Ruhestoffwechsel der Feldwespe *Polistes dominulus* (CHRIST 1791)
Resting metabolism of the Paper wasp *Polistes dominulus* (CHRIST 1791)

H. KÄFER, H. KOVAC, B. OSWALD & A. STABENTHEINER

Polistes dominulus is a primitively eusocial paper wasp occurring in small colonies (up to ~30 individuals) on an open paper nest consisting of a single comb. The species is geographically widespread throughout Central and South Europe and Asia, and was introduced in Japan, Australia, North America and Chile. In Europe, *P. dominulus* shows a strong tendency of spreading to the north, successfully adapting to climate changes. It spends much time sitting on the nest and shows an energy-extensive mode of life, even when foraging for food.

To investigate the resting metabolic rate (RMR), individual wasps were put in a flow through respirometry setup for measuring CO_2 production, with experimental ambient temperature (Ta) regulated from 2.4 to 40.1 °C. This includes the major part of the temperature range which the wasp might be exposed to during its life cycle. Infrared thermography recordings of the same individual enabled us to assess behaviour and measure body temperature, which helped to determine the wasp's activity level and thermal state.

At lower Ta the resting phases often lasted for the entire test period, but shortened increasingly at higher Ta. At Ta < 10 °C most wasps were slightly endothermic whereas at Ta > 10 °C all but one were only weakly endothermic (Tth – Tab < 1 °C) or ectothermic, respectively. At high temperatures (Ta > 27 °C) the wasps regurgitated liquid to avoid heat stress via evaporative cooling. The wasp's RMR increased sigmoidal with rising Ta. CO_2 emission increased from 29.9 nl g-1 s-1 at 6.9 °C to 773.5 nl g-1 s-1 at 35.6 °C (Fig. 1). We compared the RMR of *P. dominulus* with that of *Vespula germanica* and *V. vulgaris* (KÄFER et al. 2013) as well as *Apis mellifera* (KOVAC et al. 2007). Similar to *Apis*, *Polistes* data fitted best with a sigmoidal function while *Vespula's* RMR followed an exponential curve. At temperatures of ~22.5 °C, *Polistes* RMR was below that of *Apis*. However, both species did not reach the metabolic level of *Vespula* at rest over the investigated temperature range.

Polistes shows fewer thermoregulatory activities than *Vespula* and modulates body temperature less while collecting food and water (KOVAC et al. 2009). In social thermoregulation, heat production in *Polistes* is practically non-existent due to the nest architecture with its lack of an isolating envelope. The aerobic capacity hypothesis postulates that species with a high energetic level of activity should also have a higher RMR (BENNETT & RUBEN 1979). The RMR of *Polistes* resembles that of *A. mellifera* in the sigmoid increase and in extent, despite the fact that *Apis* reaches higher thoracic temperatures and has the same or a higher endothermic capacity than *Vespula*. The small energy investment in thermoregulation as well as phases of rest during the day allows for the energy-extensive lifestyle of *P. dominulus* as a possible adaptation to a changing environment. Resting metabolism is an important factor in the proliferation of this wasp species and may in part explain the successful dispersal to new areas.

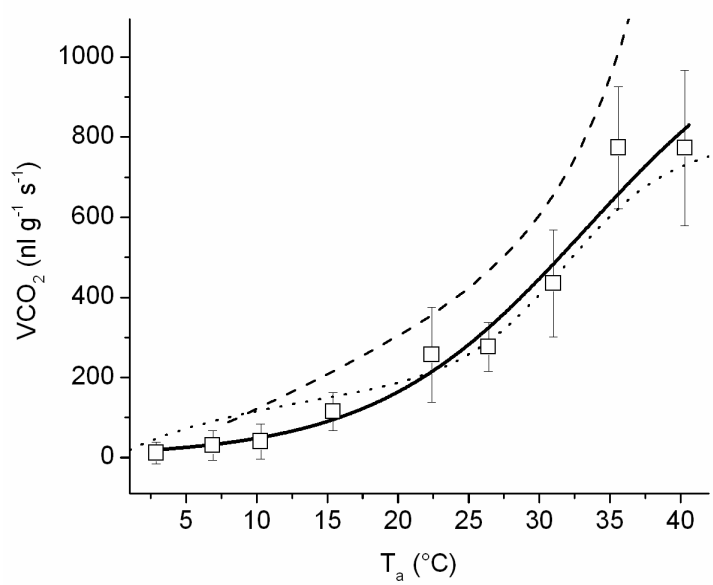

Fig. 1: RMR (CO_2 emission) in *Polistes dominulus* (mean values with SD) follows a sigmoidal function (solid curve) over the investigated temperature range. RMR of *Vespula* sp. (dashed) and *Apis mellifera* (dotted) are shown for comparison.

References

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Anschrift der Verfasser: Mag. Dr. Helmut KÄFER
Dr. Helmut KOVAC
Mag. Barbara OSWALD
Dr. Anton STABENTHEINER
Abteilung Stoffwechsel, Verhaltenund Modelling
Institut für Zoologie, Karl-Franzens-Universität Graz
Universitätsplatz 2, 8010 Graz
E-Mail: helmut.kaefer@uni-graz.at