Some like it hot . . .

SIR — Wehner, Marsh and Wehner attribute the lower limit of the foraging temperature range of the Saharan silver ant, *Cataglyphis bombycina*, to be determined by predation pressure exerted by the lizard, *Acanthodactylus dumerili*¹. This assumption may not be justified, as the authors do not show that the ant-eating lizard does in fact exert sufficient selective pressure on the ant population, and especially considering that the ants, when experimentally released at temperatures below their natural foraging window, fell victim to the lizards within "less than five minutes". The relative distribution of the two species as a function of the daily temperature could be independent phenomena and not causally related. It is also not clear how "during the hottest time of a summer day, this lizard concentrates on *C. bombycina* as its potential prey . . .", in view of the fact that "the lizard . . . retreats underground at about the temperature at which the ants' foraging activity begins".

We believe that the lower limit of this remarkable narrow foraging window may instead be shaped by interspecific competition for food resources. Differences in foraging patterns among sympatric species of ants can serve in temporal partitioning of significant resources². An example is the black ant, *Monomorium minimum*, in the grasslands of Massachusetts, which is able to forage at higher temperatures than its closest competitors, *Lasius neoniger*, *Myrmica americana* and *Tetramorium caespitum*³. Evidence for competition has been found for such disparate desert dwellers as birds, rodents, lizards and ants⁴, an indication that interspecific competition may well be widespread in such arid environments. *C. bombycina* may thus turn out to be just an efficient forager, scouring the hot desert floor for dead and dying prey at midday temperatures that no other potential arthropod competitor has yet been able to exploit.

The physical constraints imposed on the silver ant by the need of thermoregulation is also not very unusual. Ground-living desert arthropods and reptiles maintain their preferred body temperature (eccritic temperature) by regularly alternating between sites where they gain heat and those where they shed excess heat⁵. In many of these animals, the eccritic temperature is close to the upper lethal temperature. It has been postulated that the evolution of such high eccritic 'set points' may help individuals to perform strenuous heat-generating activity for extended periods of time, especially if heat dissipation is slow under conditions of high ambient temperatures⁶. The characteristic eccritic

temperature of *C. bombycina* may thus allow this species to withstand prolonged periods of heat, so enhancing its foraging efficiency; this idea is reinforced by the authors' observation that individuals can even afford to rest for as long as 75% of their search time.

Many ant species, including several desert taxa², can shift their time of foraging as an adjustment to the vagaries of the environment. For example, the red harvester ant, *Pogonomyrmex barbatus*, from the Sonoran desert not only shows age-related changes in colony organization and activity patterns, but also a more important, complex moment-to-moment regulation of task-performance in response to short-term environmental changes⁷. Is the foraging pattern of *C. bombycina* sensitive to

seasonal, or even short-term, variations in food availability? Although Wehner *et al.* have put forward an interesting interpretation, a more extensive horizontal and longitudinal study may be necessary to dissect out the true environmental correlates of the unusual foraging behaviour of the silver ant.

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. . . and some even hotter

SIR — Wehner *et al.*¹ recently reported observations of a desert ant (*Cataglyphis bombycina*) that experiences exposure to high-temperature while foraging under the midday sun, making this ant the most 'thermophilic' terrestrial animal, with a body temperature sometimes exceeding 50 °C. Apart from the fact that *Eremogarypus perfectus*, a pseudoscorpion from the Namib desert, still holds the terrestrial high-temperature record of 65 °C (ref. 2), the new result led us to ask whether the documented thermo-

tolerance of aquatic eukaryotes exceeded that of terrestrial representatives. The highest temperature at which growth of several aquatic taxa can occur is thought to be 50 °C for invertebrates, 56 °C for protozoa, 60 °C for algae and 62 °C for fungi (the highest value recorded for a eukaryote)³. It has been proposed that animals are limited to less than 50 °C, and that 60 °C is the thermal barrier beyond which eukaryotes cannot complete their life cycle because of their inability to form functional thermostable organellar membranes³. But the eggs or cryptobiotic forms of certain invertebrates can survive exposure to temperatures approaching boiling at atmospheric pressure^{4,5}. Our recent observations on deep-sea hydrothermal vent fauna show that certain marine organisms have thermotolerances that far surpass those of their terrestrial counterparts.

Alvinellid polychaete worms dwell in whitish parchment-like tubes secreted in the hottest part of the hydrothermal vent ecosystems, on the wall of chimney-like mineral structures called smokers. Here,

Main picture, photograph of a video taken from DSRV *Alvin* in hydrothermal vents of the deep Eastern Pacific, showing an *A. pompejana* standing on a substrate measured at 105 °C. Top, sketch to clarify the position of the worm and the probe.