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Evidence of Regional Warming during the 20th Century in Alpine and Subalpine Lakes in the Western United States

*** Porinchu, D**
porinchu.1@osu.edu
The Ohio State University David Porinchu, Scott Reinemann, Bryan Mark, Jason Box, Department of Geography 1036 Derby Hall, Columbus, OH 43210, United States
Reinemann, S
reinemann.2@osu.edu
The Ohio State University David Porinchu, Scott Reinemann, Bryan Mark, Jason Box, Department of Geography 1036 Derby Hall, Columbus, OH 43210, United States
Potito, A
aaron.potito@nuigalway.ie
National University Ireland, Galway Aaron Potito, Department of Geography University Road, Galway, Ireland, Ireland
Moser, K
kmoser@uwo.ca
University of Western Ontario Katrina Moser, Department of Geography Social Science Building, London, ON N6A 5C2, Canada
MacDonald, G
macdonal@geog.ucla.edu
UCLA Glen MacDonald, Depts. of Geography and EEOB 1255 Bunche Hall, Los Angeles, CA 90095, United States
Munroe, J
jmunroe@middlebury.edu
Middlebury College Jeffrey Munroe, Geology Department, Middlebury, VT 05753, United States
Mark, B
mark.9@osu.edu
The Ohio State University David Porinchu, Scott Reinemann, Bryan Mark, Jason Box, Department of Geography 1036 Derby Hall, Columbus, OH 43210, United States
Box, J
box.11@osu.edu
The Ohio State University David Porinchu, Scott Reinemann, Bryan Mark, Jason Box, Department of Geography 1036 Derby Hall, Columbus, OH 43210, United States

Subfossil midge analyses have been used to develop high-resolution (sub-decadal) reconstructions of 20th century temperature change in the Sierra Nevada, CA with success. Expansion of this earlier work to additional sites in the western United States suggests that a widespread increase in lake water temperatures has occurred in this region during the late 20th and early 21st centuries. Inference models for summer surface water

temperature (SSWT) were developed combining midge abundance data from 56 lakes in the eastern Sierra Nevada, California, with subfossil midge remains from the Uinta Mountains, UT. The newly merged Sierra Nevada–Uinta Mountains calibration set contains a greater diversity of chironomid assemblages and spans a wider SSWT range than the previously published Sierra Nevada calibration set. The lakes in the merged calibration set spanned elevation, depth, and SSWT temperature ranges of 900 m, 12.7 m, and 11.3 °C, respectively. A robust inference model for SSWT (3-component WA-PLS), based on 90 lakes, had a high coefficient of determination (r^2jack = 0.66) and a low RMSEP (1.4 °C). The midge-based SSWT inference model was applied to subfossil chironomid remains extracted from well-dated sediment sequences recovered from alpine and subalpine lakes in the Sierra Nevada, CA, Snake Range, NV and Uinta Mountains, UT. A close correspondence exists between the chironomid-inferred temperature profiles for the 20th and 21st centuries and mean July or summer temperatures measured at nearby meteorological stations. Application of this midge-based SSWT inference model to other intact, late Quaternary sedimentary sequences found in subalpine and alpine lakes in the Great Basin will help resolve the impact of late Quaternary and recent climate change in this region, improve our understanding of regional climate and aquatic ecosystem variability, and can be used to monitor the effects of climate change on aquatic ecosystems and establish ‘baseline' conditions against which future biotic changes can be compared.

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