The Tunnel at the End of the Light: Could reducing artificial nighttime illumination benefit native fish?

Brendan .M. Lehman[1,2], Thomas R. Nelson[3], Nicholas J. Demetras[1,2], Meagan P. Gary[1,2], Cyril J. Michel[1,2]

1. University of California, Institute of Marine Sciences, Santa Cruz, 1156 High Street, Santa Cruz, California, 95064
2. National Oceanic and Atmospheric Administration, Southwest Fisheries Science Center, Fisheries Ecology Division, 110 McAllister Way, Santa Cruz, California, 95060
3. George Mason University, Department of Environmental Science and Policy, 4400 University Dr. Fairfax, VA 22030

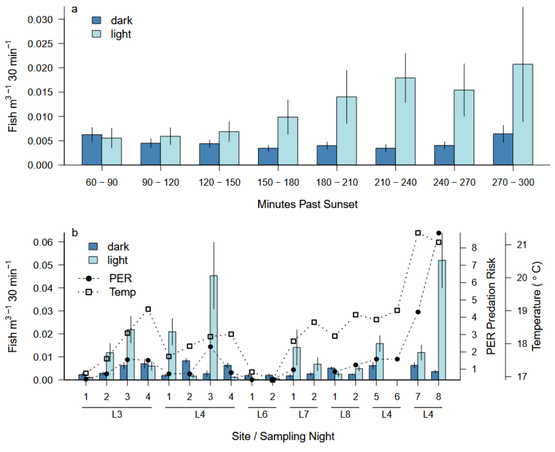
Introduction

The Sacramento–San Joaquin Delta has been invaded by several species of non-native predatory fish that are presumed to be impeding native fish population recovery efforts. Since eradication of predators is unlikely, there is substantial interest in removing or altering manmade features in the Delta that may exacerbate predation on native fish (a.k.a. "contact points"). Manmade features such as artificial lighting at night (ALAN) may contribute to increased levels of predation by attracting predators to prey, increasing predator reaction distance, and foraging success. We conducted a field experiment in the Delta that found ALAN to attract both large and small fish, and to increase predation rates on juvenile salmonids by non-native predators.

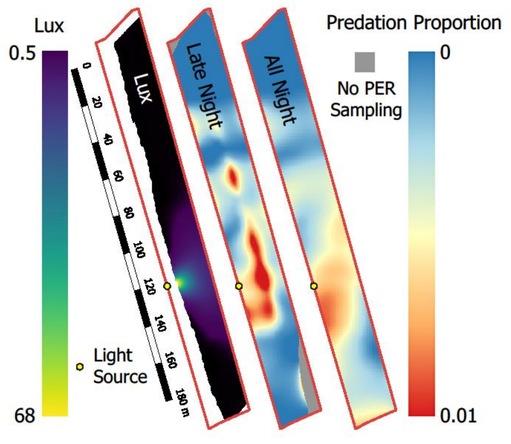
Field Experiment – Spring 2019

Spring 2019 field study focused on the effect of artificial nighttime illumination on predator-prey interactions

- We installed LED lights on the riverbank at six sites throughout the Central Delta
- Collected ARIS (sonar) and PER (predation event recorder) data across nights/weeks with lights on/off
- Conducted nightly light surveys
- Quantified other habitat and environmental characteristics to include in model selection



(A) The density of predator-sized fish aggregating in the illuminated (light blue) and non-illuminated portion of the study reach averaged across the season, as measured using ARIS sonar footage
(B) The density of predator-sized fish for each night of sampling in the illuminated and non-illuminated areas across the study season. Predator risk (as measured using PERs) is plotted with black dots.



- Interpolated light (lux) values for one field site on one sampling night.
- Predation proportion rasters for late night (>180 minutes past sunset) and all night datasets.
- We produced predation proportion rasters by generating kernel densities of all predation event recorder (PER) predation events and dividing these by kernel density of all PER GPS locations

Nelson, T. R., Michel, C. J., Gary, M. P., Lehman, B. M., Demetras, N. J., Hammen, J. J., & Horn, M. J. (2021). Effects of artificial lighting at night on predator density and salmonid predation. Transactions of the American Fisheries Society, 150(2), 147-159.

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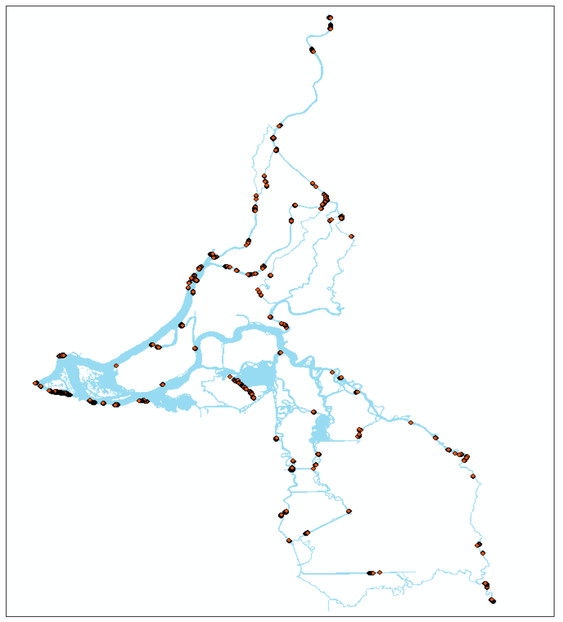
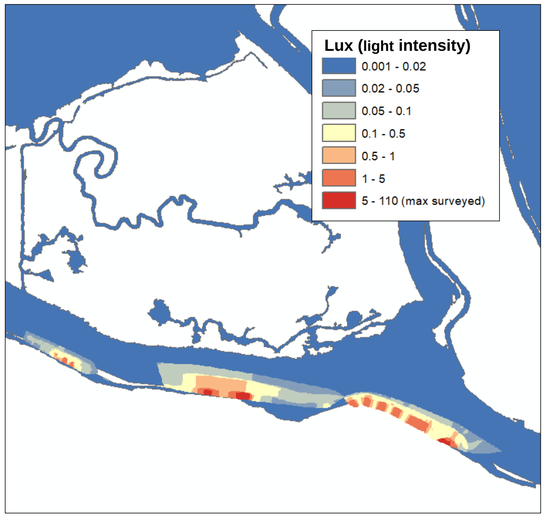
Inventory Survey of ALAN in the Delta

Removing, altering, or reducing the intensity of artificial lights that illuminate waterways is a feasible and potentially beneficial restoration action to improve the fate of native fish. However, to date there has been no inventory of ALAN in the Delta and quantifying light levels that are relevant at small spatial scales is difficult with existing remote sensing data. To inform the potential of reducing ALAN to benefit salmon, we surveyed all major channels in the legal Delta and created an inventory of illumination sources that cast measurable light onto waterways. We identified light sources and illuminated areas by conducting boat-based surveys at night time over the course of four weeks in Fall of 2021. Light intensity measurements were made using an International Light Technologies™ ILT2400 lux meter.

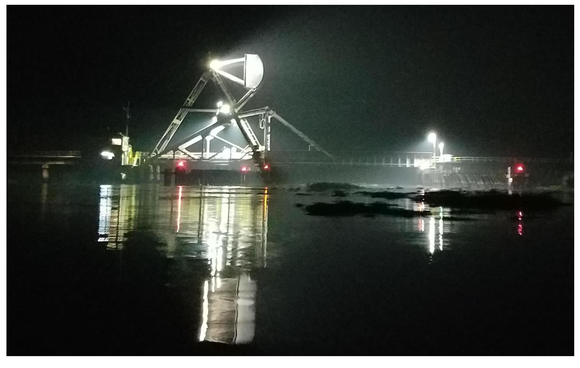
We plan to combine this with experimentally gathered information on predation rates as a function of ALAN and other environmental covariates, as well as frequency of waterway use by salmon, to prioritize light sources that could be addressed to benefit salmon.



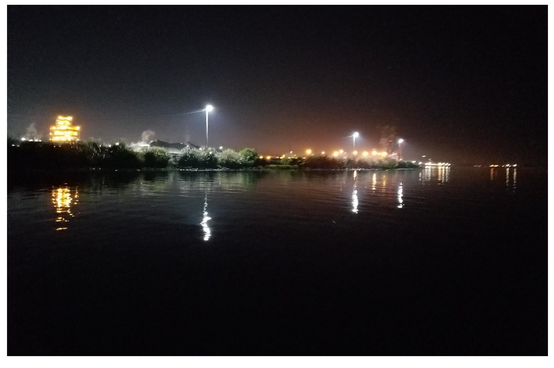
Red dots indicate areas where light sources were identified to be illuminating the river channel



Light intensity across part of the Antioch/Pittsburg shoreline. Values are interpolated from transect data collected by NOAA/UCSC



High intensity illumination coming off a railroad bridge that spans the entire channel of Middle River. Near Discovery Bay, CA.



Commercial shoreline in Pittsburg, CA