

Inconsistent effects of developmental temperature acclimation on low-temperature performance and metabolism in *Drosophila melanogaster*

Torsten Nygaard Kristensen^{1,2,3}, Johannes Overgaard², Ary A. Hoffmann⁴,
Niels Chr. Nielsen⁵ and Anders Malmendal⁶

¹Department of Molecular Biology and Genetics, Aarhus University, Tjele, Denmark,
²Department of Bioscience, Aarhus University, Aarhus, Denmark, ³NordGen – Nordic Genetic Resource Center, Ås, Norway, ⁴Department of Genetics, The University of Melbourne, Parkville, Victoria, Australia, ⁵Center for Insoluble Protein Structures, Interdisciplinary Nanoscience Center (iNANO) and Department of Chemistry, Aarhus University, Aarhus, Denmark and
⁶Department of Biomedical Sciences, University of Copenhagen, Copenhagen, Denmark

ABSTRACT

Question: Does acclimation to developmental temperature consistently affect metabolism and low-temperature performance when measured in different laboratory and field assays?

Hypothesis: Developmental acclimation reflecting naturally fluctuating thermal conditions consistently increases different components of performance at low temperatures and results in a clearly defined metabolic signature.

Organism: The fruit fly *Drosophila melanogaster* acclimated at different temperatures during development under semi-field and laboratory conditions

Field site: Mt. Rothwell (37°53'22"S, 144°26'25"E) and laboratory facilities at the University of Melbourne, Victoria, Australia.

Methods: Adult females developed under four different constant or fluctuating thermal conditions were tested for their ability to locate food under cool conditions, recovery from a cold shock, or fecundity. Flies from the different acclimation regimes were characterized biochemically using NMR-based metabolomics.

Conclusions: Flies reared at constant benign temperatures were more fecund at all acclimation temperatures. In contrast, flies reared under fluctuating natural or laboratory conditions were more successful in locating food under cool conditions in the field, while constant cool rearing conditions led to high cold resistance. The fluctuating- and low-temperature rearing conditions resulted in a similar metabolic profile, while the 24°C rearing profile was distinct and showed a lack of plasticity. The effects of developmental acclimation on performance are therefore complex and cannot be captured through experimental comparisons of constant environments.

Keywords: beneficial acclimation hypothesis, cold tolerance, fluctuating vs. constant temperatures, life-history traits, metabolomics, plasticity, semi-natural conditions.

Correspondence: Torsten Nygaard Kristensen, NordGen – Nordic Genetic Resource Center, Raveien 9, 1430 Ås, Norway. E-mail: torsten.nygaard@nordgen.org

Consult the copyright statement on the inside front cover for non-commercial copying policies.



www.evolutionary-ecology.com

***Evolutionary Ecology Research* is delighted that you wish to consult one of its articles.**

You may if your library or laboratory subscribes.

Did you know that EER invented the idea of posting final drafts of mss as soon as they are accepted?

Ask your librarian or library committee why your place does not already subscribe to the low-cost journal that is publishing splendid science in a socially responsible manner. *EER's* low prices have helped librarians to rein in the indefensible cost increases that have reduced our access to science all over the world! Just ask our partners at [SPARC](#) — the Scholarly Publishing & Academic Resources Coalition of the Association of Research Libraries.

Or maybe you should just remind the folks who order your journals to contact us and subscribe! You need — and they should support — the journal that:

- Was the first journal in the world to allow e-only subscriptions while maintaining a traditional print edition, too.
- Vests the copyrights of all articles in their authors while preserving the rights of educational and research groups to use its material in classes, seminars, etc. at **no additional cost**.
- Maintains a unified data-base of articles so you can use your web browser to find any article, author, title word or keyword in any article that *EER* has ever published. (Forget about issue numbers, author order, and other such impediments to easy access.)
- Provides *Webglimpse* so that you can search any word, place, species, variable, phrase, keyword or author in any article *EER* has ever published.
- Provides its own **new** search filter that allows you instantly to compile a hot-linked list of articles according to year, issue, author, title word or keyword (as you prefer).

EER is the place to go for great science, responsible publication policies and easy access!

[Click here for the Table of Contents](#) of the most recent issue of *Evolutionary Ecology Research*

[Click here for full access to a sample issue](#) of *Evolutionary Ecology Research*

[Click here for SUBSCRIPTION INFORMATION](#)