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Paleolimnological Indicators of Global Change

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Anthropogenic climate change and the recent increase of Saharan dust deposition are potentially affecting Sierra Nevada alpine lakes. In this chapter, we summarize the results of paleolimnological research conducted to track recent environmental and ecological changes in the lakes and their catchments during the last two centuries. We analyzed several independent paleolimnological indicators preserved in highly resolved dated lake sediment cores including spectrally inferred chlorophyll- a concentration, leaf waxes (n-alkanes), and the subfossil remains of diatoms, cladocerans, and chironomids. Our results are indicative of significant changes in the lakes and their catchments with subtly starting over a century ago that accelerated in the 1960s-1970s, concurrent with trends in rising regional air temperature, declining precipitation, and increased Saharan dust deposition in the region. Our biological indicators registered pronounced changes in the composition of aquatic communities and a recent increase in algal biomass (inferred from chlorophyll- a). Temperature was identified as the main predictor of the observed changes, whereas Saharan dust deposition drivers were secondary explanatory variables. The synchronous change among the paleolimnological proxies and climatic variables analyzed in the Sierra Nevada study lakes indicated that this is a regional shift. The nature of the change in these independent proxies is interpreted as a response to a lengthening of the lake ice-free period, an increase in lake water temperature, as well as a reduction in water availability in the catchments, which affected the volumes and water residence times. All these processes reflect the intensification of summer drought in the Sierra Nevada summit area over the last 50-60 years. In addition, distinct changes in species composition indicate an alkalinization of lake waters. Projected increases in global temperature, decreasing precipitation, and possible increases in Saharan dust inputs will further exacerbate the changes observed so far in these valuable aquatic ecosystems.
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