Deep in the shallows: Environmental variability and habitat use by native and invasive fishes in San Francisco's saltmarsh complexes

UC DAVIS WILDLIFE, FISH, & CONSERVATION BIOLOGY

Arthur Barros 1 , Levi S. Lewis 1 , Malte Willmes 1 , Micah Bisson 1 , Christina Parker 1 , Pat Crain 1 , Jon Cook 1 , James Ervin 2 , James A. Hobbs 1

1 Wildlife, Fish and Conservation Biology, UC Davis
2 San Jose-Santa Clara Regional Wastewater Facility
Contact: aebarros@ucdavis.edu

Photo Credit: Mark Anne FitzPatrick and Joey Papazian

Objective

Describe environmental similarities and differences between four Bay Area marsh complexes over a three year study period:

- Petaluma River (North Bay)
- Sonoma River (North Bay)
- Napa River (North Bay)
- Alviso Marsh (South Bay)

Characterize temporal patterns of water conditions among these marsh complexes and compare spatial and temporal habitat use by invasive and native fish species.

Methods

Eight Otter trawls were performed monthly at each complex. Tows were pulled for 10 minutes using our research vessel. Water quality parameters were taken before each tow at the surface and bottom (if depth >= 10ft).

Six target species were selected to compare habitat use and occurrence within and among the marshes:

- Longfin Smelt (native, CA state threatened species)
- Threespine Stickleback (native)
- Northern Anchovy (native)
- Striped Bass (invasive)
- American Shad (invasive)
- Yellowfin Goby (invasive)

General Additive Models (GAMs) were run on each of the target species, to determine variance accounted by four predictor variables collected during each tow:

- Average Dissolved Oxygen concentration (DO mg/L)
- Average Temperature (C)
- Average Salinity (ppt)
- Average Secchi (cm)

Acknowledgements

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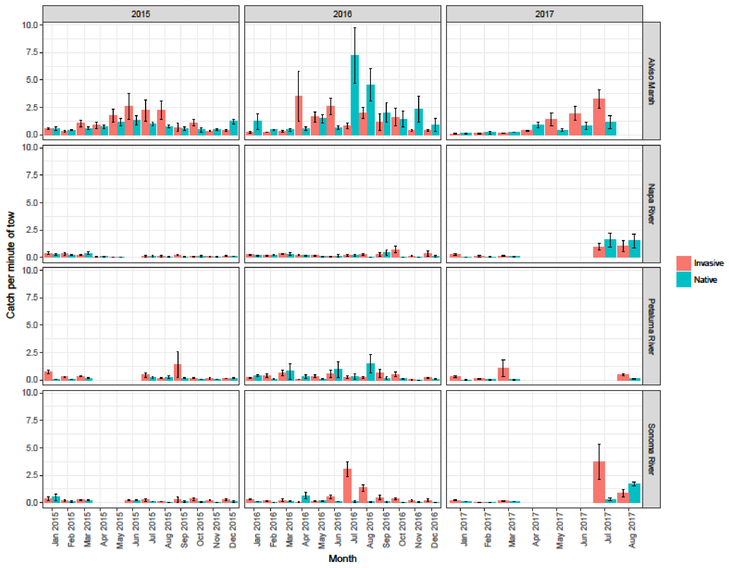
Figure 1: Average catch per minute of invasive and native fishes for each marsh complex



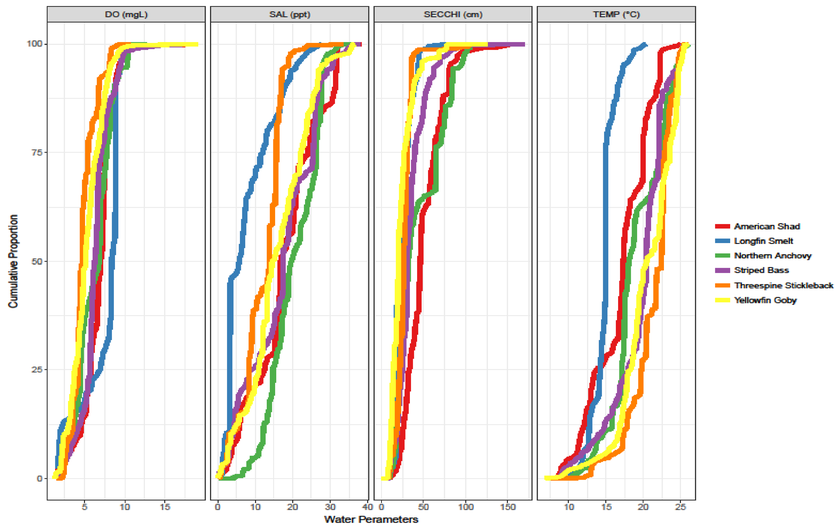
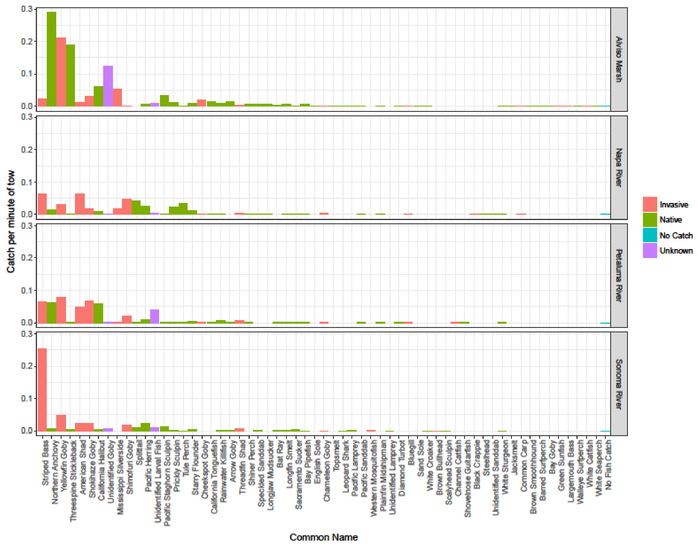


Figure 2: Cumulative proportions of catch for six target species by water parameters.

Figure 3: CPUE comparisons between invasive and native fishes for each of the marsh complexes.



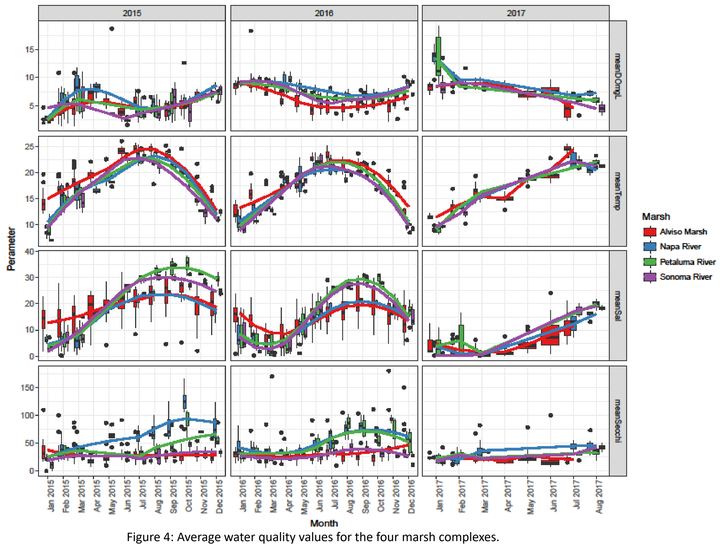


Figure 4: Average water quality values for the four marsh complexes.

Results

Species distribution:

- Overall highest catch densities in Alviso Marsh, with peak catches in summer months (figure 3).
- Higher densities of all three target native species in Alviso Marsh(figure 1).
- North Bay tributaries have higher densities of invasive Striped Bass and American Shad.
- Striped Bass dominate Sonoma River, especially during summer months.

Species habitat usage:

- Striped Bass are positively correlated with warmer water temperatures (figure 8).
- Yellowfin Goby catch is negatively correlated with both Dissolved Oxygen concentrations and Secchi depths (figure 10), preferring more turbid, oxygen lacking environments.
- Threespine Stickleback (found primarily in Alviso Marsh) were positively correlated with temperature, and negative correlations with both DO concentration and Secchi depth (figure 9).

Marsh Water Parameters

- Increased temperatures in the summer, accompanied by lowered dissolved oxygen concentrations, and increased salinities (Figure 4). This pattern is similar throughout all four marsh complexes.
- Secchi depth seemed to be fairly similar throughout the year, with the exception of the Napa and Petaluma Rivers, which see an increase in secchi depth in late Summer and Fall.

Discussion

Although water parameters were similar throughout the four Bay Area marsh complexes during the study period, species composition varied considerably.

Alviso Marsh stands out as the study area with the highest overall catch rates of both native and invasive species. The marsh also had the highest catch rate for all three target native species, with significantly higher densities of Northern Anchovies and Threespine Stickleback.

While the North Bay tributaries did have catches for natives species not in our target group (Splittail and California Halibut) they did not compare to the overall catch of native species in Alviso Marsh. The Napa, Petaluma, and Sonoma tend to have catches dominated by the three target invasive species.'

Further study must be done to determine why the Alviso Marsh catches are much denser then catches in the northern marsh complexes, especially compared to Napa river marsh catches, which have older restoration sites. A finer resolution may be needed to compare similar marsh sites and environmental variability.

Photo credit: René Reyes 2008

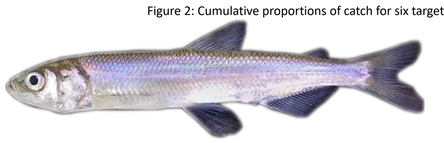


Photo credit: René Reyes 2008

Photo credit: Hobbs Lab

Photo credit: Dave Giordano 2007

Photo credit: Kasie Barnes 2009

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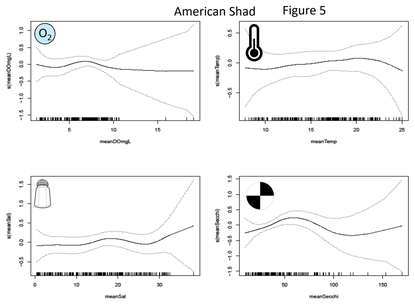
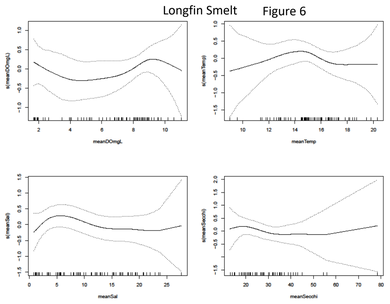
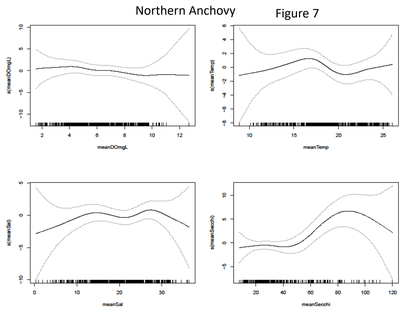
American Shad Figure 5



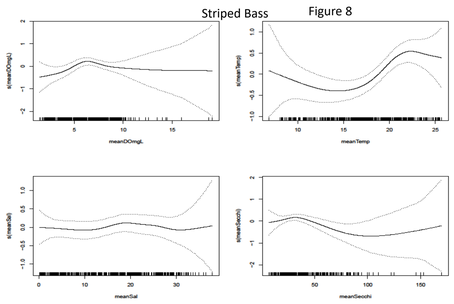
Longfin Smelt Figure 6



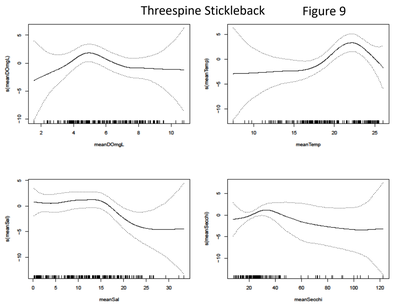
Northern Anchovy Figure 7



Striped Bass Figure 8



Threespine Stickleback Figure 9



Yellowfin Goby Figure 10