

Press release

Immediate release

HKU Ecologists Link Arthropod Declines and Ecosystem Function Loss in Tropical Rainforests to Intensifying El Niño Events

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*These tropical arthropods—now in decline even in undisturbed rainforests—play vital roles in maintaining ecosystem health, as highlighted in the new HKU-led study. From the left: Caterpillar, Black Spiny Leaf Beetle (*Rhadinosa fleutiauxi*), Sawfly Larvae (*Agenocimbex maculatus*), Caterpillar. Image credit(from the left): 1st and 4th – Kit Lee; 2nd and 3rd – Marco Chan.*

A new study published in *Nature*, led by ecologists from the School of Biological Sciences (SBS) at The University of Hong Kong (HKU), finds that intensifying *El Niño* events, driven by climate change, are disrupting arthropod populations across the tropics. This hidden collapse threatens the stability of entire ecosystems and the essential services they provide to both nature and people.

Arthropods, tiny but vital creatures, including insects and spiders, make up the vast majority of animal species on Earth. They are irreplaceable contributors, playing a crucial role in maintaining healthy ecosystems and serving as vital food sources for birds and other larger animals.

While arthropod declines in temperate regions of the Northern Hemisphere have garnered attention in recent years, their rapid disappearance from tropical rainforests, even in pristine areas untouched by human activity, has largely gone unnoticed. These rainforests, the most bio-diverse ecosystems on Earth, remain understudied, and the consequences of biodiversity loss are still poorly understood.

An international team of scientists set out to uncover this missing evidence. The study was led by researchers from the Biodiversity and Environmental Change Lab and the Global Change and Tropical Conservation group at HKU, who conducted a large-scale analysis of tropical rainforest arthropods and the essential ecological roles they perform.

Combining information from over 80 previous studies in tropical rainforest sites that have never been commercially altered by humans, the team found significant biodiversity loss in multiple types of arthropods.

‘To find such large declines across so many different studies is really bad news,’ says Dr Adam SHARP, Post-doctoral Fellow of HKU SBS, lead author and data analyst. ‘Our results strongly suggest that the immense biodiversity of tropical rainforest arthropods is under immediate threat. Since all of the data we used comes from rainforests considered “untouched”, it means even the deepest and darkest tropical rainforests are likely to be heavily impacted.’

The declines were not random. The study identified a key driver: changes in El Niño–Southern Oscillation (ENSO), which regulates tropical climate from year to year.

‘We believe the increasing frequency of *El Niño* is driving these widespread arthropod declines,’ says corresponding author Dr Michael BOYLE, Research Fellow at HKU SBS. ‘In these tropical rainforests that haven’t otherwise been physically modified by humans, we can rule out habitat loss, pesticides, pollution and various other threats. In these places, *El Niño* seems to be the prime suspect.’

These climate-driven declines are not just biological—they are functional. The study found that two critical ecosystem processes, decomposition and herbivory, are already weakening.

‘Arthropods are essential components of functioning ecosystems, carrying out vital processes,’ says Associate Professor Louise ASHTON, leader of the team. ‘We found declines in certain arthropod groups were linked to lower rates of two essential ecological processes: decomposition and herbivory, indicating that biodiversity loss is reshaping how entire ecosystems work. In light of these results, it is essential that we act now to limit the severity of global climate change and prevent further biodiversity loss.’

Key Findings of the Study

- **Tropical invertebrates are in decline:** Five out of nine major invertebrate groups—including butterflies, beetles, spiders, ants, and bugs—are showing long-term species losses, even in undisturbed rainforests.
- **Climate change is disrupting natural climate cycles:** Arthropods rely on the balance between hot, dry *El Niño* and cooler, wetter *La Niña* years—part of the **El Niño–Southern Oscillation (ENSO)**. But climate change is making *El Niño* events more frequent and intense, tipping the balance and driving long-term declines, especially in species that depend on *La Niña* conditions.
- **Ecosystem functions are weakening:** These biodiversity losses are linked to significant reductions in leaf litter decomposition and herbivory, processes critical to rainforest health.
- **Specialist species are most vulnerable:** Arthropods with narrow diets or specific ecological roles are at higher risk of disappearing.
- **Warning signs of instability:** Increasing year-to-year fluctuations in species diversity for some arthropod groups, suggests that tropical ecosystems may be losing stability, with potential long-term consequences for biodiversity and ecosystem functioning.

The international team is carrying out resampling of rainforest arthropods across Australia, Malaysia and mainland China to better understand how they are changing through time, even within protected areas.

The study, titled ‘Stronger El Niños reduce tropical forest arthropod diversity and function’, was recently published in *Nature*.

The Journal paper can be accessed from here: <https://www.nature.com/articles/s41586-025-09351-x>.

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