

# Lots of Data Without the Fishy Smell: Application of Acoustic Imaging to Evaluate Fish Behavior Near Tidal Wetlands

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## Introduction

Major tidal wetland habitat restoration efforts are planned to benefit Delta Smelt, juvenile salmonids, and other imperiled species in the Sacramento-San-Joaquin Delta. However, successful implementation of habitat restoration is constrained by a paucity of information on the function and services that tidal wetlands provide for fishes. Our current understanding of tidal wetland service and function is often fundamentally limited. The rapidly changing environmental conditions and complicated physical structure of these habitats make fish sampling difficult, and empirical studies of fish in tidal wetlands are often constrained by sample size, and frequency of data collection.

To address these limitations, this study used an acoustic camera to collect high frequency continuous monitoring data at the entrance of the Little Holland Tract tidal wetland within the Sacramento River Delta. More specifically, we evaluated fish abundance and behavior in response to rapidly changing environmental conditions. Here, we report on a study aimed at understanding responses of fishes to bi-directional tidal flows and environmental factors driving movements into and out of tidal wetland habitats. Results from this work will help understand the value or detriment of different habitat features and will assist with future habitat restoration efforts.



Little Holland Tract study area.

## Study Objectives

- (1) Determine if there are patterns of fish movement that are concomitant with tidal velocity and vector direction
- (2) Determine how fish flux in and out of the tidal wetland varies by hydrodynamic regime

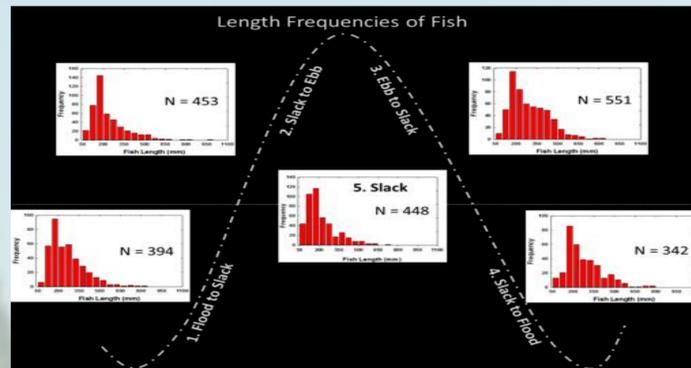
## Methods

An ARIS acoustic camera was positioned perpendicular to flow within a levee breach located at the Little Holland Tract wetland, with the camera view spanning approximately 75% of the levee breach. Acoustic data was collected 24-h a day between March 4 and April 4, 2016.

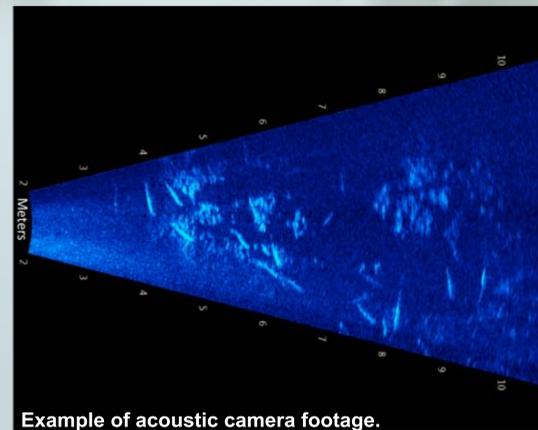
We subsampled footage from 6 dates of the sample season for analysis. A total of 151 one-minute files were randomly extracted from every hour of data collection for processing and tracking using EchoView® software. Fish targets were exported for further analysis, and grouped into small fish(30-130 mm) to represent Delta Smelt and juvenile salmonid-size fish, and large fish(>150 mm) to represent predator-size fish species.

## Results

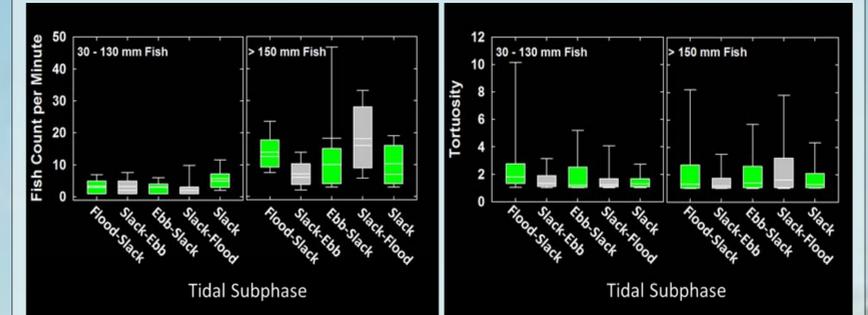
In total, 2,234 fish were observed in the subsampled footage, with an average of ~15 fish per minute. Fish observations were dominated by large fish, but small fish were also present during each tidal subphase. The following figures depict some examples of the fish count, behavior, and movement data that this methodology is capable of producing.



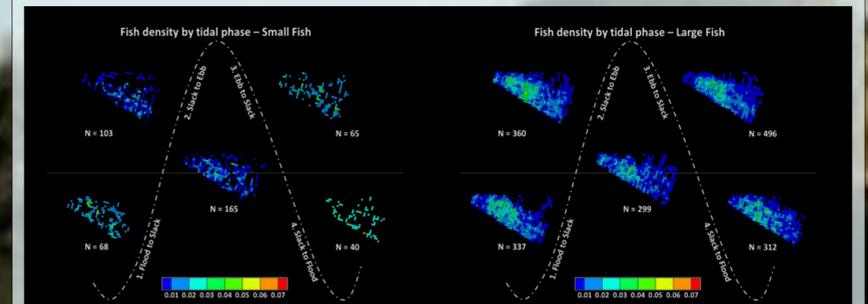
Length histograms of fish observed by tidal subphase.



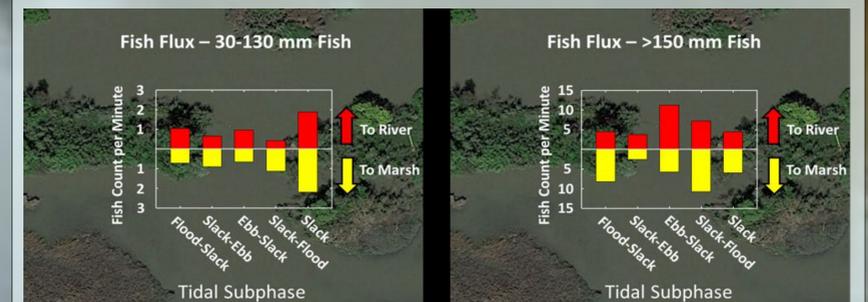
Example of acoustic camera footage.



Count per minute and tortuosity of small and large fish size classes by tidal subphase.



Lateral habitat use distributions of small and large fish size classes by tidal subphase.

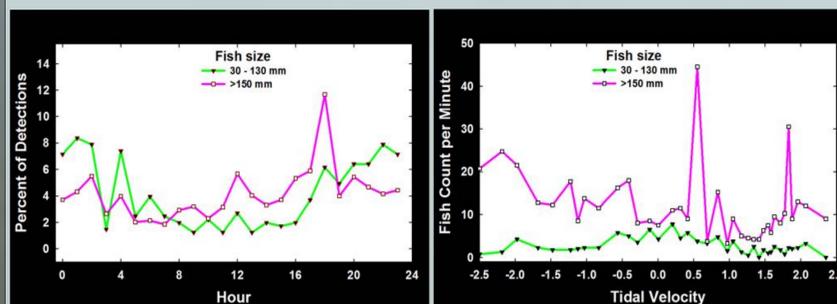


Fish flux of small and large fish size classes by tidal subphase.

## Summary

- Small and large fish were present at all hours and at all tidal phases.
- Small fish were more frequently observed during the night and periods of slack tide.
- Fish flux in and out of the wetland occurred more during the slack tide for small fish, but was variable for large fish.

Results from this proof-of-concept study indicate that an acoustic camera provided useful data for monitoring fish movements and behaviors at the entrance to a tidal wetland. This technology enabled us to continuously sample unmarked (and potentially federally listed) fish without affecting their behavior in a tidally influenced system where the physical environment changes substantially on a sub-tidal scale.



Detections of small and large fish size classes by hour and tidal velocity.