Press release

Midges in a heat-based test of endurance – evolutionary history determines adaptability to high temperatures

Frankfurt am Main, 20 November 2012. Whether midges can reproduce successfully at high temperatures depends closely on their evolutionary history. Accordingly, the manner in which they deal with heat stress depends not only on whether a representative of this midge species comes from northern or southern Europe and is therefore more accustomed to higher temperatures. This was reported recently by scientists from the Biodiversity and Climate Research Centre (BiK-F) at the Goethe University and the Senckenberg Research Institute in the specialist journal "Oecologia". In order to judge the effect of global climate change, it is therefore necessary to observe both climatic and genetic data.

The team led by Prof. Markus Pfenninger, Goethe University and Biodiversity and Climate Research Centre (BiK-F) and Dr. Carsten Nowak, Senckenberg Research Institute and BiKF, collected midge larvae of the widespread species *Chironomus riparius* in southern, central and northern Europe and reared them at three different constant temperatures in the laboratory. The 20, 24 or 28 °C chosen for the experiment represent approximately the average temperatures faced by the midge larvae at their place of origin during the main breeding period in summer. The result: the number of larvae that ultimately grow into midges at the same temperature depends firstly on the origin of the population. Secondly, the warmer it is, the poorer the chances of breeding success for the population in general, but to different degrees.

"The relative breeding success within species therefore depends on how high the average summer temperatures are in the places of origin," explains Pfenninger. Midge populations from Portugal and southern France, which are exposed to higher average temperatures in summer, were therefore more successful breeders at higher temperatures in the experiment. This indicates local adjustment to local climate conditions.

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Paper:
Nemec, Sabrina; Patel, Simit; Nowak, Carsten & Pfenninger Markus. Evolutionary determinants of population differences in populations growth rate x habitat temperature interactions in *Chironomus riparius* (2012): Oecologia, doi: 10.1007/s00442-012-2517-30

Press images:

Living at freshwaters all over Europe – the midge *Chironomus riparius*. ©B. Valentine
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Available at:
http://www.bik-f.de/images/aktuelles/photos_pressemeldungen/50440412_f1e0c70458_o_300dpi.jpg

The additional examination of the genotype of the midge also shows that the breeding success is not only explained by the temperature in the place of origin, but also by the population history and the extent of existing genetic variability. In addition to natural selection, chance also plays a role here, because in a new population established by only a few individuals, not all genetic variants are represented. Due to population size fluctuations caused by environmental conditions, in separate populations some genetic variants disappear, others are newly generated by mutations. Caused by this genetic variability, populations of one species often exhibit different characteristics. Moreover, the extent of existing genetic variability is of importance: the higher it is, the better the population is able to resist to stress and to adapt to changing conditions.

The team sees the findings as an important step towards a better understanding of climate adaptation. “The study shows that both the population history and the climate of their previous habitat must be observed in order to be able to predict how a species will react to climate warming,” summarises co-author Dr Carsten Nowak. Midges are particularly interesting research objects, as they have settled a large habitat, which – if we compare, for example, southern and northern Europe – encompasses a difference in temperature of up to 10 degrees Celsius. At the same time their bodily temperature is controlled solely by the external temperature. The next step will be to examine the genotype of midges for adaption in metabolism, so that the differences between the populations can also be explained functionally.

Rearing midges at the laboratory: The larvae live in the sandy sediment in a small aquarium. © M. Pfenninger

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With the objective of analysis the complex interactions between biodiversity and climate through a wide range of methods, the **Bi**odiversität und **K**lima **F**orschungszentrum [Biodiversity and Climate Research Centre] (BiK-F) has been funded since 2008 within the context of the **L**andes-**O**ffensive zur **E**ntwicklung **W**issenschaftlichökonomischer **E**xzellenz (LOEWE) of the Land of Hessen. The Senckenberg Gesellschaft für Naturforschung and Goethe University in Frankfurt as well as other, directly involved partners, co-operate closely with regional, national and international institutions in the fields of science, resource and environmental management, in order to develop projections for the future and scientific recommendations for sustainable action. For further details, pleasevisitwww.bik-f.de