The Past is Important – Conservation Paleobiology Data in Restoration and Conservation

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Resource managers are tasked with planning for ecosystem restoration and species conservation in a rapidly changing world. An added complication is that monitoring typically does not begin until an environment has already been altered by humans, so we often lack information about natural states and their variability. If restoration means returning to a previous condition, typically pre-anthropogenic disturbance, how do we get information about past states and how can we anticipate biological responses to future environmental changes? The emerging field of conservation paleobiology provides missing information about pre-disturbance conditions and gives insights into how ecosystems and species have changed over centuries to millennia by integrating information from geohistorical proxies, such as those available from sedimentology, paleontology, archaeology, and geobiochemistry. By studying biotic responses to past environmental change, conservation paleobiology examines the results of natural experiments (e.g., past warmer-than-present climates) that cannot be evaluated on the timescales available from standard monitoring methods. These long-term records provide the necessary context to make conservation and restoration decisions that align with the natural range of biological and environmental variation and anticipate future responses under a rapidly changing climate.

Conservation paleobiological studies can contribute to resource management in a variety of ways. For example, they can test preconceived notions about baselines and quantify historical ecosystem attributes (e.g., biodiversity, structure, function, and services). Here we give four examples: 1) In the Florida Everglades, paleontological data combined with hydrologic models provide the estimated ranges for salinity and flow prior to alteration of the hydrology that are needed to set restoration targets. 2) In Caribbean Panama, preserved fossil shark scales reveal long-term changes in coastal shark populations and shifts in community composition over the last several thousand years. 3) In the Arctic National Wildlife Refuge (AK), shed female caribou antlers indicate range shifts coincident with infrastructure development for one herd, and consistent use of calving grounds over the last 3000 years for another herd. 4) Across the landscape, geohistorical data identify which taxa have previously shifted ranges to track climate conditions and highlight which taxa are most vulnerable and in need of conservation strategies that can facilitate range shifts as climates change.

By expanding the timescales over which species and ecosystems are studied and examining the patterns and drivers of pre-disturbance change, conservation paleobiology provides resource managers with information that encompasses natural trajectories of change and ecological processes within the natural range of variability, allowing for more attainable and sustainable restoration and conservation targets.

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