

Flight

Dung beetles are strong fliers, able to travel up to several kilometres in one flight. Species fly either during daylight hours, at dusk and dawn, or at night. They can detect dung from a considerable distance by its smell, and fly upwind along an odour plume to it. They fly to fresh dung when their current supply is exhausted. When stocking rates are low, or cattle are regularly moved, dung beetles may need to fly considerable distances to find fresh dung.

Feeding

Dung beetles feed on the dung of vertebrates (i.e. animals that have spines). Adult dung beetles squeeze dung in their mouthparts to extract the fluid on which they feed. Dung beetle larvae feed on the whole dung (i.e. fluid and fibre), which they cut and chew with their mouthparts. Dung beetles do not require any other nutrients—not even water.

Young adult beetles always feed in dung for a week or more before they are ready to breed. This is known as the maturation feeding period.

Breeding

Dung beetles exhibit two main types of breeding behaviour:

- 'Tunnellers' (most species) make tunnels under the dung pat (see figure 3).
- 'Rollers' make a ball of dung at the dung pat and roll it away (see figure 4).

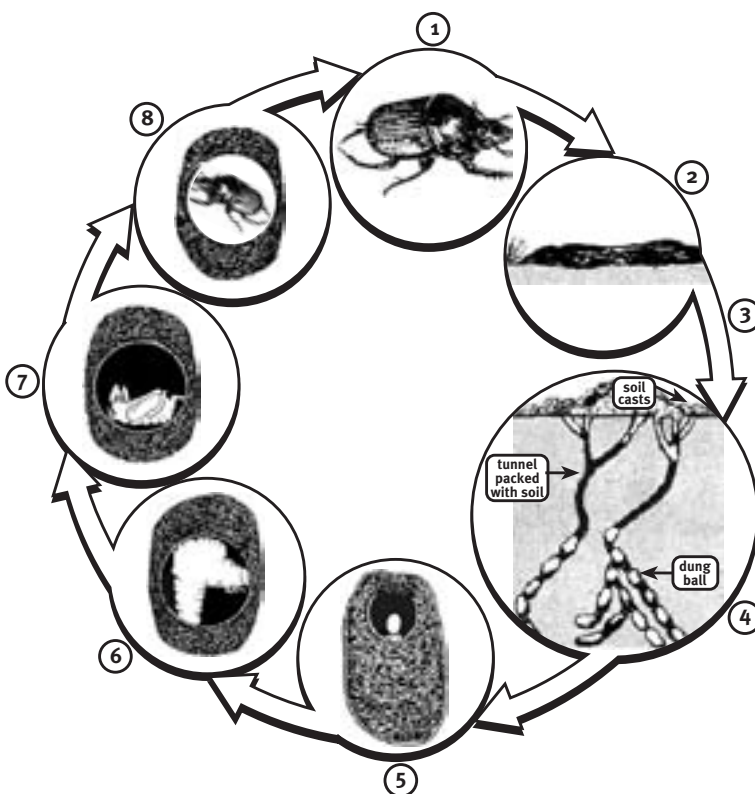


Tunnellers

Tunnellers take the dung down into an underground nest, which they provide for their offspring. The male collects the dung and passes it down to the female, who constructs the nest and makes brood balls.

Most tunnellers lay one egg into individual brood balls moulded from dung, but some make a longer sausage of dung into which two or three eggs may be laid. A pair may work together in a single dung pat for several days, or even longer, while dung is available. The beetles then fly off separately in search of fresh dung.

Larvae hatch from the eggs and feed on the dung in the brood balls. When larval growth is completed, the larva pupates. Finally, the new adult emerges and digs up to the soil surface. Depending on the species, the time between egg laying and adult emergence can vary from one month to a year or more.



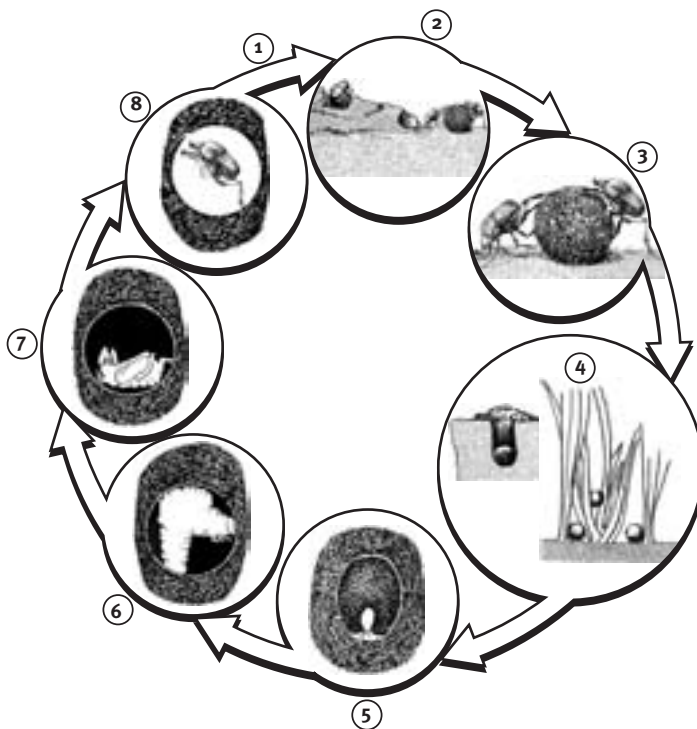
- 1 Adult digs to soil surface and flies to fresh dung
- 2 Fresh dung
- 3 Male and female form a pair
- 4 Female lays an egg in each dung ball
- 5 Egg
- 6 Larva
- 7 Pupa
- 8 New adult

Figure 3: Life cycle of tunnelling dung beetles (Source: Queensland Dung Beetle Project Training Notes 2002)

Ball-rollers

The male and female of the other group, the rollers, slave away, removing seeds and coarse fibres from the dung as they form it into a neat round ball. This is then rolled away by the pair, or by the female alone. Most (such as *Sisyphus rubrus*) bury the ball before laying an egg in it; however, *Sisyphus spinipes* lays an egg in the ball and leaves it propped up in a tussock of grass or other vegetation.

Some life cycle characteristics for the eight common species in Queensland (six tunnellers and two rollers) are shown in table 1.



- 1 Adult digs to soil surface and flies to fresh dung
- 2 Dung balls made at dung pad
- 3 Male and female roll dung ball away
- 4 Dung ball buried or propped in grass
- 5 Egg
- 6 Larva
- 7 Pupa
- 8 New adult

Figure 4: Life cycle of ball-rolling dung beetles (Source: Queensland Dung Beetle Project Training Notes 2002)

Species	Flight time	Development period (egg to adult)	Life span of adults	Number of eggs laid per day	Depth of tunnels
Tunnelling species					
<i>Onthophagus gazella</i>	dusk/dawn	4–6 wks	2 mths	1–2	20–30 cm
<i>Onitis alexis</i>	dusk/dawn	2–5 mths	>2 mths	2–3	10–20 cm
<i>Onitis viridulus</i>	dusk/dawn	6–8 wks	?	2–3	<10 cm
<i>Euoniticellus intermedius</i>	day	5–6 wks	1–2 mths	2	5–15 cm
<i>Liatongus militaris</i>	day	?	?	?	5–15 cm
<i>Onthophagus sagittarius</i>	dusk/dawn	?	?	?	?
Ball-rolling species					
<i>Sisyphus spinipes</i>	day	7–11 wks*	2–4 mths*	1 per 2 days	no tunnel
<i>Sisyphus rubrus</i>	day	5–16 wks*	2–6 mths*	1 per 2 days	10 cm

Notes:
 ? = no information available
 * = laboratory data

Table 1: Life cycles of common dung beetle species (Source: Queensland Dung Beetle Project Training Notes 2002)

Seasonal activity

Dung beetles are most active during the warmer months of the year, particularly after rainfall. The single exception to this in southern Queensland is *Onitis caffer*, which is active in autumn and early winter.

Breeding activity stops before winter. Dung beetles go underground during the cold months, either as adults or larvae. There is considerable adult mortality during this time. Some species simply become less active during winter, but others go into a state of diapause (which is similar to hibernation) and do not emerge until stimulated by environmental factors—such as a rise in soil temperature, or rainfall. In the case of *Onthophagus gazella*, the first good spring rain triggers pupation of larvae and the second good rain triggers the emergence of new adults.

Factors that affect dung beetle populations

Dung beetle populations can be adversely affected by factors including:

- dry weather
- cold weather
- predators—cane toads, ibis, crows, pigs, foxes
- dung from grain-fed animals
- chemicals—certain parasiticides used to control livestock pests can pass into the dung
- pasture quality—good quality pasture produces good quality dung (higher moisture and nitrogen content), resulting in higher rates of egg production by dung beetles and, hence, larger populations.

Managing to optimise beetle populations

Dung beetle activity is largely governed by seasonal conditions; however, there are several things that property managers can do to enhance dung beetle populations.

1. Use chemicals strategically:
 - When possible, use chemicals that have little or no impact on dung beetles.
 - Use hazardous chemicals only as necessary and at times of the year when beetle numbers are low (e.g. dry conditions, autumn and winter).
2. Reduce the amount of grain fed to cattle. The starch in grain produces an unnatural fermentation in the dung, lowering its quality and rendering it less attractive to dung beetles.
3. Manage the property to improve dung quality through better pasture quality—when the cattle are well fed, so are the beetles.

Dung beetles as competitors

(Source: Adapted from *BioScan*, 1995, Department of Agriculture, Western Australia, p. C3)

Dung beetles are not the only inhabitants of the dung pat; they share it with a range of other organisms, for example, predatory beetles, fly larvae, and mites. The dung beetles are interested in the dung pat for the bacteria-rich juices, which they extract and consume, and for the fibrous and colloidal components, which they take into their tunnels to feed to their offspring.

In search of nourishment for itself, each beetle removes some nutrients from the dung pat. The combined effect of many feeding beetles can quickly reduce one pat to fragments. Similarly, in a scramble for brood ball material, breeding beetles compete among themselves. Large numbers of breeding beetles are able to remove big pats completely within 24 hours by taking quantities of dung to their tunnels and brood chambers.

The beetles are affected little by other insects in the dung pat, apart from competition among themselves and some predation. In the scramble for dung juices and for dung for brood balls, however, the beetles render the pat unsuitable for some species (such as larvae of the bush fly and buffalo fly).

When dung beetle activity is intense, few suitable sites remain for flies to lay eggs and little suitable dung remains in which their maggots can develop.

Dung beetles and nutrients

One of the main macronutrients in cattle dung is nitrogen (N). When dung is left on the soil surface, some of the nitrogen is eventually converted to ammonia and nitrogen gas, and passes into the atmosphere—a process known as volatilisation. Some nitrogen is thus lost to the pasture system.

By rapidly burying dung in the soil, dung beetles help to preserve and recycle the nitrogen because most of it is retained below ground and converted into nitrates. These are absorbed by plant roots and used as building blocks for plant growth. The other nutrients in dung—phosphorus, potassium, calcium, magnesium and various trace elements—are not volatile and are recycled in the same fashion. These buried nutrients are located in the root zone of most pasture plants. After uptake by roots, they are locked up in plant tissue until consumed by livestock or liberated from decomposing plant litter. Recycling with the help of dung beetles makes nutrients available to plants much more rapidly than if the dung was left to decompose on the soil surface.

Dung burial also helps to reduce the problem of nutrient loss from pastures into water catchments.