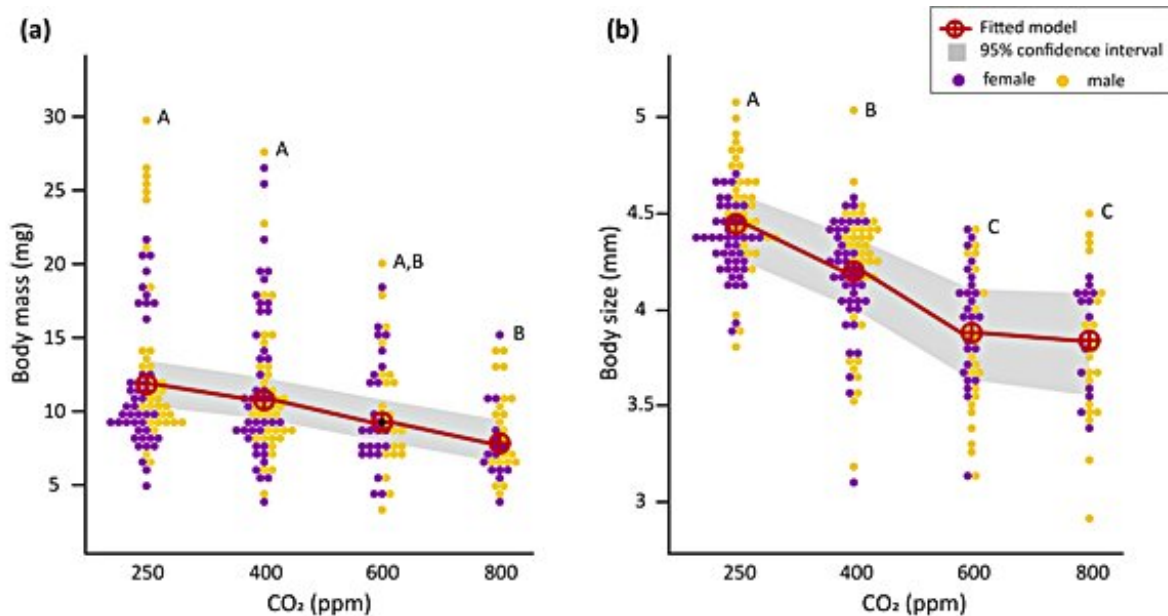


Elevated carbon dioxide levels in the atmosphere negatively affects dung beetles size and survival

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Credit: Wits University

Climate change is a truth of the 21st century that is difficult to avoid. The burning of fossil fuels in industry, for transport, and other everyday life activities of *Homo sapiens* has resulted in elevated levels of CO₂ in the Earth's atmosphere. Extreme weather conditions as seen in recent flood, drought and fire events worldwide are some of the most obvious ways in which increasing CO₂ levels are changing our world. But there

are some serious effects that CO₂ is having on our ecosystems that are less easily observed.

A new study led by Wits University post-doctoral researcher, Dr. Claudia Tocco, provides evidence that elevated CO₂ levels directly affects the development and survival of tunneling dung beetles (*Euoniticellus intermedius*). The study, published in the international journal, *Global Change Biology*, presents a possible explanation for the current 'insect apocalypse' – a global decline in insect populations that is still not well understood.

Serendipitous science

"The idea to investigate the effects of elevated CO₂ levels on dung beetles was a result of 'serendipitous science'," says Tocco. "My labmate and colleague at Wits, Mr. Nic Venter, was growing cacti under different CO₂ conditions to investigate how these plants may be affected under future scenarios in our changing world." Venter was looking at CO₂ levels under four scenarios: pre-industrial (~1750), modern-day, 30 years into the future, and 50 years into the future. "We thought, why not put some dung beetles under the same conditions and see what happens?," says Prof. Marcus Byrne, senior author of the paper and Dr. Tocco's postdoctoral advisor. What they found came as a surprise.

Beetles grown under heightened levels of atmospheric CO₂ experienced lower survival rates, and were smaller in size. "When raised under CO₂ levels predicted for the year 2070, a third fewer beetles emerged and were 14% smaller in size when compared to pre-industrial CO₂ levels," says Tocco.

"When we first found this result, we were surprised!," says Byrne. "We were not expecting such a drastic effect. In fact, we were not convinced at first that this result was real, and so we repeated the experiment—but

we kept getting the same result". "We knew that increased CO₂ levels can affect insects indirectly by changing plant quality," says Venter, "but did not expect such a direct effect on the beetles themselves".

The proof is in the soil

"Dung beetles like many insects, spend a large portion of their lives in the soil—as larvae, pupae and as adults," says Dr. Blair Cowie, another of Tocco's colleagues and fellow labmate in Prof. Byrne's research group. "Most people perhaps do not realise that increases in atmospheric CO₂ levels also affect the soil, and our study shows that this can in turn affect animals that live in soil".

The team suspects that the negative effects experienced by dung beetles under scenarios of heightened CO₂ in this study may be a result of increased competition between the beetles and bacteria in the soil. "Our next steps are to conduct further experiments to tease apart whether it is the CO₂ levels in the dung ball, the brood balls, or the soil in general that is affecting dung beetle development," says Cowie.

"It is the fact that the lives of dung beetles are so closely tied with the soil that makes them such excellent model organisms to investigate changes in soil ecology," says Tocco. "If atmospheric CO₂ is affecting dung beetles, it is affecting other insects too".

Explaining the insect apocalypse

The findings from this study may provide new insight into the cause of global insect declines. So far, other explanations put forth have been questionable, and there are no universally accepted justifications. Changes in [climatic conditions](#) vary across the globe, and some temperature changes may in fact be beneficial to insects. The use of insecticides is also patchy, and not ubiquitous across the planet. "Our

findings of how heightened CO₂ levels affect dung beetles presents a plausible explanation for the insect apocalypse, since the increases in CO₂ are consistent across the planet," says Tocco.

These new findings are hot off the heels of another recent breakthrough finding by Byrne and team, in which they found that [light pollution](#) negatively affects the ability of [dung beetles](#) to orientate themselves. "Whereas a solution to light pollution is easy—we just have to switch off our lights—the CO₂ problem is a bigger battle to fight," says Byrne. "We need to seriously support the movement away from fossil fuels, and invest in renewable energy—or else we stand to lose the vital ecosystem services that insects provide us free of charge."

More information: Claudia Tocco et al, Elevated atmospheric CO₂ adversely affects a dung beetle's development: Another potential driver of decline in insect numbers?, *Global Change Biology* (2021). [DOI: 10.1111/gcb.15804](#)

Provided by Wits University

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