Peer Review of Recent Dung Beetle Research Relevant to New Zealand

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Pastoral Productivity

Landcare Research Ltd has now completed research into whether the pastoral productivity benefits claimed in the ERMA application are applicable to NZ's pastoral production environment (see Dung Beetle Release Strategy Group website). Unfortunately, the dung beetles failed to show a statistically significant beneficial effect on pastoral productivity in these preliminary experiments. In contrast, in the same experiment, the application of dung (without beetles) did produce a statistically significant boost to pastoral productivity (approximately 20% more grass yield than occurred in the control plots that did not receive any dung or beetles).

The researchers attribute the absence of the promised dung beetle productivity dividend to the short-term nature of their trial (80 days). However, this is difficult to reconcile with their own data which showed their trial was of sufficient duration for the dung-only treatment plots (i.e. the plots with dung but not dung beetles) to show a significant increase in pasture growth.

So why did the dung beetle (plus dung) plots fail to show the significant pastoral productivity boost that was apparent in the dung-only plots? Was this difference simply due to chance – or can the beetles have negative effects on pastoral growth in some circumstances? For example, could the higher porosity and aeration of soil promoted by dung beetles have an adverse effect on pasture growth in drying or cooling conditions by promoting more rapid drying or cooling of the soil?

The New Zealand pastoral economy is highly dependent on matching the seasonal variation in animal nutrition needs to the seasonal variation in pastoral production. It will be very detrimental to New Zealand farming systems if dung beetles curtail pastoral production in key periods of the year such as late summer/autumn.

Run-off

Landcare Research Ltd has now completed research into whether the reduced run-off benefits claimed in the ERMA application are applicable to NZ's pastoral production environment (see DBRSG website). On the face of it, their results are encouraging showing significantly reduced run-off from the dung-beetle treated pasture plots. However, closer examination of the research creates questions about its practical relevance. Water was applied to the plots in two separate extreme 'down burst' rainfall simulations of ten minutes duration. The dung-beetle plots to which the water deluge was applied had contained dung beetles for two months prior to the deluge. The beetles had been fed on weekly cow pats added to the same small 2.3 m^2 plot. Not surprisingly, two months of intensive dung beetle burrowing on the same small plot created a plot area with numerous burrows that initially absorbed significantly more of the water applied to the plots in a ten minute downburst than did the plot areas without dung beetle tunnels (approximately 2 litres more water was absorbed in one trial and 650 mls in the second trial).

The researchers use these results to speculate that dung beetles will reduce flooding but do not present any time-course data to show that the increased water infiltration they observed in the dung beetle plots following a brief deluge will continue to occur at or near the same initial rate during more sustained periods of rain (e.g. once dung beetle tunnels have filled with water).

They also use these results to speculate that dung beetles will reduce the impact of droughts. However, they do not present any data on the water holding capacity of the more porous and aerated soils that result from dung beetle action. i.e. will these more porous soils dry out more quickly in drought conditions?

The researchers also make no comment on whether the increased water infiltration they observed in the dung beetle plots may worsen instability of steep slopes in hill country - promoting erosion.

Parasitology

Landcare Research Ltd has now completed research into whether the reduced livestock parasite larvae benefits claimed in the ERMA application are applicable to NZ's pastoral production environment (see DBRSG website).

Once again, on the face of it, the results of the trial are encouraging finding a significant reduction in the number of infective Cooperia sp. parasitic larvae in pasture plots with dung beetle activity. Unfortunately, the criticisms of the trial design are numerous and have included: the very high numbers of dung beetles used per faecal pat – creating questions about the practical relevance of the trial; the numbers of larvae recovered from the plots seem unbelievably high perhaps as much as twice the number of parasite eggs that were deposited in the first place – creating concerns about the methodology; the very rapid decline of the larvae from their peak numbers on pasture to near zero in 1 month was also considered very surprising given larvae can survive 6-9 months on pasture – suggesting these larvae may have temporarily moved into the soil and will be available to infect stock at a later time; the sampling regime was not considered anywhere long enough to conclude that there would be no development of the dung beetle buried parasite eggs to L3 in the soil and subsequent migration onto herbage – with soil temperatures dropping in the Autumn and evidence L3 larvae on pasture were moving strongly downward from pasture to soil one would not expect to see movement of newly developed larvae upward from soil to pasture. The latter concerns would have been addressed if the researchers had also samples soil for larval numbers. Lastly, it is not possible to extrapolate these results to other dung beetles (each species differs in their mouthparts and burial depths) or parasite species and parasitologist also point out that the introduction of dung beetles to Australia has not reduced the need for anthelmintic use in Australia and ask why this will be different in New Zealand?

Greenhouse Gases

New research from the Universities of Helsinki and Oxford gives good reason to question the previously claimed benefits for dung beetles on New Zealand's pastoral greenhouse gas emissions.

The research shows that dung beetles can potentially increase greenhouse gas emissions from livestock faeces rather than decrease them as proposed by the applicants and stated by the EPA in their record of decision. Specifically the study shows that *fresh* dung pats emitted higher amounts of carbon dioxide and lower amounts of methane per day in the presence than absence of dung beetles. The beetles also changed the timing of carbon dioxide release (causing a more rapid loss to the atmosphere) and increased nitrous oxide release. The authors go on to say that if methane and nitrous oxide fluxes are considered together the presence of beetles increased the warming effect of gas fluxes from dung pats by almost a third. They warn that calculating the overall warming potential of greenhouse gas fluxes from dung – and the effect of beetles thereon – is no simple exercise but one urgently needed. They also note that the effects of dung beetles on greenhouse gases could be species specific.