Das obere kritische thermische Limit von *Polistes dominulus* und *Polistes gallicus*

The upper critical thermal limit of *Polistes dominulus* and *Polistes gallicus*

H. KOVAC, H. KÄFER, A. STABENTHEINER & I. PETROCELLI

Temperature is a crucial abiotic parameter in an animal's life which influences nearly all physiological and biochemical processes. The actual environmental temperature is determining the distribution patterns of most insect species. A number of organisms, especially insects, are extending their range in response to the trend of increasingly warmer temperatures. Physiological studies can help predict effects of climate change through determining which species currently live closest to their upper thermal tolerance limits. *Polistes gallicus* is a closely related species of *P. dominulus*. While *P. gallicus* is restricted in its distribution to the Mediterranean climate region, *P. dominulus* is one of the most abundant *Polistes* species. Its distribution covers the whole of central and southern Europe, although it is absent from the coldest parts of northern Europe (CERVO et al. 2000). We determined the upper critical thermal limit of these two polistine wasps to compare their adaptation to environment conditions and to enable predictions about their future distribution.

Workers of *P. gallicus* were collected from nests near Firenze in Italy and *P. dominulus* workers were collected in an orchard near Graz in Austria. The critical thermal maximum (CT_{max}) of activity and respiration was investigated by using a standardized method, "thermolimitrespirometry", developed by LIGHTON & TURNER (2004). The wasps were placed in a respiratory measurement chamber and the temperature inside was increased from 25 to 55 °C at a dT = 0.25 °C min^{-1}. The CT_{max} was defined via observation of activity (activity CT_{max}, cease of controlled motoric activity, e.g. start of muscle spasms), and via thermolimitrespirometry (respiratory CT_{max}, cease of cyclic gas exchange measured as CO_2 release). The wasps' behaviour was recorded by means of an infrared thermography camera (ThermaCam SC2000 NTS; FLIR) which enabled evaluation of both the insects' activity and body temperature.

Fig. 1 shows a representative thermolimit experiment with a typical CO_2 trace and the thorax temperature excess data of a *P. gallicus* worker. The averaged values of the mortal fall provided the same knockdown temperature or activity CT_{max} for the two species (*Polistes dominulus* 47.6±0.9 °C, n=9; *Polistes gallicus* 47.6±1.1 °C, n=14; statistical details in Table 1). After the initial high activity and therefore metabolic rate, the CO_2 trace showed a typical progression, followed by a distinct postmortal peak after the respiratory CT_{max}. Averaged values of the respiratory CT_{max} were approximately identical and amounted to 47.8±1.2 °C (n=9) for *P. dominulus* and 47.7±1.0 °C (n=17) for *P. gallicus*.

The investigation revealed the same upper critical thermal limit for the two wasp species. This is not really a surprising result, as *P. dominulus* is a widespread species and also abundant in the distribution range of *P. gallicus*. Therefore it had to cope with the same environmental conditions and temperature (extremes) like the Mediterranean wasp and developed similar adaptations. The predicted increasing temperature and temperature extremes due to climate change could enable both species to expand their distribution range to the north.

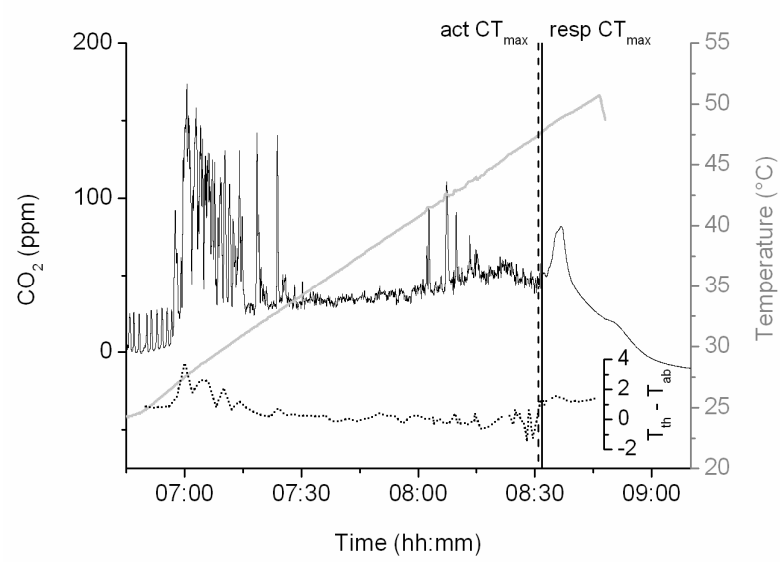

Fig. 1: CO_2 trace (solid) and thorax temperature excess (dotted) of a *Polistes gallicus* worker during a thermolimit experiment. The experimental temperature (grey) was increased at 0.25 °C min^{-1}. Critical thermal maxima of activity (act CT_{max}=47.5 °C) and respiration (respCT_{max}=47.7 °C) are indicated.

Table 1: Mean respiratory and activity critical thermal maxima of *Polistes dominulus* and *P. gallicus* derived from thermolimit experiments. N = number of individuals, respective mean critical thermal maximum (CT_{max}) with standard deviation (SD), maximum (max) and minimum (min) values in °C. No statistical differences (p>0.05, t-test) between species.

	N	***respCT$_{max}$***	SD	max	min	N	***act CT$_{max}$***	SD	max	min
P. dominulus	9	**47.8**	1.2	49.6	45.6	9	**47.6**	0.9	48.9	45.6
P. gallicus	17	**47.7**	1.0	49.4	46.1	14	**47.6**	1.1	51.7	48.2

The research was funded by the Austrian Science Fund (FWF): P25042-B16.

References

CERVO R., ZACCHI F. & S. TURILLAZZI (2000): *Polistes dominulus* (Hymenoptera,Vespidae) invading North America: some hypotheses for its rapid spread. — Insect Sociaux **47**: 155-157.

LIGHTON J.R.B. & R.J. TURNER (2004): Thermolimitrespirometry: an objective assessment of critical thermal maxima in two sympatric desert harvester ants, *Pogonomyrmex rugosus* and *P. californicus*. — J. Exp. Biol. **207**: 1903-1913.

Anschrift der Verfasser: Dr. Helmut KOVAC
Mag. Dr. Helmut KÄFER
Dr. Anton STABENTHEINER
Forschungsgruppe Stoffwechsel, Verhalten und Modelling
Institut für Zoologie, Karl-Franzens-Universität Graz
Universitätsplatz 2, A-8010 Graz, Austria
E-Mail: helmut.kovac@uni-graz.at

Iacopo PETROCELLI
Dipartimento di Biologia, Università di Firenze
Via Madonna del Piano 6,I 50019 Sesto Fiorentino, Italy

Sexual selection and ectoparasitic load in the cantharid beetle *Rhagonycha fulva*

A. LACINY

The red soldier beetle *Rhagonycha fulva*, a member of the family Cantharidae, is one of Austria's most common beetles. Despite its abundance in Central Europe, very little research has previously been done about the species' biology, life-cycle and mating behaviour.

Observations of a population of *R. fulva* in Oberpiesting (Lower Austria) in 1999 revealed an infestation with ectoparasitic larval mites of the genus *Trombidium* (Trombidiidae). The larval stages of these parasites have been found to occur on a large number of arthropod hosts. In Coleoptera they are most frequently attached to the intersegmental membranes between the subelytral abdominal tergites, where they feed on the host's hemolymph.

Based on the ambiguous results of previous research and the competing theories aiming to explain possible correlations between an individual's resistance to parasitic infections and its mating success, the goal of this study is to explore the relationship of ectoparasitic load and mate-choice in *Rhagonycha fulva*. The aim is to clarify if and how the presence, abundance and location of ectoparasites influences mate-choice in this particular species and whether parasitic load correlates with other traits such as sex and body-size.

Microscopic assessments of parasite load, size and distribution on the host's body as well as measurement of the right metathoracic femur as a size parameter were performed on 34 unmated males, 11 unmated females as well as 198 mated pairs of *R. fulva*.

The results of these observations will be used to answer the following questions:

- Is there sexual dimorphism regarding the abundance or location of ectoparasites?
- Does parasitic load and distribution differ significantly between mated and unmated individuals?
- Is there evidence for size assortative mating based on femur measurements?
- Does body-size influence infestation with ectoparasitic mites?