release, *Onthophagus gazella*, demonstrated its ability to make long distance flights over water by colonising Magnetic Island, 7 km off Townsville, and a year later it reached Palm Island, 26 km off the coast.

Use of dung
Different species of beetles use dung in different ways. Most species dig tunnels in the soil under or directly next to the dung pad. They carry the dung down into the tunnels and make it into elongated balls in which the females lay their eggs.

One egg is laid in each ball. The eggs hatch into larvae which feed within the dung ball and eventually turn into adult beetles which emerge from the soil. Beetles of another group carve a mass out of the dung and move it some distance from the pad before burying it. Some species simply butt the mass over the ground but others knead pieces of dung into smoothly-rounded balls and roll them for many metres. Eggs are laid after the ball has been buried in the soil, or hidden in vegetation.

At some times of the year the beetles shred the dung instead of burying it. This is still effective for controlling flies.

The beetles cannot eat plant matter because they do not have biting mouth parts. Adults feed by sucking the liquid from the dung.

The beetle larvae feed on a mixture of solid particles and liquid from the dung balls in which they hatch. If removed from their brood balls, they are unable to survive.

Quarantine problems
The introduction of foreign insects is of great concern because of the chance that serious problems will become apparent after they have been released. Great care is therefore taken to screen insects before mass release in a biological control programme. Two basic questions must be considered — whether the insects themselves will have harmful side effects and whether they will introduce disease organisms.

As dung beetles cannot attack plants and can only breed in dung, harmful side effects are not likely.

To avoid the introduction of disease, an elaborate and rigorous programme involving surface sterilising of eggs of two successive generations is carried out before a new species is sent to Australia. This eliminates the possibility of introducing serious cattle diseases such as foot-and-mouth and rinderpest.

After arriving in Australia, each species is bred in quarantine at CSIRO headquarters in Canberra before being released in the field.

Dung-inhabiting fly predators
Some attention has also been paid in Australia to another group of beetles that inhabit dung; the histerids. They do not eat dung, but both the adults and the larvae attack and voraciously consume fly maggots in the dung.

Unfortunately the histerid species so far examined are not expert hunters, and only 30 to 50 per cent of the maggots in the dung pads are
destroyed. Even this degree of destruction would be of value, however, and so five species have been introduced, and one species has become established in New South Wales.

Recently work has begun on mites predatory on fly larvae and eggs. Many species of mites live in close association with dung beetles — even to the extent of riding on them. These mites roam through the dung seeking fly larvae and eggs to eat. Experiments in Canberra showed far greater fly control in dung pads with mites and beetles compared with pads having only beetles. Introduction of suitable mites from overseas is therefore now being considered.

Research in Western Australia

CSIRO has recently set up a team in Perth to study dung beetles and the bushfly in the south-west. By studying seasonal and daily patterns of activity and the distribution of both native and introduced beetles, it is hoped to define the gaps in dung beetle activity in south-western Australia. From the many species available overseas, a beetle is introduced only when it is considered to occupy one of the gaps which exist in local dung beetle activity. After quarantine and mass-rearing, beetles are released at selected field sites, usually by officers of the Department of Agriculture or CSIRO.

It takes considerable time to breed up large numbers of beetles for release, and thus beetles cannot be made available on demand. Release sites for new beetles are selected on the basis of the climate, soil type and cattle numbers. When the beetle becomes established it will spread naturally into suitable areas. Land-holders will be encouraged to collect their own beetles when suitable species are established, and enough is known to make artificial spread successful.

There are ways in which a dung beetle population can be encouraged. It is important that fresh dung should be available when
a new dung beetle is becoming established. Therefore, if a paddock is shut up for hay or cropped, beetles can best be encouraged by keeping stock in a nearby paddock. Numbers of beetles also tend to increase in a paddock where stock have been grazed continuously for several years.

Spraying of pastures with insecticides in areas where dung beetles are active should be avoided, particularly in spring and summer when beetles are active on the surface of the soil.

Study of dung beetles is continuing with work by CSIRO, the Department of Agriculture and farmers.