FOREWORD

"A journey of a thousand miles starts with the first step," said Lao Tzu, hundreds of years BC. Likewise, these were my sentiments when I arrived in Australia several decades ago, with a dream to do something BIG, which no one had done before. Thus, my journey led me to a small dairy pasture near Woolooroo in Western Australia on the twenty-fifth of October 1951. There, I was struck at finding fresh cow droppings among old, hardened pads, in which there were very few endemic dung beetles, which was the opposite situation in my home country of Hungary, where pads were literally seething with bovine-dung beetles.

Upon reflection, I was inspired to embark on another journey, which I could define as the "biological control of cattle dung!" This was a long journey that took me through thirty-two countries, along tens of thousands of miles, on four continents! Along my new journey, having left many milestones of achievement behind, I was rewarded with many discoveries. My search was, of course, also rewarded with many hundreds of species of bovine-dung beetles of which my new country, Australia, was in dire need. The rest, which followed, is now history, in the annals of the realm of applied ecology. Thus, began the changing face of the pastoral industry, countrywide, by cleaning up vast amounts of cattle dung, which was buried by our "newcomers", the many species of imported dung beetles, to the delight of our graziers and dairy farmers, alike, in most parts of the country.

There were also many milestones posted by grateful rural communities, an outstanding example of which is the Lucyvale grazing community in Victoria. Acting as a catalyst, Chips Boucher with the enthusiastic Belinda Pearce, the "Lucyvale Better Beef Group" is dedicated to the raising of cattle in their valley with outstanding support from bovine-dung beetles as the cattleman's "best friend". In their bid to obtain information on these beetles, they came across some valuable data, which they found to be dispersed throughout the scientific and popular literature. This resulted in recognising that an existing gap could be filled by collating available knowledge and unpublished data.

Consequently, there evolved a compendium of information which has been organised into the "Dung Beetle Resource Package". This package is a remarkable resource, whereby people on the land may find just about any answer to a multitude of questions related to the management of dung beetles. Richly illustrated, the printed material is supported by a DVD and CD. Together, this compendium of knowledge, in conjunction with Penny Edward's outstanding account entitled: "Introduced Dung Beetles in Australia, 1967–2007", provides a monumental and comprehensive reference.

In conclusion, I would like to congratulate the group for its enterprise, effort and vision, in this project, which will ensure prosperity and success for the grazing community, through the tireless helpers on their land, the humble and magnificent bovine-dung beetles which preceded us humans on this planet by at least one hundred and eighty million years and which will endure forever!

George Bornemissza

October 2008

ACKNOWLEDGEMENTS

The material contained in this package results from the generosity and support of a large number of individuals, groups, organisations and corporations from across Australia. This endeavour has rested upon the willingness of contributors to share their knowledge and resources with others. To all of those who have contributed, we thank-you for your generosity of spirit.

Special thanks go to:

- Chips Boucher from the Lucyvale Better Beef Group for his unyielding tenacity in securing funding for this project and tracking down available resources.
- The Dung Beetles for Landcare Farming committee for providing one thousand copies of the "Dung Beetle Dictionary" for inclusion in the package.
- Dr Penny Edwards for producing the species potential distribution maps and associated comments displayed in section four.

Numerous people have assisted in reviewing content and providing support and direction throughout the life of this project. In particular the ongoing assistance of John Allen, Bernard Doube, Penny Edwards, John Feehan, Graeme Stevenson, Keith Wardhaugh and Pam Wilson is gratefully acknowledged.

The assistance of Mick Alexander in incorporating aspects of the resource package on the National dung beetle web site has been most appreciated.

It has been a thrill and an honour to have the father of the CSIRO Dung Beetle project, Dr George Bornemissza write the foreword. We wish to thank Dr. Bornemissza for his encouraging words and guidance over the course of this project.

Funding support from the Commonwealth Department of Agriculture Fisheries and Forestries, National Landcare Program is acknowledged with thanks.

The final thanks go to the people of Lucyvale, and in particular the Lucyvale Better Beef Group committee members, David Laverty, Chips and Grace Boucher, Sharon Roberts, Brian Spurgeon, Sue Josipovic, Malcolm Jarvis and Alf Coulston for having the courage to embark on such an ambitious project.

MESSAGE FROM LUCYVALE

It is my great pleasure to present the Lucyvale Better Beef Group Dung Beetle Resource Package.

The Lucyvale Better Beef Group consists of a group of farmers from the Lucyvale Valley who has met regularly to share, research and initiate new ideas to improve their farm outcomes in these current trying times.

In 2006 the group received National Landcare funding for a dung beetle program with the aim of achieving all-year dung beetle activity. In excess of fifty thousand beetles comprising seven different species have been released over twenty properties.

Initially, the Group had difficulty accessing specific information about dung beetles and how to best implement a dung beetle release and monitoring program.

To overcome this problem and to avoid duplicating research by other groups and individuals, the idea of a resource package was born. It was the brainchild of Belinda Peace the Co-ordinator of the Lucyvale Better Beef Group Dung Beetle Project. Belinda must be thanked for the hours of tireless work involved and congratulated on compiling such a comprehensive package.

By sharing our experiences and putting together a diverse range of information from other projects we hope others find it easier to experience the agricultural and environmental benefits of dung beetles.

The Lucyvale Better Beef Group would like to thank everyone who has contributed to the development and distribution of the Dung Beetle Resource Package.

We sincerely hope the work done by a handful of farmers from the Lucyvale Valley will assist ensure the future of the humble dung beetle for generations to come.

David Laverty

Chairperson,
Lucyvale Better Beef Group

1. Introduction

Background

In the summer of 2004-05, beef farmers from the remote Upper Murray community of Lucyvale witnessed an occurrence that they hadn't quite seen before. Cattle dung that usually littered paddocks for months on end was alive with activity, dung pads literally "moving" before their eyes and disappearing within days. Horse, dog and cattle dung were all buried with equal ferocity. The farmers were so impressed by what they saw they wanted to know more.

A community meeting was held with dung beetle specialist, John Feehan as the guest speaker. John has over 30 years experience with the CSIRO and his presentation was both informative and inspiring. It was clear that dung beetles had a great deal to offer. An application was made to the National Landcare Program to fund a dung beetle project. The bid was successful and the group embarked on a three-year project which saw the introduction of seven new species, monthly monitoring and numerous soil health, water quality and beetle field days. The more the farmers learnt about dung beetles, the more they wanted to know.

The group spent a considerable amount of time seeking out dung beetle information and was somewhat surprised to discover just how much information was available. As their knowledge increased, so did their enthusiasm. During the course of the project, the group received frequent requests for information about dung beetles from landholders, Landcare groups and government agencies from across Australia. It was clear that there was a high level of interest in dung beetles and Lucyvale landholders were not alone in their quest for information.

A funding application was submitted to compile a dung beetle resource package.

Project Aims and Objectives

To compile a resource that will:

- outline the agricultural and environmental benefits provided by dung beetles
- provide practical tips, tools and guidelines on how to establish a community-based dung beetle project
- bring together the diverse range of information and resources developed by past and current dung beetle projects
- enable new projects to build upon the considerable knowledge-base already developed, ensuring that future investments are used to their maximum advantage and that duplication is avoided.
- stimulate interest in dung beetles
- highlight future challenges and opportunities

To distribute 1000 resource packages to landholders, groups and government agencies with an interest in dung beetles.

To include information on the National dung beetle website: www.dungbeetle.com.au

Terminology

The term "bovine-dung beetles" provides the most accurate description of the dung beetle species that were introduced into Australia by the CSIRO. Species were selected on their capacity to rapidly bury cattle dung in open pasture environments. All references to introduced dung beetle species throughout the resource package refer to "bovine-dung beetles".

Scope and limitations

Whilst every effort was made to contact past and current dung beetles projects, this resource does not include every project that has operated in Australia. The short-term nature of projects, varying degrees of record-keeping and staff turn-over have all combined to pose significant challenges in documenting activities. The information gathered represents a beginning rather than an end point as projects, resources and reports are continually emerging. The collated material has been housed in a ring binder so that if the opportunity arises, the package could be updated some time in the future.

You are invited to send additions, corrections and updates to:

Dung Beetle Resource Package
C/- Belinda Pearce
Kergunyah Post Office
Kergunyah Vic 3691

or by email: abanas@bigpond.com

Published & Unpublished material

The Project has focused on collecting *unpublished* material that would be difficult to source through conventional means. This includes project brochures, booklets, fact sheets, release maps, identification guides, technical reports and unpublished research findings. There are some limited references to published research.

There is an extensive body of published research on dung beetles, parasiticides and bush flies. During the course of the original CSIRO dung beetle project, Australia led the world in dung beetle research, with a range of articles published in both national and international journals. This valuable research can be accessed through library journal databases.

Using the package

The package consists of three components:

1. DVD
2. Resource binder
3. Resource CD-ROM

A copy of the "*Dung Beetle Dictionary"* is also included. This has been developed and supplied courtesy of the Dung Beetles for Landcare Farming Committee with the support of the Orica Community Foundation.

 DVD

There are four items on the DVD:

1. CSIRO "Dung Down Under" documentary (1972)
2. ABC Landline segment on dung beetles: "Dirty Work" (2007)
3. ABC Stateline South Australia segment on dung beetles (2008)
4. Schools presentation: "Dr Splutter Grunt and Sally the Sick Soil"

RESOURCE BINDER

The binder is divided into five sections

1. Introduction

This includes information on how the package originated, scope and limitations, summary of contents, future challenges and opportunities, Lucyvale Better Beef Group survey results and overall summary.

2. Dung beetle benefits

This section outlines the importance of sustainable farming practices and describes the agricultural and environmental benefits provided by dung beetles. It includes selected references to published research.

3. Step-by-step guide on how to establish a dung beetle project

This section provides practical tips and general guidelines on how to establish a dung beetle project and highlights the advantages of establishing community-based projects.

4. Dung beetle potential distribution maps

This section is compiled by Dr Penny Edwards and consists of potential distribution maps for 21 dung beetles species and includes details on how each map was produced and comments for each species. The maps were originally created by Dr Edwards as part of work undertaken for the Dung Beetles for Landcare Farming committee.

5. Dung beetle projects 1965-2008

The final section outlines dung beetle projects that have operated in Australia and provides a brief overview of resources that they have developed.

RESOURCE CD-ROM

The resource CD contains brochures, fact sheets, booklets and reports developed by projects.

The material on the resource CD is linked to various sections in the resource binder and can be accessed through a series of folders. There is an additional folder containing beetle research and technical reports.

Upon inserting the CD into your computer, four folders will appear;

"Double click" on the folder of interest

Each folder contains a series of additional folders.

Use the folder headings to locate the folder that contains the item of interest.

Further instructions on how to use the folders are located on pages 3.1 and 5.1

You can use the "backspace button" to navigate your way back through the folders.

Future Challenges and Opportunities

The original CSIRO Dung Beetle Project

The original CSIRO dung beetle project aimed to introduce a range of bovine-dung beetle species that would shred or bury cattle dung in a range of habitats and climatic regions within 48 hours. Over 150 beetles were identified as suitable for introduction. Between 1968 and 1984, more than 50 dung beetle species were introduced and of these, 23 species have established. In the mid 1980's the project's funding was terminated before all of the objectives were met.

The closing of the CSIRO project marked the end of a nation-wide co-ordinated approach to dung beetle introductions and releases. In an article in the *Australian* (*Fly times when the dry comes*, 22/10/06), Professor Julian Cribbs describes the CSIRO project as "in all probability, the greatest recycling enterprise in our national history". He also states "once you have gained precious knowledge in a certain field, you ought never to abandon it entirely and lose your expertise". He describes the axing of the project as "another example of the short-termism and lack of strategic foresight that characterise our science planning".

Whilst numerous dung beetle projects of varying scale have been undertaken since the closing of the Project, the original objectives of CSIRO dung beetle project are yet to be fully realised.

Where to from here?

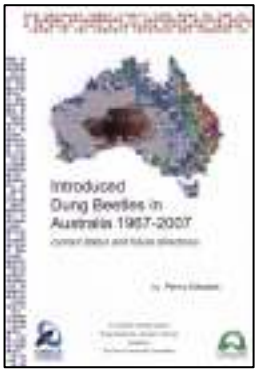
Since 2000, two major reports have put forward key recommendations in relation to:

(i) future directions for dung beetle activity in Australia (2007), and

(ii). understanding the effects of parasiticides on dung beetles (2001)

A summary of the key recommendations contained in these reports are listed below:

(i) Introduced Dung Beetle in Australia 1967-2007: Current status and future directions



In 2007, Dung Beetles for Landcare Farming released the landmark report. "Introduced dung beetles in Australia 1967-2007: Current status and future directions" written by Dr. Penny Edwards.

The complete list of recommendations is located in section 5 (pages 5.7 - 5.8) and the full report is included on the resource CD. The report also includes a discussion forum in which members of the original CSIRO Dung Beetle Project were invited to provide comments and opinions on future dung beetle activities and in particular, future dung beetle introductions.

From the 2007 report (abbreviated summary)

1. Distribution data

Up-to-date information on dung beetle distributions assists in planning redistribution activities, as well as increasing preparedness for selecting overseas species for future introductions. It would be timely to undertake an Australia-wide sampling project.

2. Native dung beetles

Little is known about the nesting behaviour of most native species. It would be useful to obtain data for the key species that utilise cattle dung.

3. Redistribution

Strategic redistribution work should be undertaken to assist slow spreading species reach their potential as rapidly as possible (Table 1 on the next page provides a summary of potential redistributions).

SPECIES	CURRENT DISTRIBUTION	AREAS SUITABLE FOR REDISTRIBTUION
Bubas bison	Southern WA, SA and Vic	Southern WA and SA, southern/inland NSW, most of Vic.
Copris elphenor	Nr Jambin Qld	Eastern Qld, northern NSW, possibly Central Australia.
Copris hispanus	Nr Williams WA	Southern WA and SA, southern/inland NSW, most of Vic.
Geotrupes spiniger	Tas, Vic, southern NSW	Widely through Vic, Tas and southern NSW, possibly small areas in SA and WA.
Onitis aygulus	Scattered through southern WA, SA, Vic and NSW.	Southern Australia (except Tas) through to southeast Qld.
Onitis caffer	Near original release sites in WA, NSW and Qld.	Southern Australia through to southeast Qld (winter-rainfall and summer-rainfall strains where appropriate).
Onitis vanderkelleni	North Qld and southeast Qld	High rainfall areas of Qld highlands and coastal NSW
Onthophagus obliquus	Cooktown [current status requires confirmation]	WA (Kimberley region) , parts of northern NT

Table 1: A selection of species identified for further redistributions (Edwards, 2007)

4. Seasonal data

To make informed decisions about future introductions, the seasonal gaps in activity are equally as important as the geographical gaps. This data is much harder to gather, particularly as there are great variations from one year to the next. A project, similar to the Queensland Dung Beetle Project could be conducted nation-wide. Ideally, two years would be required to allow for major differences between years.

5. Collating and archiving data.

A history of the dung beetle project should be commissioned to compile the full scientific and personal stories associated with such an ambitious project. A repository should be established for existing unpublished or uncatalogued data.

6. Future Introductions.

Eight steps are identified to bring about the introduction of new overseas species

1. "Demonstrate the need"

To mount a convincing case to introduce new dung beetle species into a region, it first should be demonstrated that there is an ecological niche that needs to be filled (eg a geographical, habitat or seasonal gap). For some areas the needs are already clear. A gap in early spring activity has been identified in many regions and species are available that could fill this gap.

In general terms, there is a need for better quantification of the benefits of dung beetles. Their impact on fly and parasite control, pasture productivity, nutrient cycling, water quality and soil health are well-known but poorly documented. If it can be demonstrated that an increase in dung beetle activity will result in an increase in these benefits then the case for further introductions becomes stronger. The remaining seven steps are:

2. Select the species
3. Obtain funding
4. Establish quarantine requirements
5. Collection and importation of beetles
6. Rearing beetles in quarantine
7. Release conditions for beetles
8. Monitoring of beetles

(ii) Effects of Parasiticides on Dung Beetles (2001)

In order for dung beetle colonies to survive and prosper it is vital that the effects of excreted residues of veterinary parasiticides are fully understood. In September 2001, a workshop (sponsored jointly by the Australian Pastoral Research Trust and four major animal health pharmaceutical companies) was held in Brisbane to examine these issues. The meeting was the first of its kind to be held in Australia.

Effects of Parasiticides on Dung Beetles

Report of Proceedings

The Bardon Centre Brisbane, Queensland

Mick Alexander and Keith Wardhaugh

CSIRO Entomology 2001 Technical Report No. 89

Major sponsors: Fort Dodge Australia and Pastoral Research Trust

The workshop's objectives, conclusions and recommendations are listed on page 5.13 of the resource binder. The full report is included on the resource CD.

Summary of recommendations arising from the proceedings:

1. Chemicals and chemical usage

- identify chemicals for which data is currently lacking or inadequate
- compile and circulate a list of chemicals requiring independent evaluation to appropriate research institutions
- lobby government agencies about the need to conduct regular surveys of veterinary chemical usage

2. Decision support

- devise appropriate ways of disseminating information and making the results available to graziers
- develop a user-friendly decision support system for the management of livestock parasites

3. Standardised parasiticide bioassays

- develop internationally accepted protocols for the scientific testing of the effects of parasiticides on dung beetles and other important dung-feeding organisms, including appropriate indicator species.
- standardise future product labelling to include information on the effects on beneficial organisms

4. Extension and communication

- develop and update a training package which extension officers and livestock industry groups could present within their regions

In 2003, two information brochures were produced, "Strategic use of parasiticides can help your dung beetles" and "Consider your dung beetles when using parasiticides". These were produced with the support of Agforce Queensland and the National Heritage Trust and provide guidelines on how to manage livestock parasites in a dung beetle friendly manner.

There is no provision for these brochures to be updated and the majority of the recommendations resulting from the workshop are yet to be realised. This represents an area that requires considerable and ongoing attention.

LUCYVALE BETTER BEEF GROUP 2008 SURVEY RESULTS: Summary

As part of the resource package compilation process, survey forms were sent to known dung beetle projects across Australia. In addition to describing project activities, respondents were asked to identify project challenges and highlights. The majority of responses were from small Landcare projects whose primary focus was promoting dung beetle benefits to landholders and releasing dung beetle colonies. The following Is a summary of their responses.

Dung beetle supply in Australia

A number of projects had difficulties sourcing the desired quantities of dung beetle starter colonies. Since the closing of the CSIRO project there has only been one long-term commercial supplier in Australia. Beetles are harvested in the field from areas where they are in abundance. Ongoing drought has further restricted the availability of some species.

Several long-term projects have initiated their own harvesting and redistribution programs.

Limited follow-up of released species, lack of continuity and loss of expertise

The short-term nature of many projects (one to three years) has resulted in a reduced capacity to monitor and evaluate the success of released species. It can take three to five years (or more) for a species to become established. The fate of many colonies often remains unknown.

The long-term viability of projects is largely dependent on the group's capacity to secure on-going funding. Each time a project ends due to an inability to secure ongoing funding a considerable degree of momentum and expertise is lost.

Ability to show proven outcomes

Several groups commented that they would be in a better position to attract funding if the environmental and agricultural benefits were more fully quantified. Funding bodies are increasingly requiring applicants to provide clearly defined and quantifiable outcomes. Given the increased interest in sustainable agricultural practices and the potential of dung beetles to contribute to carbon sequestration this represents an area requiring further attention.

More information about the impact of chemicals

A number of groups were concerned about not having enough information relating to the impact of a range of commonly used farm chemicals (not just drenches) on dung beetles. They would like to see independent testing on a range of products, and their impact on adult dung beetles, reproductive rates and larval survival assessed.

Seasonal activity gaps

To achieve maximum dung burial a range of species is required. Numerous projects indicated the lack of a suitable spring species. This coincides with the peak breeding season of bush flies in temperate areas.

Project Highlights

- the recovery of released beetle species
- learning the skills to undertake their own harvesting
- learning about dung beetle biology and how to identify species
- the enthusiastic and overwhelming response by landholders
- releasing dung beetle colonies
- learning about the relationship between beetles, soil and pasture productivity

CONCLUDING COMMENTS FROM LUCYVALE

The Lucyvale Beef Group has strived to promote the benefits of dung beetles to the wider community and highlight areas in need of addressing. Letters have been written and phone calls made to politicians and every opportunity has been taken to raise dung beetle issues in the media. The group would like to see substantial dung beetle funding from both government and industry to implement the recommendations identified by various groups. Until this happens, cattle dung will continue to litter pastures, and the full environmental and agricultural benefits provided by dung beetles will remain a lost opportunity.