Environmental DNA: Can it improve our understanding of biodiversity on NPS lands?

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TRADITIONAL BIODIVERSITY MONITORING APPROACHES require large investments in field time, are based largely on visual observations, and require significant taxonomic expertise. New survey techniques using DNA collected from aquatic habitats may provide a cost-effective, repeatable approach to sampling a large number of sites for many taxonomic groups (Thomsen et al. 2012b; Bohmann et al. in press).

Environmental DNA (eDNA) monitoring enables the detection of organisms from DNA present and collected in water samples (Darling and Blum 2007; Darling and Mahon 2011). Detection of organisms can be confirmed because aquatic and semiaquatic organisms release DNA contained in sloughed, damaged, or partially decomposed tissue, gametes, and waste products into the water. In fact, recent evidence suggests that DNA survey techniques may be considerably more sensitive than traditional surveys for rare species (Jerde et al. 2011; Dejean et al. 2012; Pilliod et al. 2013a) and offer the ability to identify multiple species simultaneously (Minamoto et al. 2012; Thomsen et al. 2012b; Thomsen et al. 2012a) from individual water samples.

For these reasons, the Greater Yellowstone Inventory and Monitoring Network is partnering with university and agency scientists to begin testing whether eDNA monitoring can be integrated with ongoing amphibian monitoring in Grand Teton and Yellowstone National Parks. Our monitoring program is uniquely suited to evaluate the use of eDNA for amphibian richness monitoring across Grand Teton and Yellowstone for multiple reasons. First, visual encounter surveys are completed each year at approximately 250 long-term monitoring wetlands and will provide a means of testing the efficacy (i.e., determine if it is accurate and repeatable) of eDNA monitoring and potentially develop protocols for its incorporation into long-term monitoring. Additionally, these parks had two native species (e.g., spadefoot and northern leopard frog) that have not been detected in eight years of surveying. The ability to detect species at low densities with eDNA monitoring therefore offers greater potential for detecting these secretive, rare, or now-defunct species. Finally, our work and that of others suggest that some of the most biologically rich wetlands in the region occur at lower elevations; these same wetlands may be at risk for changes in climate. Cataloging the amphibian, mammalian, avian, and invertebrate assemblages or their use of these wetlands using eDNA techniques may help to more fully characterize the biodiversity of these threatened habitats (see Bohmann et al. in press).

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