



Caltrans Division of Research,  
Innovation and System Information

# Research



# Results



Environmental

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**Project Title:**

Develop a Tidewater Goby Survey Method Using Environmental DNA

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## Develop a Tidewater Goby Survey Method Using Environmental DNA

To develop an environmental DNA survey protocol to determine if the endangered tidewater goby is present in Caltrans right-of-way.

### WHAT WAS THE NEED?

The California Department of Transportation (Caltrans) coastal districts are frequently required to initiate Endangered Species Act Section 7 Consultation with U.S. Fish and Wildlife Service (USFWS), on behalf of the Federal Highway Administration, for projects that may affect the tidewater goby. This is a small fish species currently listed as endangered under the Federal Endangered Species Act. It has a patchy and fragmented range along the entire coastline of California in estuaries, lagoons, and brackish water habitat from near the Smith River in the north to San Diego County in the south.

Sloughs and roadside ditches that Caltrans' maintenance crews need to maintain or repair can be suitable tidewater goby habitat, as are facilities within watersheds that lead to lagoon systems since these fish can be found several kilometers upstream of a lagoon. Thus, routine maintenance activities are subject to ESA consultation requirements if the activities can affect tidewater goby habitat. Often, Caltrans is required to provide mitigation for this species even when the tidewater goby is not detected since it is difficult to prove its presence or absence using the current survey methods.

An established survey protocol exists for tidewater goby, but the survey protocol is invasive, requires two survey periods conducted at least 30 days apart, and the results are not always accurate or definitive. Additionally, five consecutive years of negative survey results are needed to establish a history of absence which adds additional survey and mitigation costs for Caltrans's project delivery and maintenance programs. Thus, there is a need for an easy to use, noninvasive, accurate, cost-effective, and timely survey method to determine tidewater goby presence or absence to accompany the currently established protocol. Environmental DNA (eDNA) technology may provide an appropriate approach for determining the presence or absence of this fish species.



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## WHAT WAS OUR GOAL?

The objective of the research was to collaborate with USFWS and others to develop a reliable protocol for detecting tidewater goby using eDNA. The product will be an eDNA methodology that can be used as a tool by Caltrans personnel quickly, economically, and accurately to determine if this endangered fish is present at or near a project site.

## WHAT DID WE DO?

This study used eDNA to monitor the presence and absence of two endangered tidewater goby species, the northern tidewater goby (*Eucyclogobius newberryi*) and the southern tidewater goby (*Eucyclogobius kristinae*), across their combined geographic range that encompasses the entire California coast (1,350 km). A total of 209 sites were surveyed in coastal California from Del Norte to San Diego counties. A multi-scale occupancy model designed specifically for eDNA methods was used to account for imperfect detection and to estimate true site occupancy.

## WHAT WAS THE OUTCOME?

Out of the 209 sites surveyed, 12 were dry during the survey and assigned a status of non-detection. Among the 197 sites with water present, 430 samples were collected, filtered and tested for presence/absence using species-specific quantitative PCR (qPCR) assays. Northern tidewater goby was detected at 81 of 175 locations and southern tidewater goby were detected at 4 out of 22 sites, resulting in combined naïve occupancy of 0.43.

In contrast, the multi-scale occupancy model estimated site occupancy at 0.55 indicating that tidewater goby was present but not detected at 23 additional sites. Even though eDNA typically has higher detection probabilities than traditional field approaches, these findings indicate that imperfect

detection needs to be accounted for in eDNA surveys. The distributional information generated herein is critical for management as it will serve as a baseline for determining site occupancy and if tidewater goby is expanding or contracting in the number of sites occupied.

## WHAT IS THE BENEFIT?

Caltrans project delivery and maintenance activities in areas within this species range would be streamlined if they used this method to quickly determine the presence or absence of the tidewater goby. The improved survey methods would allow more accurate and streamlined consultation with resource agencies. Development of this methodology could lead to the use of eDNA from water samples for additional species, including amphibians which will also simplify and expedite Section 7 Consultations with the USFWS. This project will help develop a tool that will assist Caltrans in meeting its obligations under environmental laws and regulations and expedite the completion of sustainable transportation projects in a cost-effective manner.

## LEARN MORE

View the Final Report  
<https://dot.ca.gov/-/media/dot-media/programs/research-innovation-system-information/documents/final-reports/ca18-2724-finalreport-ally.pdf>

## IMAGES



Image 1: Tidewater Goby