Author's Accepted Manuscript

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PII: S0306-4565(17)30450-3
DOI: https://doi.org/10.1016/j.jtherbio.2018.04.004
Reference: TB2094

To appear in: *Journal of Thermal Biology*

Received date: 25 October 2017
Revised date: 12 March 2018
Accepted date: 4 April 2018

Cite this article as: Tomáš Ditrich, Supercooling point is an individually fixed metric of cold tolerance in *Pyrrhocoris apterus*, *Journal of Thermal Biology,* https://doi.org/10.1016/j.jtherbio.2018.04.004

Supercooling point is an individually fixed metric of cold tolerance in *Pyrrhocoris apterus*

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Abstract

Measuring the supercooling point (SCP) is a standard procedure to describe the cold tolerance of freeze-avoiding arthropods. The SCP of an individual animal is a stochastic event that will occur with increasing probability as the temperature is lowered below the freezing point of that animal. Nevertheless, the repeatability and extent of stochasticity of the SCP has not previously been determined. The repeatability of the SCP in post-diapause, laboratory cold-acclimated and naturally acclimated field-collected linden bugs (*Pyrrhocoris apterus*; Heteroptera: Pyrrhocoridae) was investigated in this study. Two methods were used: (a) repeated freezing of previously frozen and thawed individuals, and (b) repeated cooling of groups of individuals to the population median SCP. The results showed a significant positive correlation between the SCP and repeated SCP. All individuals died when frozen, whereas none died at temperatures above the SCP. Most of the individuals survived repeated cooling to the population median SCP. Survivorship increased from 85% to 97% (first to fourth repeated cooling to the population median SCP) when individuals were frozen to within 0.5 °C above the population median SCP. The SCP in post-diapause, cold-acclimated insects is a fixed, intrinsic cold tolerance metric with slight individual stochastic variance (SD < 1 °C).

Keywords: cold tolerance, SCP, freeze avoidance, repeated cooling