



DUNG BEETLES' LIFE IN MANURE HELPS PLANTS GROW

Sandra Milena Gelviz-Gelvez¹, Alfredo Ramírez-Hernández^{2*} and Felipe Barragán²

¹Instituto de Investigación de Zonas Desérticas (IIZD), Universidad Autónoma de San Luis Potosí, San Luis Potosí, Mexico

²CONAHCYT/IPICYT—División de Ciencias Ambientales, San Luis Potosí, Mexico

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AGE: 13



PRACHI

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PRANJALI

AGE: 16

Semiarid environments are drylands characterized by very little rain and high temperatures. In Mexico, these environments are found in the center and north of the country. It is common to think that few species could exist in these hot, dry environments, but semiarid environments actually contain a great variety of life forms. Insects called dung beetles are one very important example. Dung beetles use the manure (poop) excreted by mammals as a food source and to make their nests. By using manure, dung beetles help the environment in ways that also benefit humans. In this article, we will describe how one species of dung beetle helps plants grow in semiarid environments. By burying manure into the soil, dung beetles make the nutrients in the manure available to plants, so the plants can grow faster and taller than they could in the absence of the beetles.

ECOSYSTEM SERVICES

The benefits that plants or animals provide to an ecosystem, which often improve human health, the economy, and peoples' quality of life. Examples include pollination and dung removal.

MANURE

Product generated from the digestion of different species.

SEMIARID ENVIRONMENTS

Semi-arid environments are defined as geographical and ecological units with average annual rainfall of <600 mm and where extreme weather conditions (low rainfall and high temperatures) limit the development of vegetation cover.

Figure 1

The role of dung beetles in removing manure helps to reduce greenhouse gases and accelerate dung decomposition. By burying dung also some seeds are buried into the soil. Manure removal is good to increase oxygenation in the soil (bioturbation), enrich the soil with nutrients promoting seed germination, and help plants grow.

DUNG BEETLES: AN OVERVIEW

Insects (beetles, bees, ants, ladybugs, and many more) live all around us and are responsible for carrying out many important tasks in most ecosystems on Earth, even in cities where many people live. These helpful tasks, called **ecosystem services**, ultimately benefit humans. Some of the critical ecosystem services performed by insects include pollinating flowers, recycling dead organisms (leaves or animals, for example), and protecting crops from pests that would eat them. But have you ever wondered exactly what insects are? Insects are a group of invertebrate animals (that is, animals without backbones) that come in a wide variety of species. All insects have one pair of antennae, three pairs of legs, and two pairs of wings.

Dung beetles are insects commonly known for using **manure** (animal poop) to survive (Figure 1). Much research on dung beetles has been done in tropical forests (for more info, please see [this Frontiers for Young Minds article](#)). Dung beetles also exist in **semiarid environments**, where climate is extreme with very little rain and high temperatures. In Mexico, these environments are found in the center and north of the country. It is common to think that few species could exist in these hot, dry environments, but semi-arid environments actually contain a great variety of life forms. Little is known about the function of dung beetles in semi-arid environments. Do you think the dung beetles might do the same job there as they do in tropical forests, where they remove dung and contribute to nutrient cycling and soil enrichment, plus they have been found to contribute as much to seed germination?

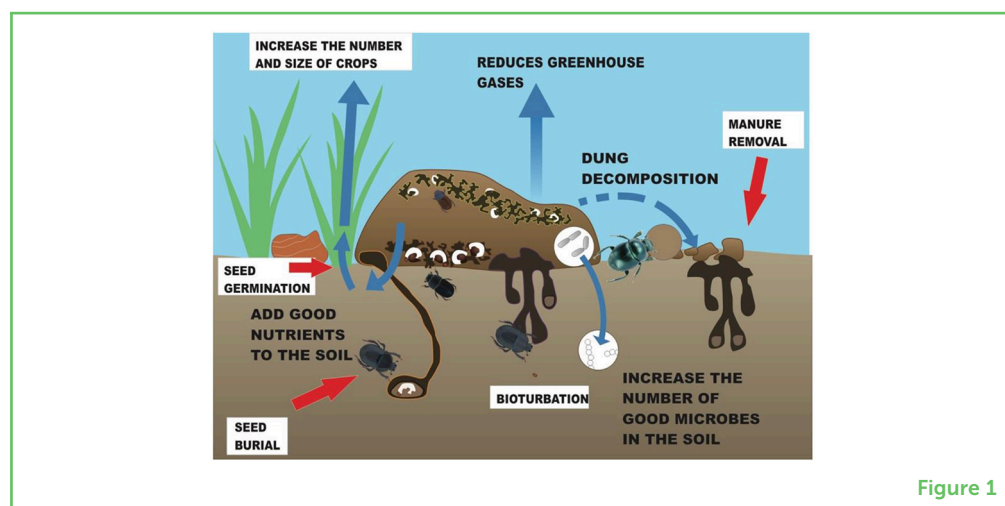


Figure 1

DUNG BEETLES: SMALL INSECTS DOING A BIG JOB

We studied the dung beetles that are distributed throughout pastures located in the semi-arid areas of the Potosino Highlands, which are part of the southern Chihuahuan Desert. We found a great variety of dung

beetles in this ecosystem [1]. The most abundant is a species called *Canthon humectus*, which is a roller dung beetle (Figure 2). Usually, dung beetles work in pairs (one male and one female). The male is the first to arrive at the dung, and he forms it into a ball. Then the female arrives, and together they roll the dung ball until it is buried in the ground. Once the dung is buried, the dung beetles use it as a nest—a place to lay their little eggs and to feed.

Figure 2

Several roller dung beetles of the species *Canthon humectus* removing cow dung in a field in a semiarid environment in Mexico.



Figure 2

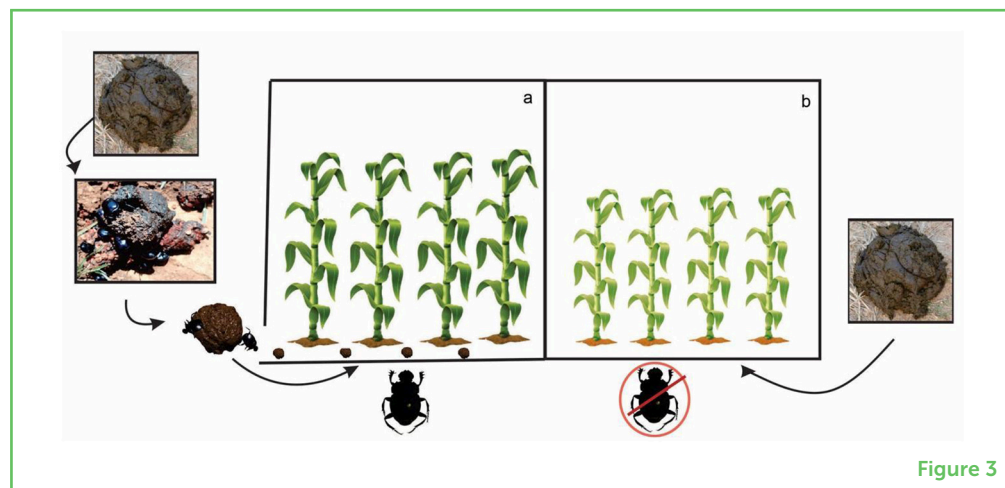
We were curious about the importance of this dung beetle species—what ecosystem services is it providing when it is removing manure? In particular, we addressed the following questions: (1) How does *Canthon humectus* affect the health of the soil? (2) Do plants grow better in soils containing dung beetles? To answer these questions, we used 15 pots filled with soil obtained from a semiarid zone in central Mexico. We placed 100g of manure on the soil, which we weighed daily and replaced with fresh manure. Some pots contained dung beetles (five females and five males). As a control treatment, we placed pots with the same amount of manure but without the presence of beetles. Corn seeds were then planted in all of the pots. We used corn because corn plants grow quickly and, in most arid environments, corn crops are common. At the end of the experiment, we analyzed the soil for activity nitrates, ammonium levels and total soil organic to see if there were differences in the chemical characteristics of soils in our beetle treatment and our control treatment matter and we evaluated the growth of the plants.

In terms of how dung beetles affect soil health, our results showed that, by burying dung, these beetles increase the amounts of nitrogen and ammonia in the soil. Nitrogen is very important for development and is necessary to build enzymes, chlorophyll, nucleic acids, storage proteins, and cell walls, amongst others [2]. Plants take nitrogen up by their roots after soil microbial communities have mineralized nitrogenous compounds to ammonia or nitrate. Low concentrations of these inorganic nitrogen compounds or poor soil microbial activity

lead to nitrogenous-deficient plants. To answer our second question regarding plant growth, we examined the corn plants and found that those planted in soils where beetles buried manure grew larger and faster than the plants in soils without beetles did (Figure 3).

Figure 3

We measured the growth of corn plants in the presence of 100 g of manure under two different conditions. (a) With *Canthon humectus* (five females and five males); and (b) without *Canthon humectus*. Our results showed greater growth of corn plants in the presence of dung beetles.



DUNG BEETLES: IMPROVING SOIL HEALTH AND HELPING PLANTS GROW

In arid and semiarid ecosystems, the days are very hot, the nights are very cold, and all the rain falls during just a few months of the year. In these environments, it is generally difficult for plants to survive. Dung beetles, however, help to improve soil health so that more plants can grow. In our experiments, we found that corn plants grew better in semiarid soils when dung beetles were present. We believe there are several reasons for this. First, our results showed that, by mixing the manure into the soil, dung beetles increase the amount of nutrients in the soil, such as nitrogen and ammonia. We also believe that the presence of dung beetles promotes soil **bioturbation** because these beetles dig many tunnels throughout the soil [3]. The tunnels give the soil more space to hold oxygen and they also prevent the soil from being packed down too firmly, which inhibits plant growth. Less compact soils can hold more water, so dung beetles help soils to remain moister, as well. We also believe that, if dung beetles do not remove the dung deposited on soils, plants cannot grow because the manure dries up and forms a crust that prevents oxygen from entering the soil. This stops seeds from germinating.

Human beings cannot survive on Earth alone—we rely on many other creatures and the ecosystems services they provide. Think about the important work we just described, all performed by a single species of beetle! This tiny insect can help us to appreciate the often unseen impact that other species can have on our lives.

BIOTURBATION

The reworking of soils and sediments by animals or plants. Bioturbator species have the ability to transport dissolved oxygen, enhance organic matter decomposition and diagenesis, and alter sediment structure.

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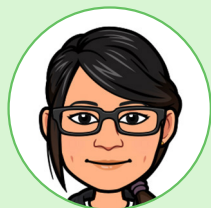
INTERNATIONAL SCHOOL OF BERGEN, AGE: 13

Our class is made up of students with multiple nationalities and we strive to collaboratively find connections between our classroom and the real world. We use the Frontiers for Young Minds articles to understand the principles of the scientific method through reviewing the work of real scientists and thereby improving our critical thinking skills.



PRACHI, AGE: 14

Life is the pursuit of knowledge. It is about asking questions and seeking answers. And being excited by those questions you do not have answers to yet. That is why science captivates me, there is so much to know and so much that is yet to be discovered. Let us study science and make this world a cool place.



PRANJALI, AGE: 16

My passion for science relates to my fascination with how the world around me works. I love to watch how my actions affect this world in small and significant ways. I am studying to be a physician in order to make a difference, heal people and bring smiles to their faces.



SANDRA MILENA GELVIZ-GELVEZ

Sandra Milena Gelviz-Gelvez has a degree in Natural Sciences and Environmental Education from the University of Pamplona, and a doctorate in Biodiversity and Conservation from the Universidad Autónoma del Estado de Hidalgo. She did postdoctoral work at the Institute of the Faculty of Higher Studies Iztacala of the Universidad Nacional Autónoma de México, and at the Division of Environmental Sciences of the Potosino Institute of Scientific and Technological Research. She is interested in evaluating the effect of ecosystem change by humans (for example, from forests to grasslands) on different species (birds, insects, and plants) and evaluating how the diversity of these species can be recovered as a strategy for conservation.



ALFREDO RAMÍREZ-HERNÁNDEZ

Alfredo Ramírez-Hernández has a degree in Biology (Universidad Veracruzana, Mexico), and a master's and Ph.D. in Biodiversity and Conservation (Universidad de Alicante, Spain). He carried out postdoctoral work at the Instituto de Ecología A.C. He received the Extraordinary Doctorate Award from the Universidad de Alicante, and he is a member of the Mexican National System of Researchers and Honorary Collaborator of the Ibero-American Center for Biodiversity, CIBIO (Spain). He is interested in the ecology of insects (entomology) in forests and

deserts, in particular those insects that participate in breaking down organic matter.
[*alfredo.ramirez@ipicyt.edu.mx](mailto:alfredo.ramirez@ipicyt.edu.mx)



FELIPE BARRAGÁN

Felipe Barragán is a biologist from the Technological Institute of Huejutla, with a master's degree in Natural Resources and Rural Development from the Colegio de la Frontera Sur, and a doctorate in Biodiversity and Conservation from the Universidad Autónoma del Estado de Hidalgo. He did postdoctoral work at the Institute for Research in Ecosystems and Sustainability of Universidad Nacional Autónoma de México. Since 2014, he has been part of the Mexican National System of Researchers. His research focuses on biodiversity, ecosystem services, and functional diversity. Since 2014, he has been a professor of Consejo Nacional de Ciencia y Tecnología, commissioned to the Division of Environmental Sciences of the Instituto Potosino de Investigación Científica y Tecnológica.