Social-ecological system dynamic over the past 150 years revealed by lake sediments: A case study review from the middle and lower reaches of Yangtze River, China

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Abstract

Understanding social-ecological system dynamics is a major research priority for sustainable management of landscapes, ecosystems and resources. Since that long-term monitored records are short or lacking in most situations, paleoenvironmental reconstructions based on lake sediments may provide continuous multi-decadal records for an array of ecosystem states, processes and services. Combining these records with conventional sources of historical information from instrumental monitoring records, official statistics and archival documents produces an evolutionary framework for reconstructing integrated regional histories. Here we demonstrate the integrated approach with published studies from the middle and low reaches of Yangtze River Basin (MLYB), where contains around 25% of the China population (338 million people) and are responsible for 24% of the whole national agricultural production. Based on the monitoring records (from 4 lakes with records since 1950s) and multiple-proxy paleolimnoligcal analysis (from 10 lakes), we have a better understanding on the evolutionary process of the shallow lake ecosystems under the strong human activity coupled with natural climate changes over the past 150 years. Three major conclusions we can draw so far: 1) Significant regime shifts has occurred during the 1950s and 1980s in most of the MLYB lake, suggesting common large-scale extrinsic drivers (hydrological modification and nutrient enrichment. 2) The pattern of ecosystem service (regulating services) in 4 lakes from the MLYB since 1900 was reconstructed, providing empirical evidence of long term environmental degradation, with declines in air quality regulation, soil stability, sediment regulation, biodiversity and water purification, which is particularly notable after 1980. Our data on a typical lake (Taibai L.) (including a total of 55 annually resolved time series representing the main trends in social, economic and ecological conditions since 1950) indicates that successful economic development and poverty alleviation has led to rapid environmental degradation; 3) Based on high-resolution diatom records from ten MLYB lakes, their ecological and chemical reference conditions, the historical variability and its controlling factors were defined.

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