Water Quality in the Delta and Chinook Salmon: A Hot Issue with Murky Consequences

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Understanding for relationships between water quality and Pacific salmon smolt predation is limited. In our study, we addressed the hypothesis that poor water quality will decrease a salmon smolt's swimming performance, and presumably its predator evasion capabilities. Predation is a major factor affecting salmon smolt survival throughout California's San Joaquin River and Delta. Acoustic telemetry, predator stomach content analysis, and baited predation event recorder studies have quantified predation rates, but the effect of water quality on predator evasion capability has not previously been evaluated. We quantified the swimming performance of juvenile Chinook salmon, *Oncorhynchus tshawytscha,* in relation to water quality parameters. We measured maximum swim speed (U_{max}) for hatchery-reared Chinook salmon smolts in both a controlled and field environment using a mobile swim tunnel respirometer. U_{max} was measured for fish before and after a two-day exposure within the lower San Joaquin River (California, USA) while being held in flow-through cages. In order to sample across a diversity of environmental conditions, we conducted trials during a six-week period that coincided with the peak smolt outmigration. We constructed regression models to evaluate relationships between swimming performance and several water quality metrics. We found a negative relationship between maximum swim speed and temperature and turbidity, respectively, and described these relationships graphically. Our findings suggest that opportunities for water quality management that may improve salmon smolt survival include managing temperatures and suspended sediment concentrations to optimize the swimming capacity of migrating smolts. These management actions may also improve a migrating smolt's ability to evade predators.

Keywords: Chinook salmon, water quality, temperature, swim performance, aerobic scope

Poster Cluster: Non-Native Predator Fish Research in the Sacramento-San Joaquin Delta

Seasonal Movements and Distribution of Central Valley Striped Bass (*Morone saxatilis*)

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Striped bass (*Morone saxatilis*) are highly mobile and thus have the potential to both be impacted by various environmental and human stressors, and impact widespread native prey fish populations via predation. Unfortunately, very little is known about the movement or migration patterns of one major population on the west coast, except that they are also highly mobile and widely distributed. However, abundant research on east coast populations indicates striped bass movements can be deliberate and dynamic, leading to distinct life history strategies. The goal of this project is to quantitatively summarize Central Valley striped bass seasonal movements and look within general patterns for groups exhibiting unique behaviors. In spring 2011-2013, we acoustically tagged 81 striped bass (220-625 mm fork length) on the Sacramento River at Freeport and downtown Sacramento. Acoustic receivers span from San Francisco Bay to China Rapids near Red Bluff, CA. We quantified residence times within regions (San Francisco Bay, Suisun Bay, Delta, and Sacramento River), number of movements between regions, and maximum distance traveled for individual striped bass. To examine general movement patterns, these data were summarized by season, year, and size/maturity. To investigate potential distinct life history strategies, we used a cluster analysis on these metrics. Preliminary results found seasonal differences in striped bass distribution: spring showed the most upstream distribution into the Sacramento River, while summer and fall had widespread distribution from the bays to the delta, and winter showed a restricted distribution primarily in the delta. Understanding movement patterns of this important Bay-Delta species will likely have implications on life history, adaptability, and food-web effects. Furthermore, evidence of diversity in behaviors within a population may provide substance for resilience in the face of changing environmental conditions (e.g. drought, climate change, human habitat alteration), or conversely, lack thereof may explain recent declines in the population.

Keywords: striped bass, movement, telemetry, Sacramento

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Examining the Spatial and Temporal Distribution of Striped Bass within the Delta in Wet vs. Dry Years

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Understanding the distribution of mobile predators is critical for recognizing the potential impact of predation on threatened and endangered species. According to foraging theory, mobile fish such as striped bass select habitat that will maximize their fitness through overlap with prey and optimal temperature. Habitat is heterogeneously distributed throughout space and time, and drought can significantly alter fish habitat distribution through increases in temperature and shifting salinity gradients. Some research suggests that striped bass spend more time in freshwater during low-flow, which may also interact with temperature to influence distribution. To investigate how the distribution of striped bass may be influenced by drought conditions we are synthesizing existing datasets and incorporating new microchemistry analyses of striped bass otoliths as part of a Delta Science Fellowship awarded in the spring of 2016. This project is currently underway and the preliminary results will be presented. To synthesize what is known regarding the spatiotemporal distribution of striped bass in relation to annual water runoff within the Sacramento-San Joaquin Delta three different types of striped bass distribution data will be evaluated: 1) several years (2011-2015) of sonic telemetry data that reveal the movement and distribution of tagged individuals, 2) a long-term (1969-2015) database provided by CDFW that has capture and recapture locations of disk-tagged striped bass, and 3) striped bass otolith microchemistry analyses using Sr:Ca elemental ratios to determine the proportion of time an individual striped bass spent in fresh vs. saltwater for each year of life. The distribution information will be summarized per year by sex and life stage (sub-adult vs. adult). Continuous and categorical statistical approaches will be used to examine the relationship between annual water runoff and striped bass distributions. Preliminary analysis indicates yearly variation in freshwater use by individual striped bass.

Keywords: striped bass, predator, telemetry

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