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Heart of Cold: Cold Hardiness of the Golden Stonefly Nymph

Jack Hanson

University of Montana, Missoula, jh184034@umconnect.umt.edu

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Abstract UMCUR

Jack F. Hanson; James I. Frakes; Jackson H. Birrell; H. Arthur Woods

The golden stonefly (*Hesperoperla pacifica*) is an ecologically important aquatic insect native to western North America. These large-bodied predators prey on other insects and support healthy trout populations. Despite their importance, little is known about the cold hardiness or freeze tolerance of golden stonefly nymphs. In winter, stonefly nymphs experience temperatures down to 0 °C, and may experience even colder temperatures as they make contact with ice forming within stream substrates. I carried out a set of experiments to determine the cold tolerance limits of *H. pacifica* nymphs, and whether they are freeze tolerant or freeze avoidant. Freeze avoidant insects can prevent their tissues from freezing < 0 °C but die when ice nucleation occurs. Freeze tolerant insects, however, can survive freezing completely. My first experiment measured the nymph's supercooling points (SCP), the point of freezing which is marked by a clear exotherm. I measured survival after each nymph reached their SCP. In the second experiment, I held nymphs at constant temperatures (-1 to -5 C) and measured whether nymphs reached their SCPs and whether they survived. The SCP of each individual was determined by attaching a thermocouple to the nymphs and recording their body temperatures. On average, *H. pacifica* survived all temperatures above their SCP (-3.92°C). Holding the nymphs at or below their SCP for an extended period caused death 100% of the time, suggesting that internal freezing is lethal for *H. pacifica*. *H. pacifica* can suppress the freezing point of their tissues and can survive acute exposure to temperatures below 0 °C, suggesting they are freeze avoidant. Stoneflies, in general, are considered coldwater specialists, adapted to survive the extreme temperature fluctuations present in many temperate streams. *H. pacifica* confirm this notion as they can tolerate sub-zero temperatures, which may put them at an advantage over other aquatic insects.