INSIDE JEB

Greenlandic seed bugs cope well with heat

Two Greenlandic seed bugs (*Nysius groenlandicus*) on a grass seed head. Photo credit: Simon Bahrndorff.

Creatures that live in the Arctic have a reputation for hardiness, weathering bitter winters and chilly summers. Even insects have to deal with drastic temperature ranges in the summer 'Coping with such extremes is critical for survival and reproduction of insects in these regions', says Natasja Noer from Aalborg University, Denmark. But the climate is changing and Arctic warming is particularly alarming, with record-setting heatwaves exceeding 30°C in June 2022. How well will the robust insects in this rapidly heating region cope with higher temperatures? Greenlandic seed bugs (*Nysius groenlandicus*) complete a single life cycle during the brief Nordic summer, so Noer and her colleagues Torsten Kristensen and Simon Bahrndorff (Aalborg University) ventured to Greenland in late summer 2018 to find out how well the seed bugs deal with warmer temperatures.

Over a 3-week period, the team ventured out on five separate days to collect the 2.5–4 mm long insects from Narsarsuaq, Greenland – where the researchers were also keeping track continuously of the air temperature – retrieving the insects in the early morning, midday, late afternoon and evening. The researchers then either warmed the seed bugs, to find out how quickly they would pass out, or quickly plunged them into a –3°C bath before rewarming them, to find out how soon they would recover from a chill.

After reconstructing the temperatures that the insects had experienced in the run-up to the tests, the team realised that the females that had experienced warmer conditions in the preceding hours were better prepared for the sudden heatwave, whereas those that had experienced cooler conditions resuscitated most swiftly from their chilly bath. In contrast, the male seed bugs that had experienced a warm period in the 8–10 h run-up to the sudden chill took longer to revive, and the weather conditions prior to the unexpected heatwave did not improve their ability to withstand heat. In short, female seed bugs respond quickly to sudden blasts of heat, adjusting within 45 min, whereas male seed bugs are less able to deal with sudden temperature rises. However, a chilly blast 12 h earlier seems to prepare both males and females for a heatwave later that day.

Next, Kåre Nielsen, Elsa Sverrisdóttir (both Aalborg University) and Noer checked how the better prepared female seed bugs were affected by the weather conditions, by determining which genes they were activating and repressing on a chilly (top temperature ∼10°C) and a hot (∼22°C) day. As the temperature rose on the hotter day, the female seed bugs increased the activation of more than 100 genes, especially in the morning. But which genes were the seed bugs switching on for protection?

This time, Toke Høye (Aarhus University, Denmark) delivered seed bugs from Narsarsuaq to Aalborg, where the team either warmed the females gradually to 43°C or cooled them to 3°C, discovering that when hot, the insects boosted genes that would protect proteins in their bodies from heat damage as well as prioritizing egg production to ensure the future of the next generation. But when the team compared the gene activation levels of the insects that had experienced high temperatures in their Narsarsuaq home with those in the laboratory, the wild seed bugs seemed more sensitive, activating protective genes at lower temperatures than the seed bugs in the lab.

So, the future is reasonably bright for Greenlandic seed bugs, which are well prepared for heatwaves and night-time chills in their polar home, continuously tracking the temperature to adjust their bodies accordingly.

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