Summary of paleorecords of environmental change and catchment deforestation at Lake Tanganyika and impacts on the Lake Tanganyika ecosystem

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Abstract

Paleorecords from multiple indicators of environmental change provide evidence for the interactions between climate, human alteration of watersheds and lake ecosystem processes at Lake Tanganyika, Africa, a lake renowned for its extraordinary biodiversity, endemism and fisheries. This paper synthesizes geochronology, sedimentology, paleoecology, geochemistry and hydrology studies comparing the history of deltaic deposits from watersheds of various sizes and deforestation disturbance levels along the eastern coast of the lake in Tanzania and Burundi. Intersite differences are related to climate change, differences in the histories of forested vs. deforested watersheds, differences related to regional patterns of deforestation, and differences related to interactions of deforestation and climate effects. Climate change is linked to variations in sediment accumulation rates, charcoal accumulation, lake level and water chemistry, especially during the arid-humid fluctuations of the latter part of the Little Ice Age. Differences between forested and deforested watersheds are manifested by major increases in sediment accumulation rates in the latter (outside the range of climatically driven variability and for the last ~40 years unprecedented in comparison with other records from the lake in the late Holocene), differences in eroded sediment and watershed stream composition, and compositional or diversity trends in lake faunal communities related to sediment inundation. Variability in regional patterns of deforestation is illustrated by the timing of transitions from numerous sedimentologic, paleoecologic and geochemical indicators. These data suggest that extensive watershed deforestation occurred as early as the late-18th to the early-19th centuries in the northern part of the Lake Tanganyika catchment, in the late-19th to early-20th centuries in the northern parts of modern-day Tanzania, and in the mid-20th century in central Tanzania. Rapid increases in sediment and charcoal accumulation rates, palynological and lake faunal changes occurred in the early-1960s. We interpret this to

be the result of greatly enhanced flushing of sediments in previously deforested watersheds triggered by extraordinary rainfall in 1961/62. Regional differences in deforestation histories can be understood in light of the very different cultural and demographic histories of the northern and central parts of the lake shoreline. Incursion of slaving and ivory caravans from the Indian Ocean to the central coast of Lake Tanganyika by the early-19th century, with their attendant diseases, reduced human and elephant populations and therefore maintained forest cover in this region through the late-19th to early-20th centuries. In contrast, the northeastern portion of the lakeshore did not experience the effects of the caravan trades and consequently experienced high human population densities and widespread deforestation much earlier. These studies demonstrate the importance of paleolimnological data for making informed risk assessments of the potential effects of watershed deforestation on long-term lake ecosystem response in the Lake Tanganyika catchment. Differences in sediment yield and lake floor distribution of that yield, linked to factors such as watershed size, slope, and sediment retention, must be accounted for in management plans for both human occupation of currently forested watersheds and the development of future underwater reserves.

Keywords

DeforestationEast AfricaLake levelLake TanganyikaLate HoloceneSoil erosion