Why do dung beetles matter to climate change?

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- *Researchers have recorded new species of beetles in India, including two in the country's northeastern region.*
- *Dung beetles play a key role in breaking down animal dung, recycling nutrients, improving soil, controlling pests, mitigating diseases and even reducing methane emissions.*
- *Experts say that studying dung beetles can help monitor environmental health, including habitat loss*

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Rolling around and digging into excrement might not sound ideal, but for the dung beetle, it's a way of life and one that plays a vital role in sustaining ecosystems. With a hard, metallic exoskeleton, the dung beetle is usually born inside a brood ball made from dung or within dung pats. Inside this unassuming cradle, the drama unfolds as the larva transforms into a pupa and eventually metamorphoses into an adult beetle. From then on, dung beetles play a key role in breaking down the dung, recycling nutrients, improving soil, controlling pests, mitigating diseases and even reducing methane emissions. A diverse population of dung beetle species in a habitat paints a picture of a thriving ecosystem.

This is why a recent study that recorded new species of beetles in India, including two in the country's Northeastern region, is being described by researchers as significant in the understanding of biodiversity in the subcontinent.

"There are three types of dung beetles (based on their behaviour in the dung) – rollers, tunnellers and dwellers. Our paper looked at tunnellers of the Ontinis genus," said Seena Narayanan Karimbumkara, one of the authors of the study and a research associate at the Ashoka Trust for Research in Ecology and the Environment (ATREE). The ATREE researchers found three new-to-science species of Onitis dung beetles – *Onitis bhomorensis* (found in the northeastern state of Assam), *Onitis kethai* and *Onitis visthara* (found in Karnataka in the southern part of India). The researchers also found the *Onitis bordati* for the

first time in the Indian subcontinent in the state of Meghalaya, which borders Assam in northeastern India.

"With the addition of three new species and one new distribution record from India, the number of Onitis species from the Indian Subcontinent has been raised from 16 to 20," the researchers mentioned in the study, which was published in September in the *European Journal of Taxonomy*.

The researchers also found *Onitis bordati* (male and female) for the first time in the Indian subcontinent in Meghalaya, which borders Assam in northeastern India. Images by Seena Narayanan Karimbumkara.

Studying dung beetles

From forests to deserts, dung beetles are found in all kinds of ecosystems in the world, except in the far north and Antarctica. According to various estimates, there are between 2000 and 6000 dung beetles in the world.

"From the time of the Egyptians, dung beetles have a mythological significance because of their role in forest and agricultural ecosystems," Kailash Chandra, the former director of the Zoological Survey of India, a government organisation that conducts zoological research in the country, told Mongabay. Chandra wasn't involved in the ATREE study that revealed new dung beetle species in different parts of India.

Dung beetles display varied behaviours when it comes to nesting. The tunnellers dig tunnels in the soil under the dung pats and make brood balls at the end of these tunnels where they mate and lay eggs. The rollers make brood balls in tunnels away from the dung pat while dwellers make these brood balls inside the dung pat itself. Aside from these are the Kleptocoprids that steal the brood balls made by other dung beetles.

The dung beetles can also be classified based on the type of dung they prefer. "There are some species that are generalists (which survive on the dung of any animals) and then there are the specialists," said Seena. Dharma Rajan Priyadarsanan, the study's co-author and a Senior Fellow and Programme Leader at ATREE, added, "Specialist species like *Heliocopris dominus* can survive only on wild elephant dung." The new species, so far, have not been confirmed as generalists or specialists as samples were collected only from cattle dung for the study.

A statue of a dung beetle at the Karnak temple complex, Egypt. Image by Ryan Postlethwaite via Wikimedia Commons (CC BY-SA 3.0).

For their study, the ATREE researchers looked at 1260 specimens of Onitis (of the Scarabaeidae family) beetles that had been collected from 1998 to 2021. Priyadarsanan told Mongabay that he had started collecting the specimens back in the 1970s from BR Hills in Karnataka – the point where the Eastern Ghats of the country meet the Western Ghats. "We were trying to understand the answers to the ecological questions. [Later] we expanded this to the Western Ghats as a part of various other projects," said Priyadarsanan.

"Till 2012, we didn't have any projects in the Northeast," Seena recalled. She had started researching dung beetles only a year prior. "It was only after I got married to someone from Assam that I started collecting specimens from there." The researchers would use cow dung as bait to collect the specimen. They then studied the morphological characteristics of the specimen, to identify them using the keys in the works of three other entomologists including G.J. Arrows, A. Janssens and Vladimir Balthasar.

In the study, the researchers described the differences in characteristics of the new species. For instance, the *Onitis bhomorensis*, which was found in cattle dung in the flood plains of the Brahmaputra river in Assam's Tezpur, was smaller with a reddish body when compared to the *Onitis assamensis* – a species from a nearby locality.

"The paper is an interesting and insightful study of the genus Onitis in the Indian subcontinent and indicates the research potential inherent in this region," remarked Marek Bunalski, a professor at the Poznan University of Life Sciences's Department of Entomology and Environment Protection in Poland. Bunalski wasn't involved in the study by ATREE researchers but has extensively researched dung beetles.

"The Indian subcontinent, due to its surface area and diversity of habitats, is a valuable object of research on various groups of insects, including coprophagous beetles. This also applies to other regions of the world, especially in the context of climatic changes observed in recent decades," he said.

A dung beetle from the genus *Scarabaeus*, rolling dung, photographed in 2024 at Hyderabad. Image by coelbraou via Wikimedia Commons (CC BY-SA 4.0).

Ecological indicators

Experts say that studying dung beetles can help monitor environmental health including habitat loss, fragmentation and climate change.

“They help in removing the dung from the surface, by which they increase the fertility of the soil. Through this, they keep away vectors of many diseases and the secondary dispersal of seeds,” Seena said and added that the process of removing dung, helps remove greenhouse gas emissions.”

In 2023, 67 researchers from several countries published a study on how cattle density affects dung beetle diversity and their dung-removal abilities across 38 pastures worldwide.

“Cattle dung accounts for almost 8% of GHG (greenhouse gas) emissions. Of these, dung beetles mitigate up to 3-4%,” said Priyadarsanan, who was among the 67 researchers involved in the study. He added, “We found that it is not the number of dung beetles but the heterogeneity that has a major role.”

The study, published in the Nature Communications journal, highlighted that the “clearance of native vegetation and intensification of land use are known to reduce both dung beetle species richness and their role in ecosystem functioning”.

Priyadarsanan said that he doubts if even 20% of the species he first studied in the BR Hills five decades ago, remain there because of the lantana invasion. Then there is rapid urbanisation as a result of which farmlands in and around the residential and industrial areas were taken over. In cities like Bengaluru, Priyadarsanan said, in some places, large cattle came to replace sheep (which made up the livestock earlier). “Even the livestock change has caused a lot of species turnover of the dung beetles,” he said.

Dung beetle activities can mitigate upto half of the greenhouse gas emissions from cattle dung. Image by Vijayshinare via Wikimedia Commons (CC BY-SA 4.0).

Challenges to taxonomy

While infrastructure growth has been known to harm different species of dung beetles, the building of roads has aided in the access to areas that were previously uncovered. This was especially true in the case of the Northeastern states.

The ATREE study on the new dung beetle species in the *European Journal of Taxonomy* highlighted that "a void exists in the systematic studies of dung beetles in Northeast India, as the discoveries were made only around cities which were accessible through roads".

"Because of this development in a way, there is connectivity, which might lead to more discovery of species, earlier the discovery was made around cities, where you can reach by road. Earlier you would have to walk for days before reaching these places," Seena said.

In the last few decades, a majority of the taxonomic studies including ones in and around the Northeastern region of India were undertaken by the Zoological Survey of India. According to Seena, the species brought back would have to be deposited in repositories where other taxonomists could study them. But, she said, most of these repositories weren't being curated and maintained well.

Another challenge in taxonomic research in India and around the world was the lack of funding and government permits. "In my 30-35 years in this field, I have only gotten one or two grants for these taxonomic studies. The funds for ecological studies are dwindling. There is a lack of interest from the government," said Priyadarsanan.

Kailash Chandra, the former director of ZSI admitted that there was a lack of resources in the study of biodiversity. He said, "Biodiversity is the most important thing for our survival. Ultimately, we are surviving because of the complex interaction in our ecosystem. And we haven't been able to study even 1% of this ecosystem."

Editor's Note: An image caption was modified for accuracy on December 25, 2024.

Banner image: (From left) *Onitis kethai, O. bhomorensis* and *O. visthara,* as described by the researchers. Images by Seena Narayanan Karimbumkara.

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