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Molecular genetic analyses of historical lake sediments from the East African Rift Valley

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Ancient DNA research, especially that of environmental samples, has to date focussed mainly on samples obtained from colder regions, owing to better DNA preservation. We explored the potential of using ancient DNA from sediments and sediment cores of shallow lakes in Kenya. These lakes, located in the eastern branch of the East African Rift Valley, are in close proximity, yet display strikingly different hydrological and geological features. Present day lakes range in alkalinity from pH 11 (Lake Elmenteita) to pH 8 (Lake Naivasha), and in depth from less than one meter to 15 meters. Historically they have undergone a number of drastic changes in lake level and environmental conditions, both on geological timescales and during the last centuries. Within this setting we employed molecular genetic methods to study DNA from recent and historic lake sediments, focussing on rotifers and diatoms. We analyzed population and species succession in the alkaline-saline crater lake Sonachi since the beginning of the 19th century, as well as distributions in recent and historic sediments of other lakes of the East African Rift System. To specifically detect diatoms, we developed a protocol using taxon-specific polymerase chain reactions and separation of products by denaturing high performance liquid chromatography (DHPLC). Employing this protocol we retrieved “ancient” DNA from a number of taxonomically diverse organisms, but found diatoms only in sediments younger than approximately 90 years. Using higly specific reactions for rotifers of the genus Brachionus, we tracked species and population succession in Lake Sonachi during the last 200 years. Populations were dominated by a single mitochondrial haplotype for a period of 150 years, and two putatively intraspecific turnovers in dominance occurred. They were both correlated to major environmental changes documented by profound visible changes in sediment composition of the core: the deposition of a volcanic ash and a historical lake level lowstand. The study of historical dynamics within single species is a very promising approach to reveal biotic responses to environmental pressures at a fine, intraspecific scale, and can be carried out using sediment cores as records of continous stratified genetic data.