



Landcare Research
Manaaki Whenua

The New Zealand Dung Beetle Project: Background, Potential Benefits, Progress

Shaun Forgie

**LCR, science providers for the Dung Beetle
Release Strategy Group (DBRSG)**

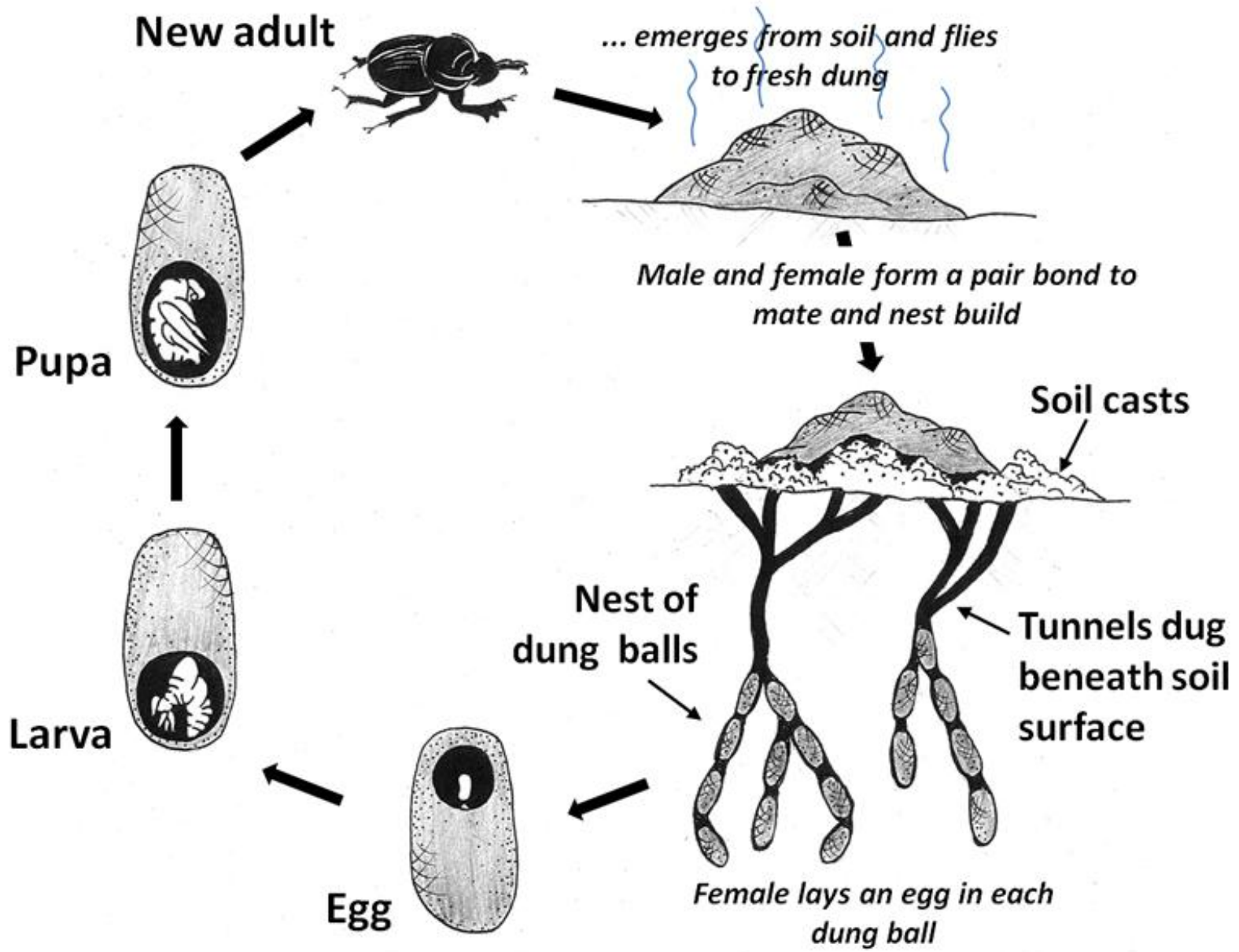


Three 'types' of dung beetle

Tunnelers are:

- **by far the most abundant**
- **responsible for the most dung buried**





**What dung beetles do we
already have in NZ?**



d



etl



Exotic pastoral dung beetles already in NZ



Exotic pastoral dung beetles already in NZ



Why do we want to introduce dung beetles

What's the problem?

Many problems stem from intensive livestock farming.....



Most importantly, intensive livestock farming promotes.....

surface runoff

- dependent on slope, soil texture and soil structure

degradation in water quality

- nitrogen and phosphorus
- faecal coliforms and pathogens (Cryptosporidium, Giardia)

A18

nzherald.co.nz The New Zealand Herald Monday, December 31, 2012

Clean up waterways, say scientists

Fouling of lakes and rivers country's 'largest' environmental concern

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Two scientists speaking at a major freshwater conference have described reversing the fouling of New Zealand's waterways as our largest environmental problem.

The New Zealand Freshwater Sciences Society's annual conference opens in Dunedin today, after a year that has thrust the state of lakes and rivers into the spotlight.

Most recently, New Zealand's "100% Pure" image was challenged when a Ministry for the Environment report found that more than half of our monitored river sites were unsafe to swim in, information later used in a *New York Times* article on

the eve of last week's premiere of *The Hobbit*.

Professor David Hamilton, the Bay of Plenty Regional Council's lake restoration chairman and biological sciences professor at Waikato University, said the status of New Zealand's freshwater was now "crucial".

"The current rate of intensification and the ability to maintain or enhance our aquatic systems don't match up at the moment," he told the *Herald*.

"What we've got to do is apply the same level of technology and thinking to the back end, the effluent end, as we have done at the production end. It's as simple as that.

"We've got a very expensive system

and we've become leaders in the production side of things in aspects of milking and production, but we are a long way off in regard to the effluent side of things."

Dr Hamilton also believed a bigger focus could be made on preventing nutrient loading into waterways upstream.

Dr Mike Joy, a senior lecturer at Massey University's Environmental Science and Ecology Group, said waterways would continue to deteriorate if the Government did not get tougher on land intensification.

Dr Joy said most of the nutrient-loading stemmed from dairy waste.

"One cow produces 14 times the human equivalent – that means we've got a population of 70 or 80 million, so no wonder we've got a problem."



Clear, clean waters are a priority for scientists. Picture / Alan Gibson

Potential Benefits

There are many key benefits that can potentially mitigate adverse effects of dung.

- **Soil structure and function.**

Tunnelling beetles increase levels of plant nutrients in the subsoil (e.g., phosphorus, nitrogen).

Tunnels increase aeration, reduce compaction, bring subsoils to the surface (bioturbation)

Burying dung increases the amount of organic matter in the soil, stimulates microbial activity, and nutrient cycling

Burying dung provides a food source for soil organisms such as earthworms

Potential Benefits

- **Water issues**

Tunnelling and improvements to the physical structure of soils have a “flow-on” effect which can include:

1) Improved water infiltration reduces surface ponding, assists agricultural inputs (lime, fertilisers) to enter the upper soil profile and reduce the level of contaminants entering the waterways...

(Waterhouse 1974; Bormemissza 1976; Doube 2005b)

2) ...which leads to improved water quality (Doube 2008)

**Who is introducing dung
beetles to NZ?**

The Dung Beetle Release Strategy Group



Landcare Research is the science provider for this group

EPA granted permission for importation and full unconditional release of all 11 species of dung beetle for use in NZ pastureland.



Benefits

Significant

Risks

Negligible

Selection Criteria

At least 11 species needed to control livestock dung 24-7, 365 days a year throughout NZ.....

- All species occupy differing but overlapping seasonal activity periods
- Some species are day active, others night active or active only at dawn and dusk
- All species are habitat specific to open grasslands
- All species evolved to feed specifically on the dung of herbivorous mammals (artiodactyles)
- Climatic suitability





Bubas bubalus
17mm



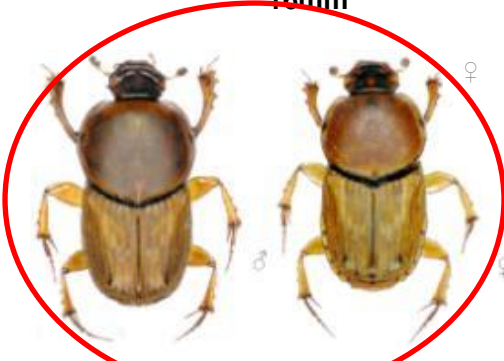
Bubas bison
16mm



Copris hispanus
18mm



Copris lunaris
18mm



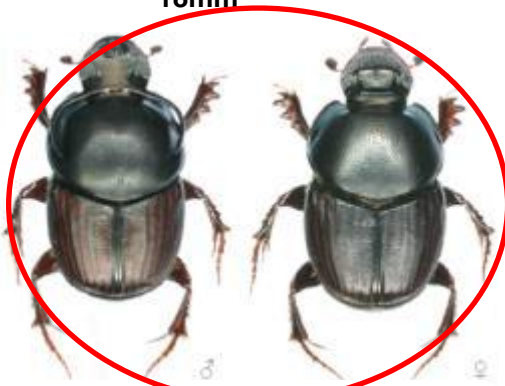
Euoniticellus fulvus
10mm



Onitis alexis
20mm



Geotrupes spiniger
22mm



Onthophagus taurus
9mm



O. (Digitonthophagus) gazella
11mm



Onthophagus binodis
12mm



O. (Paleonthophagus) vacca
10mm



Summer



**Spring-
Autumn**



**Spring-
Autumn**



**Autumn-Winter (SI)
Year round (NI)**

EPA granted permission for importation and full unconditional release of all 11 species of dung beetle for use in NZ pastureland.

EPA and LCR have subsequently done several intensive reviews surrounding questions of risk subsequently raised. EPA stands by its decision 100%.

LCR has completed several internationally reviewed tests on disease risk (B-Tb, MAP) and food preference with results showing no risk.

LCR commissioned international review of the EPA application with review showing the process was thorough.

Technical Advisory Group

- **DBRSG has organised a TAG to advise how best to progress the project so potential benefits can be maximized while taking into account the needs of all stakeholders and need to protect environment.**
- **TAG proposed two caged field trials.**

Caged Field Trails

- Three livestock farms
- Three soil types: sandy loam, clay loam, compacted clays
- 9 cages (3x D+B, 3x D, 3x C (NoD+NoB)) at each site per trial.



Caged Field Trails

1. Surface run-off

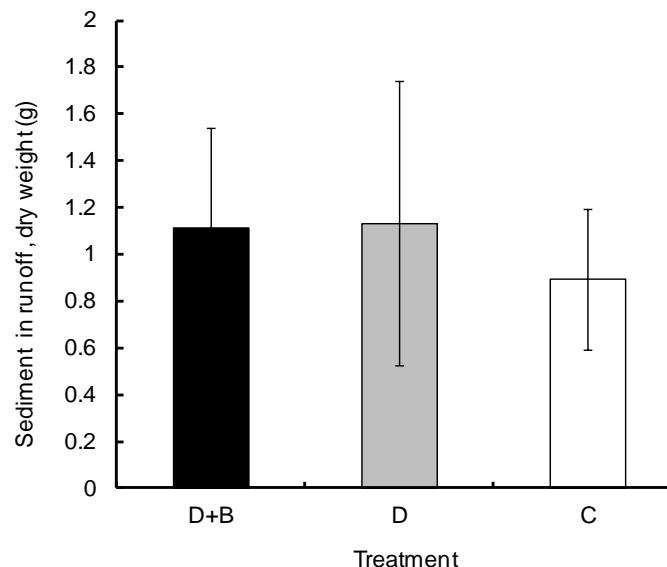
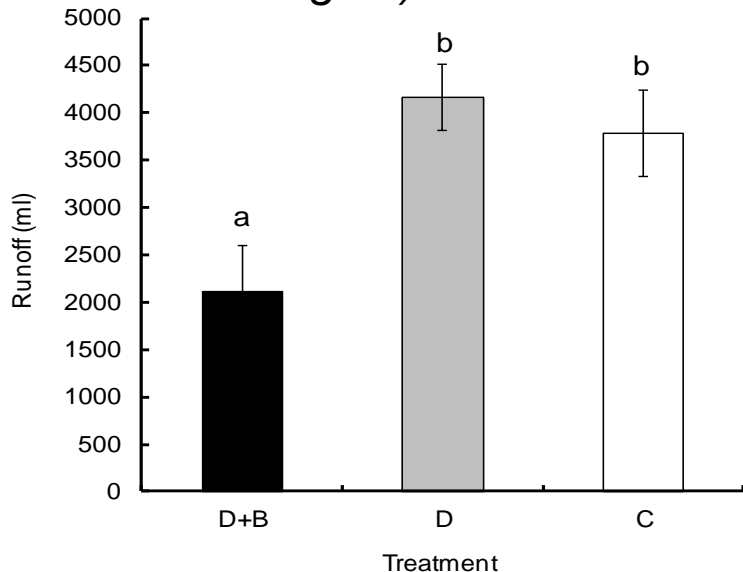
- All caged soil surfaces sloping 11Deg.
- 10x *G. spiniger* per D+B cage



Experiment 1. 12,500ml

rainfall simulation over 10 minutes.

(represents a > 1% ann. exceedence probab. (aep) event (> 1 in 100 yrs) in the trial region).



Caged Field Trails

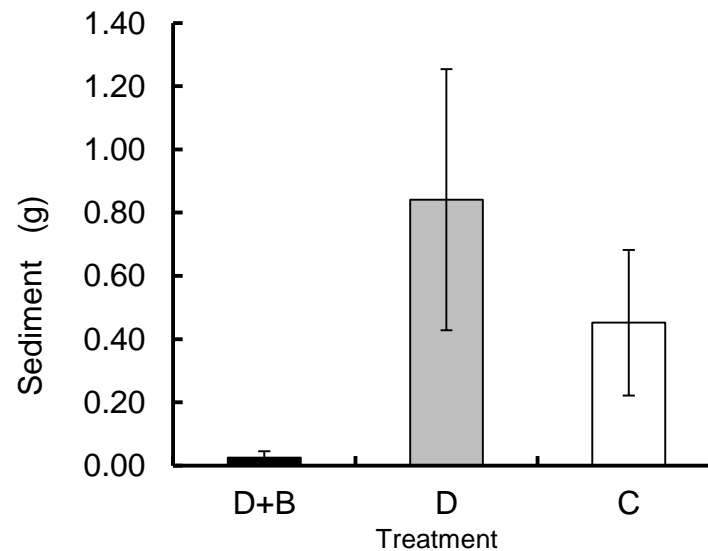
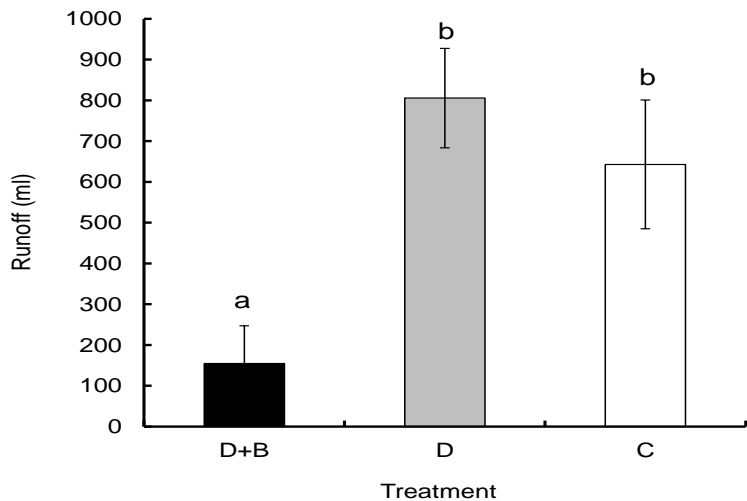
1. Surface run-off

- All caged soil surfaces sloping 11Deg.
- 10x *G. spiniger* per D+B cage



Experiment 2. 6,000ml

rainfall simulation over 10 minutes.
(represents a 2.2% aep event (1 in 46 yrs) in the trial region)



Caged Field Trails

2. The effect of dung beetle activity on the survivorship of parasitic nematodes of livestock

- Nematode infected dung ex. Agresearch experimental cattle herds, Palmerston North.
- *Ostertagia* sp and *Cooperia* sp. Density ~ 300 eggs/gram.
- D+B Cages each contain:



40x *O. binodis*



40x *D. gazella*



2x *G. spiniger*



- 1x 2.5L nematode infected dung pad added to each D+B and D cage.
- Grass samples taken from D+B, D, C cages at least every 14 days.
- L3 nematode larvae extracted and counted.

Testing Risk Scenarios

Scenario: The transmission and spread of Bovine TB in NZ may be increased by possums opportunistically feeding on an abundant supply of exotic pastoral dung beetles.

Test: Examine gut contents of possums collected (in pleasant and humane way) from bush margins flanking livestock pastures abundant with exotic pastoral dung beetles.

- 30 Possums collected in Whangarei.
- Dung beetle abundance survey carried out at trapping locations over trapping period.



- Dung pads surveyed for foraging disturbance by opportunist predators.

Acknowledgements

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Landcare Research

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