



The cryptic origins of environment-indicating phantom midges (*Chaoborus*)

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ABSTRACT: Fragile freshwater ecosystems have acted as important sentinels for global environmental change. A detailed understanding of the implications of global change in aquatic ecosystems relies on indicator species whose body parts are preserved in aquatic sediments for millennia. The phantom midge, *Chaoborus flavicans* (Meigen, 1830), for example, has well-preserved mandibles in aquatic sediments and may act as an indicator of boreal zone temperatures, lake depth, and the presence of fish. Nevertheless, we report that *Chaoborus* with *C. flavicans*-type mandibles are common in fishless tundra ponds above the tree line in western Alaska. We carried out genetic comparisons of nuclear and mitochondrial deoxyribonucleic acid (mtDNA) sequences in *Chaoborus* at a Holarctic scale to determine the origins of the Alaskan *C. flavicans*. Nuclear DNA, mtDNA, and morphological results indicated that the Alaskan *C. flavicans* represents a unique lineage of *Chaoborus*. The average mtDNA divergence (Kimura's two-parameter) between the Palearctic *C. flavicans* and the Alaskan *C. flavicans* was >17%. mtDNA strongly supported *Chaoborus crystallinus* (De Geer, 1776) as the sister species to the Alaskan *C. flavicans*. Our present understanding of larval mandible morphology disagrees with the major ecological properties and evolutionary lineages of *Chaoborus*. We identify a new mandible character and highlight the value of validating the diagnostic morphologies of environmental indicator species with genetic studies.

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