



Using environmental DNA to improve detection and shorten survey time frames for endangered fairy shrimp

Project # 16-786

Background:

Department of Defense (DoD) installations contain some of the most extensive and best examples of vernal pools remaining in California, many of which contain federally endangered species of fairy shrimp. As a result, DoD assumes an enormous management and Endangered Species Act consultation burden associated with vernal pool species. Current U.S. Fish and Wildlife Service (USFWS) survey protocols for federally listed fairy shrimp require intensive efforts that can span up to five years. Surveys can be costly, time-consuming, and can lead to misleading results if a morphologically similar non-listed species is misidentified as the listed species. These issues can delay implementation of new training activities and military construction projects by years.

Environmental DNA (eDNA) has been shown to be a highly sensitive and efficient tool for identifying target organisms from their DNA in water and soil samples. It offers a possible alternative to conventional surveys by increasing sensitivity, improving efficiency, and eliminating species misidentification.

Objective:

The objective of this project was to develop eDNA methods to detect San Diego (*Branchinecta sandiegonensis*), versatile (*B. lindahli*), and Riverside (*Streptocephalus woottoni*) fairy shrimp in water and soil samples and compare this approach to standard field-based surveys for these species.

Summary of Approach:

After developing and validating quantitative Polymerase Chain Reaction (PCR) assays for target species, we paired eDNA sampling with standardized field surveys. We collected water samples from 10 pools with simultaneous dipnet fairy shrimp surveys repeatedly during the 2017 and 2018 wet seasons and collected soil samples from the same pools during the 2017 dry season. We also sampled an additional 20 pools once during the wet seasons and sampled one additional pool during the dry season. We analyzed all samples for eDNA of the three fairy shrimp species and compared detection probabilities and costs for each approach.

Results/Benefits:

During the wet season, we detected target species eDNA at every location where they were seen during field surveys (N = 11) and an additional six sites where they were not observed in the field. During the dry season, we detected target species eDNA at six of the eight sites that had dipnet surveys or eDNA evidence of target species in the previous wet season. The sites without detections in the dry season had low levels of eDNA during the wet season and no field detections. The cost of eDNA sampling one time in a single pool was higher than a single dipnet survey. Therefore, the overall annual costs of either a dipnet or eDNA sampling program depends on the number of sampling events that are needed to detect the species. If detection probabilities for eDNA sampling are higher than for dipnet surveys, the overall cost to sample a single pool for a season would be lower for eDNA surveys compared to dipnet surveys.

Accomplishments:

We showed that eDNA sampling can reliably detect fairy shrimp at rates the same as or higher than field surveys. Environmental DNA methods are highly accurate, which can prevent misidentification for species that are difficult to identify in the field. Additionally, eDNA sampling does not require a USFWS permit, which has stringent requirements for qualifications of survey personnel and may take months to obtain. We showed that eDNA sampling can detect fairy shrimp later in the season than field surveys, and eDNA may be more likely to accurately detect them early in the season when immature fairy shrimp are often difficult to distinguish from co-occurring species. With the high eDNA detection probabilities shown in this study throughout an extended sampling season, combined with reliably accurate species identification from the validated fairy shrimp eDNA assay, eDNA sampling may shorten the overall survey time needed to verify the presence of federally endangered fairy shrimp.

Contact Information:

Dr. Katherine Strickler
Washington State University
PO Box 645825
Phone: 509-335-6435
k.strickler@wsu.edu

CLEARED
For Open Publication

Nov 04, 2020

Department of Defense
OFFICE OF PREPUBLICATION AND SECURITY REVIEW

