An inordinate fondness for beetles

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In 1987, Edward Wilson, a noted rainforest ecologist described insects as "the little things that run the world". Among them, beetles represent the most spectacular and diverse group, and as Haldane remarked "The creator, if He exists, must have an inordinate fondness for beetles". In Ancient Egypt, dung beetles were sacred because they were believed to transform death into life by rolling and burying balls of decayed matter into the ground from which life emerged. Scientists have confirmed that the Egyptians' respect for dung beetles is well founded; dung beetles play crucial roles in the ecosystem by recycling the soil nutrients, controlling parasites and dispersing seeds.

Dung beetles are strongly influenced by variations in their habitat, and by the presence of vertebrates on whom they rely for food (dung). Scientists have often investigated how variations in one environmental factor affect a particular species of dung beetle, but some factors are likely to be more important than others, and also, it is difficult to know how beetles are affected by the complexity of habitat factors (soil features, temperature, vegetation, other animals, etc.). I wanted to understand how some of these factors interact to determine where dung beetles are found. I selected a site where conditions gradually changed from one type of vegetation to another. Of course, what I also needed were two organisms which are easy to sample and to identify.....Welcome to the world of *Amphistomus pectoralis* and *Temnoplectron involucre*!

These two dung beetles are far from "sexy"; at first sight people often confuse them for ticks. Both species are tiny (2-3mm), flightless (see figures 1 and 2), nocturnal and generally most active during the wet season. They are found only at Mt Spec (975m above sea level), a small area of the Wet Tropics World Heritage Area, in the Paluma range. I set pitfall traps across a natural boundary of rainforest and wet eucalypt forest (also called sclerophyll) to collect and observe both species, and to record other details about the habitat (see figure 3).

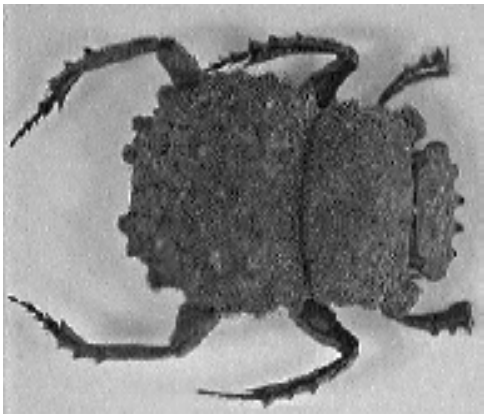

Figure 1 *Amphistomus pectoralis. To date, A. pectoralis has never been observed to roll a ball of dung. This observation is surprising given the curved posterior legs of these beetles, particularly marked in A. pectoralis.*

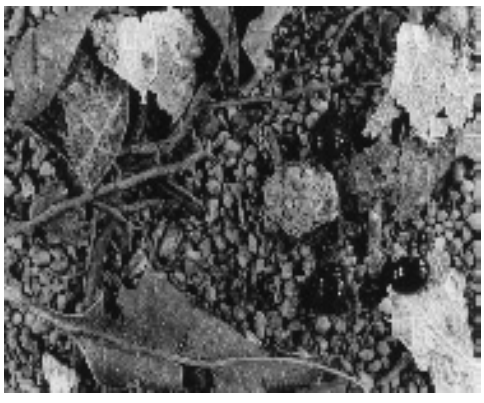

Figure 2 *Temnoplectron involucre. Although similar in size to A. pectoralis, this species is black and shiny and is seen here next to a ball of dung which it has rolled (photo: R. Yeldham)*

An important aspect of this study was to assess the influence of variations in vegetation structure and soil texture on the distribution of the beetles. On a 2 metre square area around each trap, I recorded the number of trees and I estimated the coverage of canopy, shrubs, grass, ferns, leaf litter, bare soil and dead wood. I also analysed soil texture (amount of clay, sand, and silt) with a laser particle sizer.
The results show that *A. pectoralis* is rare and its distribution is patchy, whereas *T. involucre* is abundant and widely distributed across the boundary. Moreover, *A. pectoralis* never occurred further than 50 metres into the eucalypt forest, whereas *T. involucre* occurred as far as 150m into this habitat. Both species seem to prefer habitat with a tall forest canopy and lots of tall shrubs. Also, *A. pectoralis* was more likely to be found in silty soils.

The investigation continues

Differences in vegetation and soil texture, therefore, only partly explain the pattern of distribution of these two species. The reality is that there are possibly more important ecological and behavioural factors determining what is happening across the boundary. For example, dung beetles live and reproduce within the soil, and therefore, soil moisture and temperature are likely to be important factors influencing dung beetle survival. *A. pectoralis*, which is

The Rainforest CRC is a research partnership involving the Commonwealth and Queensland State governments, the Wet Tropics Management Authority, the tourism industry, Aboriginal groups, CSIRO, James Cook University, Griffith University and The University of Queensland

mostly restricted to the rainforest habitat, may have a low tolerance for the drier soil conditions or temperature fluctuations outside the rainforest. I am aiming to test this by comparing the physiological tolerance of each species, in the lab, to different conditions of soil moisture and temperature.

The amount and type of dung

In 1996, another Rainforest CRC researcher, Dr Chris Hill, found that *A. pectoralis* and *T. involucre* are preferentially attracted to the dung of omnivores (for example, pig) and herbivores (for example, wallaby), and to larger rather than smaller dung piles. If the amount and type of dung determines the distribution and abundance of the beetles, we would expect more omnivorous and herbivorous dung, and in larger amount, where the beetles are the most abundant. Steve Williams (Rainforest CRC researcher) has studied small mammal abundance at the rainforest—wet eucalypt boundary. Steve found the biomass of small mammals decreased from the rainforest to the sclerophyll. So too do the dung beetles! The type and quantity of dung may, therefore, also explain the distribution of the two beetle species.

Figure 4 *Researcher Agnes Rortais collecting specimens*

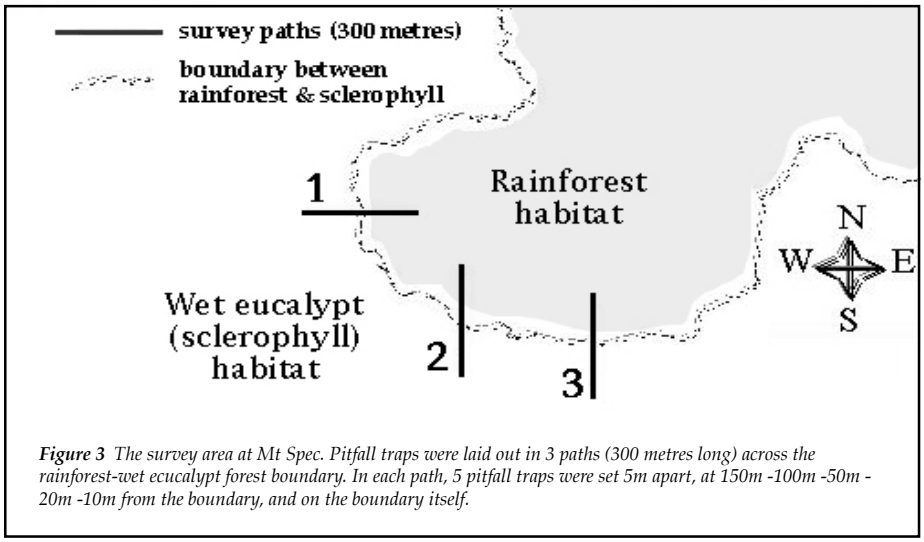

Figure 3 *The survey area at Mt Spec. Pitfall traps were laid out in 3 paths (300 metres long) across the rainforest-wet eucalypt forest boundary. In each path, 5 pitfall traps were set 5m apart, at 150m -100m -50m -20m -10m from the boundary, and on the boundary itself.*

How to be a good competitor

For dung beetles, the more dung they get, the more competitive they are. There are many ways to be a good competitor such as being first on the dung pad and rolling balls away. This rolling behaviour allows dung beetles to take away, store, hide, and protect food from competitors. Beetles which roll dung often bury the balls in the ground or store them under leaves where the moisture level is more favourable. Observations in the lab and in the forest show that *T. involucre* is more mobile than *A. pectoralis* and that *T. involucre* arrives first on dung. I have also observed that *T. involucre* feed either directly on the dung or roll balls, whereas *A. pectoralis* does not roll, it only feeds directly on the dung pad. Why is this important? The sclerophyll is drier and has less dung, and *A. pectoralis* might find itself outcompeted by the faster actions of *T. involucre*. Further research and observations are required to evaluate whether competition for dung is an important factor determining where these two species are found.

Dung beetles respond differently to changes in the environment. These responses, when fully understood, may indicate different things about the environment, depending on the species and the habitat. For example,

- *A. pectoralis* may indicate the presence of an important ecological boundary between the rainforest and the eucalypt forest
- *T. involucre*, in the eucalypt forest, may be an indicator of vertebrate diversity
- *A. pectoralis* and *T. involucre*, in the rainforest, may be correlated to the biomass of vertebrates.

For more information

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