Temperature change as a driver of spatial patterns and long-term trends in chironomid (Insecta: Diptera) diversity

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Anthropogenic activities have led to a global decline in biodiversity, and monitoring studies indicate that both insect communities and wetland ecosystems are particularly affected. However, there is a need for long-term data (over centennial- or millennial timescales) to better understand natural community dynamics and the processes that govern the observed trends. Chironomids (Insecta: Diptera: Chironomidae) are often the most abundant insects in lake ecosystems, sensitive to environmental change, and, because their larval exoskeleton head capsules preserve well in lake sediments, they provide a unique record of insect community dynamics through time. Here, we provide the results of a meta-data analysis of chironomid diversity across a range of spatial and temporal scales. First, we analyse spatial trends in chironomid diversity using Northern Hemispheric datasets overall consisting of 837 lakes. Our results indicate that in most of our datasets summer temperature (T jul) is strongly associated with spatial trends in modern-day chironomid diversity. We observe a strong increase in chironomid alpha diversity with increasing T jul in regions with present day T jul between 2.5-14 řC. In some areas with T jul >14 řC chironomid diversity stabilises or declines. Second, we demonstrate that the direction and amplitude of change in alpha diversity in a compilation of subfossil chironomid records spanning the last glacial-interglacial transition (15,000-11,000 years ago) are similar to those observed in our modern data. A compilation of Holocene records shows that during phases when the amplitude of temperature change was small, site-specific factors had a greater influence on the chironomid fauna obscuring the chironomid diversity-temperature relationship. Our results imply expected overall chironomid diversity increases in colder regions such as the Arctic under sustained global warming, but with complex and not necessarily predictable responses for individual sites.
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