Calling on More Troops –
New Beetles Help Degrade Dung on Canadian Pastures

It can take hours, days or weeks for dung-breeding beetles to scatter or bury cow pies deposited on pastures. Much depends on the number and species of beetles at hand – and they have a lot of work to do. A cow can deposit up to 22 kg of fresh dung each day throughout the grazing season, and Canada has a national herd of about 14 million animals. The tireless efforts of these beetles in degrading cattle dung provide huge returns to Canada's ranchers.

Dr. Kevin Floate, a scientist and dung beetle specialist with Agriculture and Agri-Food Canada (AAFC) in Lethbridge, Alberta, leads a research team to increase awareness of these beetles and introduce more efficient dung-degrading species onto Canadian pastures.

Benefits of Dung Degradation

Undegraded dung reduces the amount of pasture available for grazing, provides breeding sites for pests of cattle, and removes nitrogen and minerals from pasture soils. Through their feeding and tunneling activities, dung-breeding insects hasten the return of organic matter from the pat back into the soil to increase forage yields, increase soil aeration and water retention, remove breeding sites for livestock pests, and generally improve the aesthetic value of the countryside.

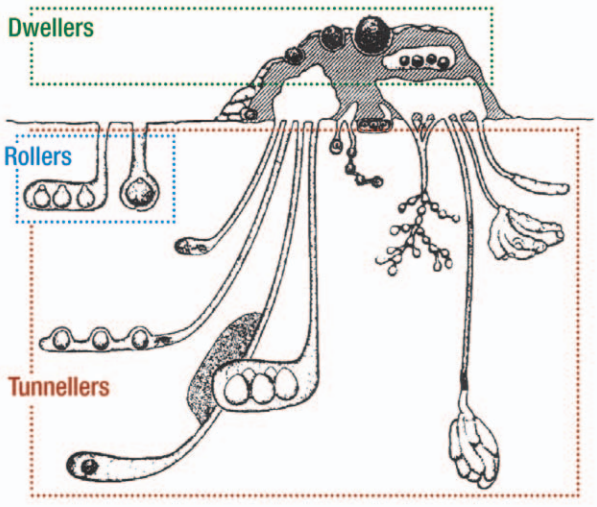
It is difficult to capture the economic benefits of these services, although some have tried. One study calculated a potential annual benefit of $2 billion associated with accelerated dung pat degradation in the United States[1]. A second study estimated that the dung deposited by a group of 455 cattle on pastures in northern California equated to a loss of about $4800 from time of deposition to complete degradation (3 years)[2].

Dung-Breeding Insects

Literally within minutes, fresh cow pats deposited on pastures during the grazing season are colonized by a mix of dung beetles, flies, parasitic wasps, and predatory beetles. More than 450 species of insects occur in cattle dung in North America with more than 80 such species in western Canada[3]. Face fly, horn fly and stable fly are pests, but represent a small fraction of the total. The vast majority of dung-dwelling insects are beneficial as they are natural enemies of pest species or, through their feeding and tunneling activities, accelerate the degradation of the pat.

Insect activity is highest in the spring, declines during the hot, dry months of July and August, and then increases again in autumn before the onset of winter. From October through April, the insects remain inactive in soil or dung. In spring, they emerge to colonize moist, fresh dung, passing by older pats that are dry and no longer attractive. This pattern of activity helps explain why pats deposited in February can remain intact for years.

Dung beetles, often the largest and most abundant insects in cattle dung, are the main contributors to pat degradation. Although there are many species, dung beetles are commonly grouped as 'tunnelers', 'rollers' or 'dwellers'. Tunnelers and rollers are most desired. They can scatter and bury a fresh pat in less than a week. Adults arrive at the pat to remove small pieces of manure. Tunnelers will bury this manure in chambers that may be 15-20 cm below the pat. Rollers will carry the manure away from the pat and then bury it. The manure provides food for beetle grubs that hatch from eggs laid in the chambers. Burying the manure not only increases soil fertility, but also increases soil aeration and its permeability to water. Dwellers are least desired.



They degrade dung pats over a period of weeks and do not tunnel in the soil. Instead, adults lay eggs in chambers they form in the pat. Feeding by the grubs that hatch from these eggs slowly degrades the pat to the consistency of sawdust. Dwellers are most common on Canadian pastures.

New Beetles for Canada?

In 2007, funding from the Canada/Alberta Livestock Research Trust provided the opportunity to assess the likelihood of establishing two new species of tunnelers in Canada. *Digitonthophagus gazella* and *Onthophagus taurus* are European species that were introduced into the southeastern United States in the early 1970s.

AAFC researchers developed computer models, performed temperature studies, and made field-cage releases to determine whether these two new species could survive in Canada.

The computer models, developed by Dr. Owen Olfert (AAFC, Saskatoon Research Centre, Saskatoon, SK), use temperature and moisture data from sites where the two species occur elsewhere in the world to predict establishment based on corresponding data for Canada. Results ruled out *D. gazella* for Canada, but predicted survival and establishment for *O. taurus* across most of southern Canada with greatest potential in southern Ontario and Quebec.

Temperature studies support these predictions. Lab colonies of *D. gazella* and *O. taurus* were established at Lethbridge using insects provided by Dr. Wes Watson (North Carolina State University, Raleigh, NC). Eggs from these colonies were then held at constant temperatures ranging from 10 to 32°C in 2°C increments. A minimum temperature of 22°C was required for egg-to-adult development for *D. gazella*, but of only 16°C for *O. taurus*. Both species develop in manure buried in the soil at depths of about 10-15 cm. Cool soil temperatures at these depths in southern Canada prohibit development of *D. gazella*, but not necessarily of *O. taurus*.

Field releases confirmed results of the computer models and lab experiments. Plastic tubs of soil were placed in the ground during the summers of 2009 and 2010. Adult *D. gazella* and *O. taurus* were released into the tubs, which were provisioned weekly with fresh dung until October and kept covered with wire mesh to prevent the escape of beetles. In spring of 2010 and 2011, the soil and spent manure in each tub was carefully examined. Live *O. taurus* recovered in the tubs in each year were determined to be the adult progeny of the beetles placed in the tubs. Thus, *O. taurus* can both overwinter and complete egg-to-adult development in southern Alberta. No live *D. gazella* were recovered.

Releases of *O. taurus* were made on native pastures near Lethbridge in 2009 and 2010. Small numbers of *O. taurus* were recovered in dung-baited pitfall traps in 2010, but none were recovered in 2011. AAFC researchers continue to monitor the release sites to assess establishment success.

Ideally, populations of *O. taurus* will establish and gradually spread to increase the degradation of cattle dung and promote the productivity of pastures in southern Alberta.

References

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Onthophagus taurus
(6-12 mm in length)

Digitonthophagus gazella
(8-13 mm in length)

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