Non-Invasive Environmental DNA Monitoring to Support Tidal Wetland Restoration

Study Period
2022 - 2025

Funded By

Delta Science Program
DELTA STEWARDSHIP COUNCIL

BUREAU OF RECLAMATION

About this Project

Monitoring wetland restoration projects is an important step to ensure that restored wetlands meet the goals of providing habitat and food for native fishes, such as Delta smelt, longfin smelt, and Chinook salmon. Conventional monitoring methods include fish capture, acoustic telemetry that requires capturing and tagging fish, monitoring angler harvests, and using video cameras to record fish. Although these methods are reliable, they are costly in terms of money, labor, and time.

To develop a new, easier, and less costly method for wetland monitoring, scientists developed environmental DNA (eDNA) methods to monitor tidal wetland restoration sites in the San Francisco Bay-Delta (Delta) in collaboration with the Department of Fish and Wildlife. eDNA refers to the DNA found in an organism's skin, scales, mucus, urine, blood, and feces that naturally leaves its body and is deposited in its environment—in this case, water! Scientists collect water samples, isolate the eDNA in the lab, and identify which species are present. Compared to conventional monitoring, eDNA methods are cost-effective and pose minimal risk to the target organisms.

Lead Investigators

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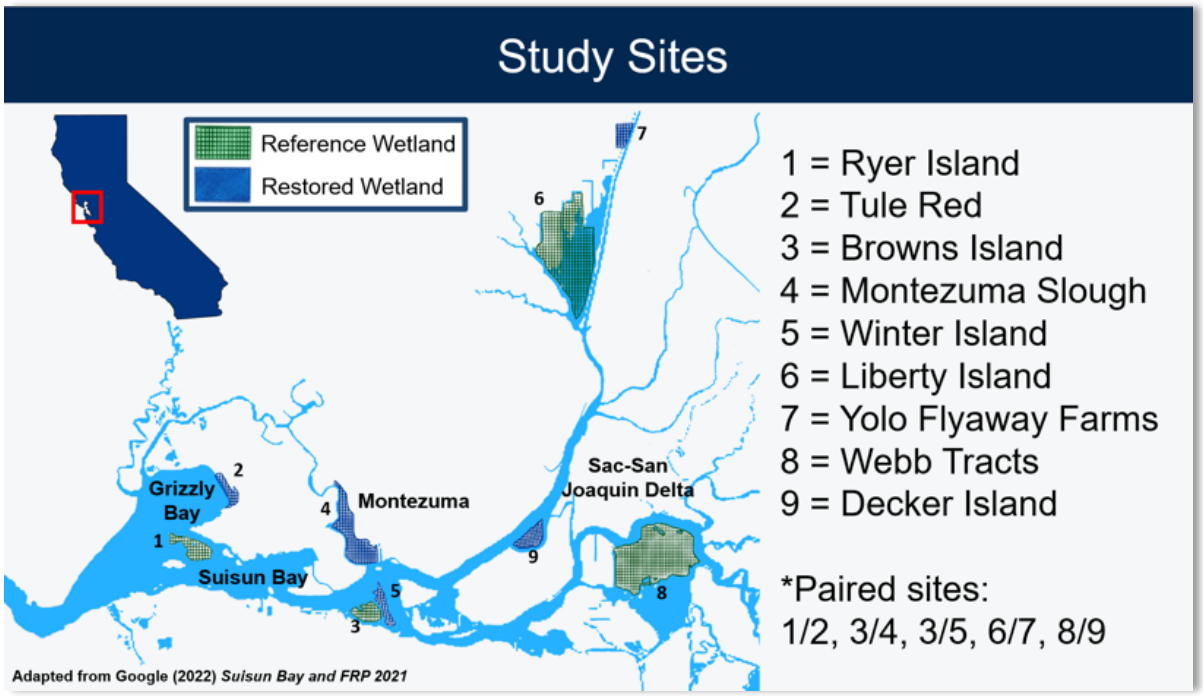
Project Objectives

- Use eDNA multispecies monitoring to detect fish diversity at tidal wetland restoration sites.
- Use eDNA multispecies and single-species methods to determine how fish communities and individual fish species vary seasonally within restoration sites.
- Evaluate if eDNA detection methods for fish can also provide information about non-fish species in wetlands that could be developed for future study.

Why this Research Matters

Monitoring is instrumental to evaluating wetland restoration projects, but with rapidly declining fish populations, we need new methods that are less expensive, less invasive, and more accurate. This project aims to demonstrate that environmental DNA methods can effectively monitor fish in wetlands without the risk of incidental take, unnecessary collection, and accidental killing of endangered fish.



*Paired restoration and reference tidal wetland study sites in the San Francisco Bay and Sacramento-San Joaquin Delta. Green – reference sites. Dark blue – restoration sites. *Adapted from Google Maps 2022 and Fish Restoration Progam 2021.*

Management Application

Using eDNA methods, it is possible to detect species that are difficult to capture in trawls and nets due to their rarity, size, or behaviors. This non-invasive method can detect endangered species even at low abundance. Leveraging eDNA data can reveal patterns of species assemblages and estimates of species richness. Water samples containing eDNA can be used to determine the presence of a single species and whole communities, from fish to invertebrates, through a multi-taxonomic eDNA monitoring approach.

This project established eDNA monitoring as a complementary tool for monitoring fish populations in restored wetlands in Delta, thereby helping managers measure the progress of tidal wetland restoration efforts. The data will be used in an adaptive monitoring framework for tidal wetland restoration to increase the likelihood of success of future restoration projects across the Delta and beyond.

Next Steps

All data and metadata are shared and archived on Data Dryad (https://datadryad.org/). Links to datasets are available on the GVL website (https://gvl.ucdavis.edu/publications) and in open-access publications for use by resource managers, interested researchers, and the general public.

Connections to the 2017-2021 Science Action Agenda

3: Develop Tools and Methods to Support and Evaluate Habitat Restoration
5: Modernize Monitoring, Data Management and Modeling