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Dynamics of biotic and abiotic markers of the Anthropocene at Jasper Ridge Biological Preserve, California, USA

M. Allison Stegner[1], SeanPaul La Selle[2], Brian Sherrod[2], Anthony Barnosky[1], and Elizabeth Hadly[1]
[1]Stanford University, Department of Biology & Jasper Ridge Biological Preserve, United States of America
[2]United States Geological Survey, United States of America

Human activities changed our planet over the course of the Holocene, but the scale of impacts increased dramatically around the mid-20th century, representing the start of the Anthropocene. These pervasive anthropogenic impacts, including pollution, road-building, the rise of plastics, etc., are comparable in magnitude, uniqueness, and geologic perseverance to global changes that mark previous major geologic time intervals. To identify the preservable global and local signals that might be used to characterize the Anthropocene, we examine sediment cores from Searsville Reservoir, a 129-year-old reservoir located in the eastern foothills of the San Francisco Peninsula. We collected eight sediment cores ranging from 7.4 to 8.5 meters in length that appear to have bottomed out on the pre-reservoir surface, indicating average sedimentation rates of 6 to 7 cm per year. This exceptionally high sedimentation rate allows us to explore the Anthropocene geologic record on a sub-annual scale.

Our analyses to date include sedimentary DNA (sedDNA), pollen, computed tomography (CT) scanning, Carbon and Nitrogen isotopes, radionuclides, Mercury, and X-ray fluorescence (XRF). We find a strong relationship between sediment type and both sedDNA and pollen frequency: sedDNA and pollen are more abundant in the thin, low-density units that are thought to be associated with lower sedimentation rates and high organic inputs during the dry season. SedDNA analyses successfully identified a diversity of insects and vertebrates to the species level, including invasive fish and mosquitos. Computed tomography scans of the cores revealed >300 distinct layers ranging in thickness from <1mm to ~30mm. Many of the thicker laminae show upward-fining, indicative of individual storm events. Sediment density generally decreases from the bottom to the top of the cores, consistent with both sediment compaction and increasing organic inputs as the reservoir filled with sediment and eutrophied. $\delta^{15}N$ declined over the record, reflecting global $\delta^{15}N$ depletion due to fossil fuel combustion and artificial nitrogen fertilization for agriculture. $\delta^{13}C$ was fairly stable prior to around 1950, then became highly variable, possibly related to changes in aquatic productivity (algal blooms) that began in the 1950s. A sharp and well-defined peak in ^{137}Cs provides evidence of nuclear testing in the 1950s and '60s, and serves as a secure chronological tie point for the year 1963. The ^{137}Cs peak correlates well with the chronology estimated by counting back suspected annual couplets of high density (wet season)/low density (dry-season) sediments. Our analyses reveal a complex interplay between local and global human impacts at Searsville Reservoir, and document the onset of the Anthropocene epoch at fine scale. Searsville is

particularly appropriate as a candidate Global Boundary Stratotype Section and Point for the Anthropocene not just because of the unique and highly resolved nature of the sediments, but because the record itself is a direct consequence of human activity—the emplacement of a dam.