

Dataset Title

Temperature Thresholds for Aquatic Species in the Sacramento San-Joaquin Delta

Abstract

The effects of increasing water temperature on species in the Sacramento San-Joaquin Delta is of growing importance for conservation and resource management; however, species metrics of temperature sensitivity vary across agency groups and can result in varied understanding and predictions of species vulnerability and modeling. Here, we provide a catalogue of key temperature metrics for several species in the Sacramento San Joaquin Delta that may be used as a standard for scientists studying temperature effects and resource management of native and non-native species. The dataset includes both documented physiological thresholds for suboptimal and upper temperature tolerances from metrics such as growth or critical and lethal limits, as well as calculated minimum, maximum and mean temperature values of species catch in the Delta from long-term monitoring surveys from 1954-2022. Species include critical estuarine fishes such as Delta Smelt, Longfin Smelt, Chinook Salmon, and sturgeon, as well as the species they interact with such as invasive fishes and invertebrates, cyanobacteria, and aquatic vegetation. The dataset includes values for different life-stages where possible and references for information. This information can help guide conservation measures and species management needed to lessen the impact stressful temperature conditions.

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Keywords

estuaries, rivers, fishes, endangered species, invasive species

temperature, tolerance, Sacramento-San Joaquin Delta, San Francisco Estuary, Interagency Ecological Program

Funding of this work:

California Department of Water Resources, Delta Stewardship Council, Bureau of Reclamation

Timeframe

- Begin date: N/A
- End date: N/A
- Data collection ongoing or completed: Completed, possible occasional updates

Geographic location

- Verbal description: Sacramento San-Joaquin Delta
- North bounding coordinate (decimal degree):
- South bounding coordinate (decimal degree):
- East bounding coordinate (decimal degree):
- West bounding coordinate (decimal degree):

Taxonomic species or groups

Oncorhynchus tshawytscha, *Oncorhynchus mykiss*, *Hypomesus transpacificus*, *Spirinchus thaleichthys*

Methods

Data Collection methods

Temperature Thresholds

We compiled an integrated dataset (or catalogue) of temperature thresholds for fishes, invertebrates, aquatic vegetation, and cyanobacteria using documented values in peer-reviewed research, technical reports or field data when nothing was found in literature. While hundreds of native and non-native species exist in the Sacramento-San Joaquin Delta, we included only a subset of species focused around 1) resource management (e.g., state or federally listed endangered or threatened species), 2) species that may negatively affect management-relevant species (e.g., non-native predators, clams, aquatic vegetation), and 3) other native fishes where information is less known. For each species and life-stage (if found) we conducted a literature search and recorded documented suboptimum or tolerance temperature values. Often literature and experimental research values varied based on the metric (e.g. growth, metabolic scope, critical thermal maximum or lethal thermal maximum) or acclimation temperature where species can acquire thermal tolerance. For variable values, a range was documented in the dataset to capture the variability across literature.

Life Stage Designations

Most monitoring programs report length data for fish catch, but do not report life stage. To connect temperature thresholds with monitoring data, we conducted a literature search to find

documented lengths for each life stage (larvae, juvenile, adult) so that we could make life stage designations for monitoring data. See notes on data quality (below) for more details on how these designations were made.

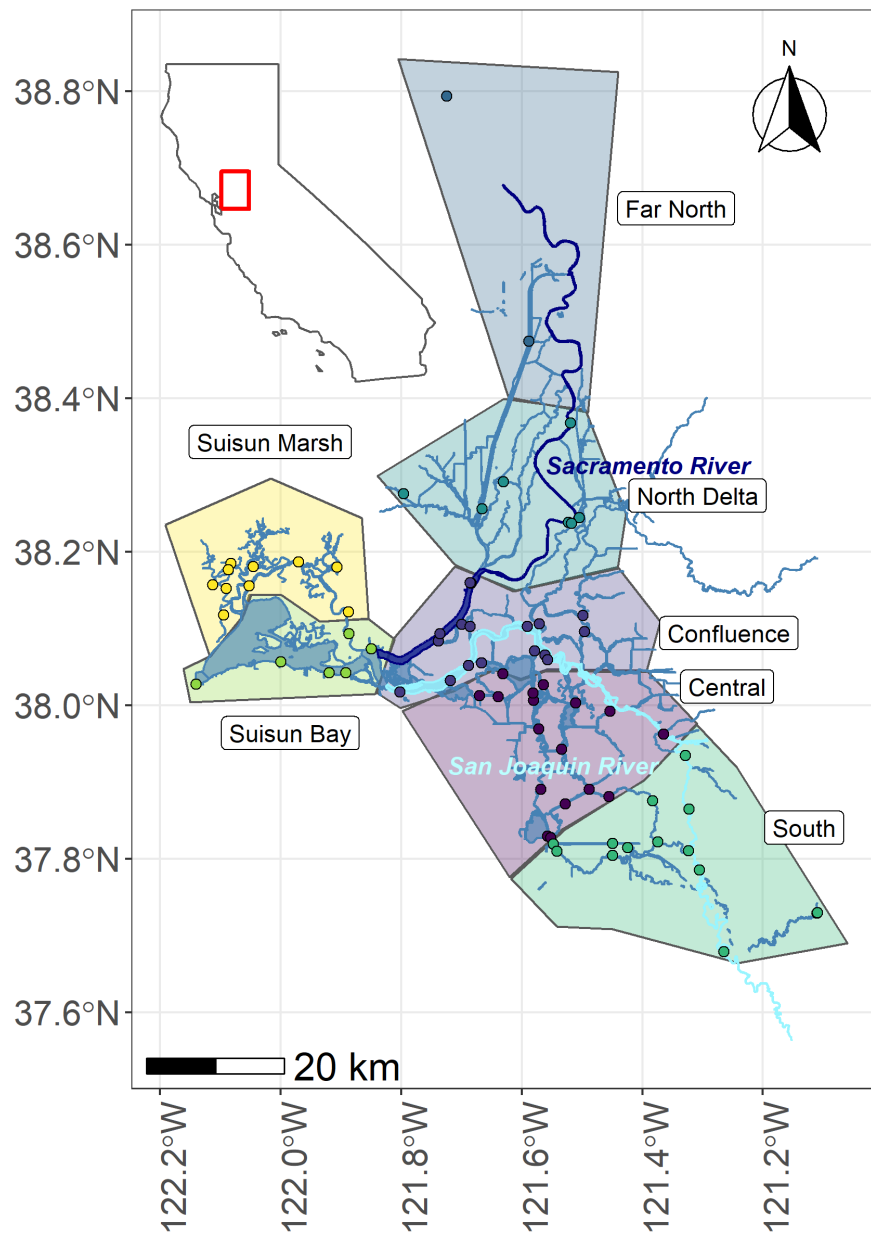


Figure 1. Region Designations.

Quality Assurance and Control

Notes on Data Quality

Life Stage data

Due to the scarcity of literature, there were some differences in how life stage was designated, depending on the species. We generally used minimum length at maturity or minimum spawning length as the designation for minimum adult lengths, but sometimes literature sources would mention sizes for adults that did not specifically indicate how the life stage designation was made. For larvae, we often used maximum length at yolk-sac larvae completion stage, but not always. Juvenile ranges often encompassed the whole range between larval and mature adult lengths, and thus could include sub-adult life stages. If we could not find larval or juvenile cutoff lengths, we combined the two life stages. See **life_stage_designations.csv** for additional notes and references. Additionally, there were three types of length measurements that were referenced through our literature search: standard length, total length, and fork length. There can be differences of several millimeters depending on the type of measurement used. Given the uncertainty around the different ways maturity and life stage were designated, and the uncertainty in how to interpolate a standardized length for each species-life stage, we decided to stick to the recorded values despite different length measurements.

Field data

Each monitoring program used different gear types and methods to target specific habitats and species, and each monitoring program has a different temporal resolution (both in terms of how often the program samples, and the total duration of the survey). Thus, there is some inequality in sampling for the dataset. Nevertheless, we hope our summary statistics provide useful information about the temperatures in which each species-life stage was observed.

Calculations and Analysis

For each species and life-stage we calculated corresponding field temperatures using three fish monitoring datasets. Bashevkin et al. 2022 integrated data from nine surveys in the San Francisco Estuary (USFWS Delta Juvenile Fish Monitoring Program, USFWS Enhanced Delta Smelt Monitoring Program, UC Davis Suisun Marsh Study, CDFW Bay Study, CDFW Fall Midwater Trawl, CDFW Spring Kodiak Trawl, CDFW 20mm Survey, CDFW Smelt Larval Survey, and CDFW Summer Townet), while IEP et al. 2022 contains data from the Yolo Bypass Fish Monitoring Program, and CDFW 2022 contains data from the salvage facilities in the South Delta. Datasets were integrated into one dataset.

Datasets were filtered for our species of interest, regions of interest (using latitude and longitude data), and for observations that had length data so we could classify organisms by life-stage. Life stage cutoffs (described above) were used to designate each organisms to a life stage, based on reported length. The mean, maximum and upper quartile (75th percentile) temperature at which each species-life-stage grouping was observed was then calculated.

Review Processes

- *Internal Review:* Co-authors reviewed literature sources used for threshold and life stage cutoff information.
- *External Review:* Integrated field data sources were previously QA/QC'ed by each individual monitoring program. Please see each monitoring program's metadata or contact programs for more information.

Data Table

Table name: Temperature Thresholds

Table description: Temperature thresholds for aquatic species

Column name	Description	Unit or code explanation or date format	Missing value code
Common_name	Species common name	character	
Taxon	Species scientific name	character	
Assigned_life_stage	Life stage from reference	categorical	
Status	Native or non-native	categorical	
Field_detection_temp_mean	Mean field detection temperature	celsius	NA
Field_detection_temp_75Q	75th quartile field detection temperature	celsius	NA
Field_detection_temp_max	Max field detection temperature	celsius	NA
n	Number of samples used in mean, 75Q and maximum, with each sample generally referring to one fish	dimensionless	NA
Threshold_suboptimum	Range of suboptimum temperature thresholds	character	NA
Threshold_tolerance	Range of tolerance temperature thresholds	character	NA
Spawning_growth_temp_range	Spawning and growth temperature ranges	character	NA
Metric_suboptimum	Suboptimum metric	character	NA
Metric_tolerance	Tolerance metric	character	NA

Column name	Description	Unit or code explanation or date format	Missing value code
Reference_suboptimum	Reference for suboptimum information	character	NA
Reference_tolerance	Reference for tolerance information	character	NA
Reference_spawning	Reference for spawning and growth information	character	NA

Table name: Life Stage Length Designations

Table description: Length cutoffs for species life stages

Column name	Description	Unit or code explanation or date format	Missing value code
Common_name	Species common name	character	
Taxon	Species scientific name	character	
Assigned_life_stage	Life stage assigned based on length	categorical	
Length_mm	Length in millimeters	character	
Length_type	Type of length	FL = fork length; SL = standard length; TL = total length; order refers to order of length types	
Notes_life_stage_designation	Additional notes	character	
Reference	Source	character	NA

Articles

Article DOI or URL (DOI is preferred)	Article title	Journal title

Scripts/code (software)

File name	Description	Scripting language

Data provenance

Dataset title	Dataset DOI or URL	Creator (name & email)	Contact (name & email)
Fish abundance in the San Francisco Estuary (1959-2021), an integration of 9 monitoring surveys.	https://doi.org/10.6073/pasta/0cdf7e5e954be1798ab9bf4f23816e83	Sam Bashevkin; sam.bashevkin@deltacouncil.ca.gov	Sam Bashevkin; sam.bashevkin@deltacouncil.ca.gov
Interagency Ecological Program: Fish catch and water quality data from the Sacramento River floodplain and tidal slough, collected by the Yolo Bypass Fish Monitoring Program, 1998-2021.	https://doi.org/10.6073/pasta/f5c4362f4a1f370723e2b9113432909f	Catarina Pien; cpien@usbr.gov	Nicole Kwan; Nicole.kwan@water.ca.gov
CDFW Fish Salvage Monitoring Data	filelib.wildlife.ca.gov - /Public/salvage/	Geir Aasen; Geir.Aasen@wildlife.ca.gov	Geir Aasen; Geir.Aasen@wildlife.ca.gov

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Notes and Comments

Versioning History

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