Food-webs Workshop

November 8-9, 2023

Exploring Scientific and Management Implications of Upper Trophic Level Food Webs in the Delta

Poster Session Abstracts

Delta Independent Science Board

DELTA STEWARDSHIP COUNCIL

On **November 8 and 9**, the Delta Independent Science Board will host a two-day workshop to assess the importance of food-web interactions in the Delta and help identify where improved understanding and tools (e.g., food-web models) might substantially improve predictions of an individual species' response to environmental drivers and management actions (see meeting notice). The workshop will feature a poster session. The abstracts of the poster presentations are found below, and a copy of the presentation can be found here.

Posters

Asterisk (*) designates corresponding author.

Impacts of Storm-Driven Contaminants on Adaptive Capacity of Prey Species in the San Francisco Bay Delta.

Irina Polunina-Proulx*[1]: Irina.Polunina001@umb.edu

Richard Connon[2]: reconnon@ucdavis.edu

Michael Lydy[3]: mlydy@siu.edu

Helen Poynton[1]: helen.poynton@umb.edu

[1] University of Massachusetts Boston, 100 Morrissey Blvd, Boston, MA 02125
[2] University of California Davis, 1 Shields Ave, Davis, CA 95616
[3] Southern Illinois University, 1263 Lincoln Dr, Carbondale, IL 62901

Prey species found within the San Francisco Bay Delta face significant stressors, particularly from storm-driven contaminants such as insecticides. These stressors have significant impact on the food web through shifts in prey items and invertebrate community structures. For example, there have been recorded instances of prey communities evolving resistance to insecticides, which suggests ecological impairment and contributes to trophic transfer of high insecticides concentrations to fish. However the extent of adaptive resistance across invertebrate communities is not known. To better understand the extent of adaptive resistance in the San Francisco Bay Delta, common invertebrates were collected for evaluation of resistance in two genes: resistance to dieldrin (RDL) and voltage-gated sodium channel (VGSC). These genes are common targets of insecticides and mutations in these genes can confer resistance to the insecticide. The common prey items were divided by their orders, including Trichoptera, Plecoptera, Diptera, Amphipoda, Cladocera, Copepoda, Ephemeroptera, and Odonata. For each order and gene, degenerate primers were made and tested for their validity on a small number of samples from each order. Most of the degenerate primers were able to produce the expected product size for their appropriate gene and order. Degenerate primers for RDL successfully amplified gene products for Trichoptera, Plecoptera, Diptera, Cladocera, Ephemeroptera and Odonata and were identified correctly via sequencing. Degenerate primers for VGSC successfully amplified gene products for Trichoptera, Diptera, Ephemeroptera and Odonata and were identified correctly via sequencing. To date, none of the correctly identified gene sequences contained amino acid changes that would confer resistance; however the number of individuals tested per order ranged from 4-12 individuals during the project. This project has opened the door to further optimizing an assay to evaluate insecticide resistance across the key prey species of the Delta.

Efficacy of a long-term predator removal program in Clifton Court Forebay

Steven Brumbaugh[1]: Steven.Brumbaugh@water.ca.gov

Curtis Yip[1]: Curtis.Yip@water.ca.gov

Thomas Agosta*[1]: Thomas.Agosta@water.ca.gov

Amy Chase[1]: Amy.Chase@water.ca.gov

Asha Pluton[1]: Asha.Pluton@water.ca.gov)

Alexander Tasoff[1]: Alexander.Tasoff@water.ca.gov

[1,]California Department of Water Resources

In 2009, the National Marine Fisheries Service (NMFS) Biological Opinion for the Central Valley Project and State Water Project (SWP) prescribed a reduction in the number of juvenile salmonids lost to predation (i.e., pre-screen loss) in Clifton Court Forebay (CCF) to no more than 40%. NMFS and the California Department of Water Resources (DWR) subsequently met and agreed that DWR would attempt to reduce pre-screen loss through predatory fish removal in CCF. From 2016 through 2018, predator removal using electrofishing was investigated during the Predator Reduction Electrofishing Study (PRES). Following PRES, in 2019 and 2020, an investigation into using nets and traps, the Predatory Fish Removal Study (PFRS), was conducted. During this time, predator removal efforts were again included in the 2019 NMFS Biological Opinion, following a re-consultation, and the 2020 California Department of Fish and Wildlife Incidental Take Permit for the SWP. Therefore, the Enhanced Predatory Fish Removal and Relocation Study (EPFRRS) was conducted, building on the most successful methods in PRES and PFRS. EPFRRS was conducted from 2021 through 2023, using electrofishing, a 2,000 ft beach seine, hoop traps, hook-and-line, and a large Kodiak trawl. Concurrently, the Delta Fish Facilities Performance Evaluation study (DFPE) acoustically tagged juvenile salmon, released them near the radial gates where water enters CCF, and tracked their survival to the Skinner Fish Facility to evaluate the effect of EPFRRS on pre-screen loss. Despite the large-scale effort of EPFRRS, which included anywhere from 20-30 field staff fishing multiple gear types each day, DFPE showed very little effect on pre-screen loss. In addition, pre-screen loss remained well above the NMFS prescribed 40% despite these intensive efforts. Based on these results, we found that predator removal in CCF is a costly and ineffective method of reducing pre-screen loss of juvenile salmonids.

Loss of larval fish biomass to water export from the south San Francisco Bay Delta

Walter K. Griffiths*[1]: Walter.Griffiths@wildlife.ca.gov

Virginia Afentoulis[1]: Virginia.Afentoulis@Wildlife.ca.gov

Morgan Gilbert[1]: Morgan.Gilbert@Wildlife.ca.gov

Timothy D. Malinich[1]: Timothy.Malinich@Wildlife.ca.gov

[1]Affiliation: California Department of Fish and Wildlife R3 Fish Facilities and Entrainment Unit

Larval fish play important roles in the San Francisco Bay Delta food web as prey for larger organisms and as mid-level consumers. As adult life stages of Delta fishes have declined, so too have larval densities for some species. Larval biomass or density could be an important component of models of the food web of the San Francisco Bay Delta but estimates of larval abundance and size are needed to inform food web models. Attempts to quantify larval fish density in the Delta are challenged by low replication and untested assumptions in distribution and larval behavior, leading to uncertainty in the relative importance of various sources of mortality. Losses of larval fish biomass due to water export, which can approach half the total inflow to the system, could result in both a direct reduction of fish abundance and an indirect reduction of larval biomass as a food source. The Larval Entrainment Study is an effort to quantify larval transport from the south Delta to the State Water Project export facility, the larger of two major water export facilities in the south Delta, resulting in removal from the system. This study surveys the south Delta channel immediately outside the State Water Project's export facility and targets the federally Threatened Longfin Smelt, but also gathers data on other species. During the first two years of the study, which occurred during a shift from drought to wet conditions, daily mean larval biomass density reached a maximum of 69 milligrams per cubic meter. Most of the biomass was Prickly Sculpin, a native species. Total larval biomass was similar between the wet and dry years and showed similar temporal patterns. Given the export from the state facility is typically millions of cubic meters per day, loss of larval biomass due to export could be substantial.

Relative predation risk of fish in a restored tidal wetland

David E. Ayers*[1]: deayers@ucdavis.edu

Jesse R. Schroeder[1]: jrschroeder@ucdavis.edu

Cyril J. Michel[2]: cyril.michel@noaa.gov

Ann E. Holmes[3]: aholmes@ucdavis.edu

Andrew L. Rypel[1]: rypel@ucdavis.edu

[1]UC Davis, Center for Watershed Science, 1 Shields Ave, Davis, CA 95616
[2]UC Santa Cruz & NOAA Fisheries, 110 McAllister Way, Santa Cruz, CA 95060
[3]UC Davis, Department of Animal Sciences, 1 Shields Ave, Davis, CA 95616

Scientists must understand if restored tidal wetlands provide essential habitat for juvenile fishes, including, for food and rearing purposes, and as predation refugia. Indeed, the prospect of increased refugia from predation underlies motivation to remediate estuarine habitats globally; yet this putative benefit is almost never quantified. We evaluated relative predation risk for juvenile Chinook salmon (*Oncorhynchus tshawytscha*) using chronographic tethers – devices that record the exact time when prey fish are retrieved by a predator. Timing of predation events, along with corresponding measurements of the environmental setting, provide novel insight into how abiotic factors shape predation risk overall. In 2022, we conducted a series of tethering trials at Tule Red, one of many tidal wetland restoration projects in the San Francisco Bay-Delta. Preliminary results demonstrate that relative predation risk is non-random and driven by tidal phase, water depth, and wetland location. These insights, particularly the relationship between water depth and predation risk, may help scientists better categorize, quantify, and restore tidal wetland habitats which support native and imperiled fishes.

Statement of relevance:
Our study seeks to understand predation dynamics in tidal wetlands – important stopover habitat for out-migrating Chinook salmon in the San Francisco Bay-Delta. We endeavor to provide information that helps optimize tidal wetland restoration design and achieve conservation goals for native fishes, including but not limited to juvenile Chinook salmon.

End-to-End Modeling Reveals Species-Specific Effects of Large-Scale Coastal Restoration on Living Resources Facing Climate Change

Kim de Mutsert*[1]: kim.demutsert@usm.edu

Kristy A. Lewis[2]

Eric D. White[3]

Joe Buszowski[4]

[1] Division of Coastal Sciences, School of Ocean Science and Engineering, University of Southern Mississippi, MS, USA
[2] National Center for Integrated Coastal Research, Department of Biology, University of Central Florida, Orlando, FL, United States
[3] Research and Planning Division, Louisiana Coastal Protection and Restoration Authority, Baton Rouge, LA, United States
[4] Ecopath International Initiative Research Association, Barcelona, Spain

Coastal erosion is affecting Louisiana to such an extent that wetland loss between 1932 and 2016 was close to 5,000 km^2. To mitigate this decline, the 2017 Louisiana Coastal Master Plan (CMP) was developed, which includes a suite of projects that are predicted to build or maintain land and protect coastal communities. This research uses an ecosystem model to evaluate the effects of CMP implementation versus a future without action (FWOA) on the biomass and distribution of fisheries species in the estuaries over 50 years of model simulations. Simulations are performed under two relative sea level rise (SLR) scenarios to understand the effects of climate change on project performance and subsequent fisheries species biomass and distribution. Simulation output of eight economically important fisheries species shows that the CMP mostly results in increases in species biomass, but that the outcomes are species-specific and basin-specific. The SLR scenario highly affects the amount of wetland habitat maintained after 50 years (with higher levels of wetland loss under increased SLR) and, subsequently, the biomass of species depending on that habitat. By making this type of information available to resource managers, precautionary measures of ecosystem management and adaptation can be implemented.

Quantifying the white and green sturgeon die-off resulting from the 2022 San Francisco Bay Area harmful algal bloom (HAB) event.

Analicia Ortega*[1]: Analicia.Ortega@Wildlife.ca.gov

Joshua Canepa Gallo[1]: Joshua.Canepa@Wildlife.ca.gov

Dylan Stompe, PhD[1]: Dylan.Stompe@Wildlife.ca.gov

James Hobbs, PhD[1]: James.Hobbs@Wildlife.ca.gov

[1]California Department of Fish and Wildlife – Region 3 Headquarters, 2825 Cordelia Rd #100, Fairfield, CA 94534

Harmful algal blooms (HABs) occur when colonies of algae overpopulate. HABs can produce toxins, causing adverse effects for humans, fish, shellfish, marine mammals and birds. The decomposition of algae that follows a HAB event can also trigger a depletion of dissolved oxygen (DO) in the water. In the San Francisco Bay Area, a HAB event caused by the algae, *Heterosigma akashiwo,* lasted from early to late August of 2022 and caused a massive fish kill of an extent that has not been observed before in this system. As a result of this event, numerous white sturgeon (*Acipenser transmontanus*) and southern distinct population segment (sDPS) green sturgeon (*Acipenser medirostris)* were killed. White and green sturgeon carcass data were aggregated from citizen science sources, such as iNaturalist, the San Francisco Estuary Institute (SFEI), as well as from Cramer Fish Sciences and CDFW's open water and shoreline surveys. To control for potential misidentification and multiple reports of the same carcass, records and associated images were manually analyzed. From these data, a total of 877 sturgeon carcasses, including at least 203 white sturgeon and 21 green sturgeon, were identified. These numbers represent minimums, since sturgeon carcasses may sink before they wash up on shore, and large sections of shoreline were not surveyed. Given the potential that many more sturgeon likely died in the 2022 HAB than were recorded, this event may represent a population scale impact for both white sturgeon (a state species of special concern) and sDPS green sturgeon (ESA Threatened). These events may also increase in frequency and severity due to climate change and water management, as associated changes in water temperature and flow create conditions suitable for HABs.

Statement of relevance:
Sturgeons and other migratory species depend on appropriate water quality in the San Francisco Estuary to persist. This investigation of sturgeon casualties documents the impacts of the 2022 HAB event as it relates to the SFE white and green sturgeon populations.