Metadata: Environmental and biological data associated with captive-reared Delta Smelt Study, Sacramento-San Joaquin Delta, CA, January-April 2019

Version: 1.0

Dataset Title

Environmental and biological data associated with captive-reared Delta Smelt Study, Sacramento-San Joaquin Delta, CA, January-April 2019

Abstract

The endangered Delta Smelt *Hypomesus transpacificus* is an osmerid fish endemic to the upper San Francisco Estuary. A captive breeding program for the species led by the Fish Culture and Conservation Laboratory (FCCL), University of California, Davis, began in 1996 to create a refuge population. In order to better understand how captive Delta Smelt would fare in conditions outside of the hatchery, we placed captive-reared fish in enclosures in the Sacramento San-Joaquin Delta, and evaluated their ability to survive, feed, and maintain condition.

Fish were acclimated in the hatchery at FCCL, tagged, swabbed, weighed, measured, and transferred to enclosures in the field. There were three types of enclosures (n=2 for each type), varying in mesh size and wrap condition. In January 2019, 384 adult Delta Smelt (243 days post hatch) were transferred to enclosures in Rio Vista. In February 2019, 360 adult Delta Smelt (278 days post hatch) were transferred to enclosures in the Deepwater Shipping Channel. For each deployment, fish remained in enclosures for approximately one month, then were retrieved from enclosures, euthanized, identified, weighed and measured. A subset were also analyzed for diet contents. During the one-month long deployments, cages were checked for biofouling, damage, and dead fish, and water quality measurements and zooplankton samples were collected.

Investigators

First Name	Middle Initial	Last Name	Organization	e-mail address	ORCID ID (optional)
Catarina		Pien	Bureau of Reclamation; California Department of Water Resources	cpien@usbr.gov	0000-0003-4427-6300
Nicole	M. A.	Kwan	California Department	Nicole.Kwan@water.ca.gov	0000-0003-

First Name	Middle Initial	Last Name	Organization	e-mail address	ORCID ID (optional)
			of Water Resources		1178-7788
Brian		Schreier	California Department of Water Resources	Brian.Schreier@water.ca.gov	
Melinda		Baerwald	California Department of Water Resources	Melinda.Baerwald@water.ca.gov	

Other personnel names and roles

First Name	Middle Initial	Last Name	Organization	e-mail address	ORCID ID (optional)	Role in project
Craig		Stuart				Field crew, data entry
Naoaki		Ikemiyagi		Naoaki.Ikemiyagi@water.ca.gov		Field crew
Jeff		Jenkins		Jeff.Jenkins@water.ca.gov		Field crew
Brittany		Davis		Brittany.E.Davis@water.ca.gov		Field crew
Mallory		Boro				Field crew

License

context of the original study. While substantial efforts are made to ensure the accuracy of data and associated documentation, complete accuracy of data sets cannot be guaranteed. All data are made available "as is." The Data User should be aware, however, that data are updated periodically, and it is the responsibility of the Data User to check for new versions of the data. The data authors and the repository where these data were obtained shall not be liable for damages resulting from any use or misinterpretation of the data. Thank you.

Keywords

Delta Smelt, zooplankton, enclosure, hatchery, Sacramento-San Joaquin Delta, Rio Vista, Deepwater Shipping Channel

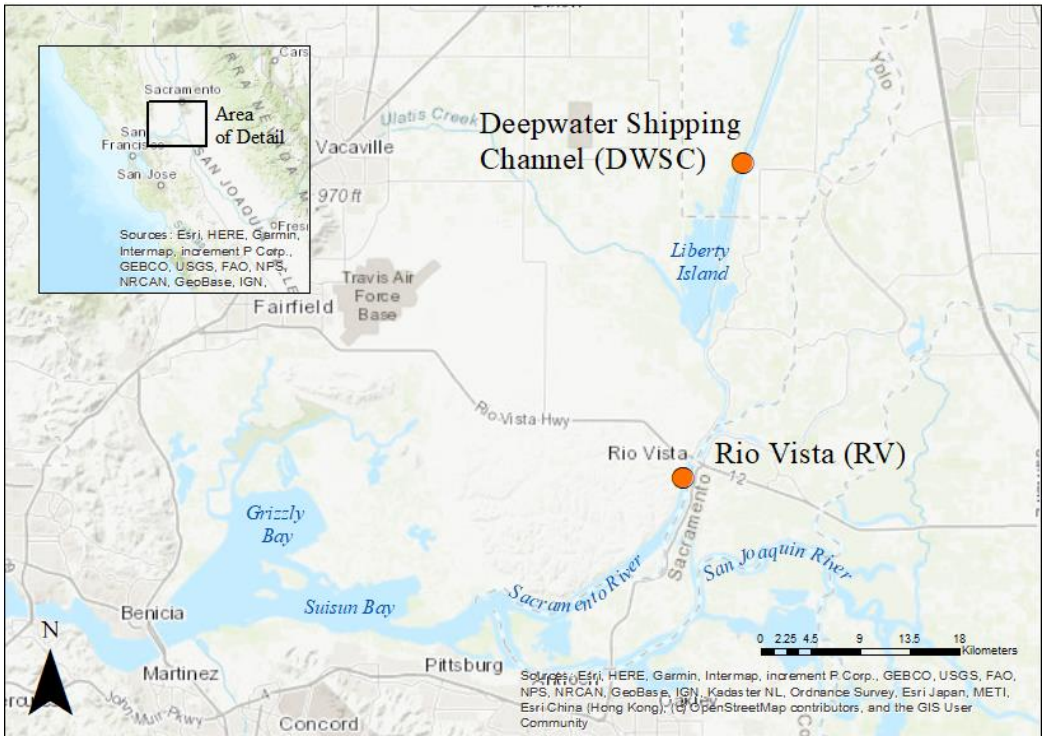
Permitting of this work:

PI First Name	PI Middle Initial	PI Last Name	Permitting Agency and Permit Type	Permit Number	Brief Description
Tien-Chieh		Hung	UC Davis IACUC	19841	Animal care and use permit
Tien-Chieh		Hung	USFWS	TE-027742	10(a)(1)(A) Recovery Permit

Timeframe

- Begin date: 1/23/2019
- End date: 3/27/2019
- Data collection ongoing or completed: Completed

Geographic location



- Verbal description: Rio Vista and Deepwater Shipping Channel, Sacramento-San Joaquin Delta
- North bounding coordinate (decimal degree): 38.32583
- South bounding coordinate (decimal degree): 38.14627
- East bounding coordinate (decimal degree): -121.65
- West bounding coordinate (decimal degree):-121.692

Taxonomic species or groups

Delta smelt, zooplankton, aquatic macroinvertebrates

Methods

Deployment and Retrieval

1. In January 2019, 384 adult Delta Smelt (243 days post hatch) were transferred to six enclosures in Rio Vista (64 fish per cage) using black 19L buckets with screw top lids.
2. Fish were retrieved after approximately one month.
3. In February 2019, 360 adult Delta Smelt (278 days post hatch) were transferred to six enclosures in the Deepwater Shipping Channel (60 fish per cage) using black 19L buckets with screw top lids.
4. Fish were retrieved after approximately one month.

5. There were three different types of enclosures (n=2 for each type). See table below for details.

Enclosure design type	Side/bottom material	Hole Size (mm)	Center to Center Distance (mm)	Openness (%)	Mesh Size of wrap (mm)
A = small	perforated steel sheet	3.18	4.76	41	N/A
B = large	perforated steel sheet	3.97	4.76	63	N/A
C = wrap	perforated steel sheet with outer wrap of stainless steel mesh on lower 50%	3.97	4.76	63 + mesh	4 x 4

Field Data Collection

Water Quality

1. During site visits, a YSI Pro DSS was used to collect measurements of water temperature (°C), dissolved oxygen (mg/L), specific conductivity (µSiemens/cm), electric conductivity (µSiemens/cm), pH, and turbidity (FNU) approximately 1m below the surface
2. A secchi disc was used to collect secchi depth (m)
3. Velocity measurements were taken using a portable handheld velocity meter (m^3/s, Hach, model #FH950) which was angled to face the direction of highest velocity
    a. Since velocity was highly variable, three 10-second average replicate velocity readings were collected

Zooplankton

1. Zooplankton were collected during each site visit using a 53 µm mesh conical 0.5 m x 2 m plankton net (SEA-GEAR) with a General Oceanics flowmeter (Model 2030R) suspended from the center of the net mouth
2. Tows were collected just below the surface for 2 minutes
3. When high winds precluded boat-based sampling, a plankton net was hand towed along a nearby dock 5.0 – 6.5 m (dimensions: 0.3 m x 1 m, 53 µm mesh)
4. All samples were stored in 1 L wide-mouth Nalgene bottles and preserved with 5% formalin dyed with Rose Bengal

Lab Sample Processing and Tracking

Fish Measurements

1. Fish were obtained from the University of California – Davis Fish Conservation and Culture Laboratory (FCCL).
2. Prior to deployment of fish in the field, fish were anesthetized with MS-222 (Tricaine Methanesulfonate) and weighed (g), measured (fork length; mm) and tagged with Visible Implant Alphanumeric (VIA) tags (Northwest Marine Technology Inc, Olympia, WA).
3. After fish were collected from the field at the end of the study period, fish were euthanized with MS-222 (400 mg/L). Each fish was weighed (g), measured (fork Length; mm), identified (VIA tag) and preserved in formalin.

Zooplankton

1. Samples were enumerated and identified by BSA Environmental Services, Inc. (Beachwood, OH USA)
2. Individuals were identified to genus for cladocerans, order for harpacticoids, and species and life stage for calanoid and cyclopoid copepods

Diet

1. After fish were collected from the field at the end of the study period, 10 fish per enclosure (60 fish per site) were assessed for diet
2. 2-3 fish were randomly selected from discrete size bins
3. The fish were dissected and the stomachs (no intestines) were removed, cleaned of any other tissue, and preserved in 10% formalin
4. Stomachs were removed and sent to the University of Washington's Wetland Ecosystem Team laboratory (WET lab; Seattle, WA USA) for analysis
5. The total contents of each stomach were weighed and enumerated
6. When possible (not too digested), individuals were identified to genus for cladocerans, order for harpacticoids, and species and life stage for calanoid and cyclopoid copepods

Quality Assurance and Control

Data quality control

1. Field data are checked before leaving the site by a different crew member than the recorder
2. Datasheets are reviewed when entered into Excel and a separate staff member then compares the field datasheets to the entered data
3. During analysis, data are reviewed for outliers and suspect data is flagged or removed

Instrument quality control

1. The YSI Pro DSS used to collect discrete water quality is calibrated, following standard manufacturer protocols, monthly for all sensors and each morning prior to sampling for dissolved oxygen
2. The Hach FH950 flowmeter is calibrated following manufacturer guidelines prior to the start of the sampling season

Notes on Data Quality:

- For Delta Smelt measurements, tags were occasionally shed, mis-read, or fish died in enclosures, leading to pre-deployment measurements that didn't have a post-deployment match, and vice versa.
- The method of zooplankton collection (boat tows vs. hand-tow) may affect the data quality in ways that are not fully understood.

Calculations and Analysis

- Biomass estimates for zooplankton were obtained from the San Francisco State University Kimmerer lab's unpublished synthesized biomass dataset. For less common zooplankton species that did not have a unique estimated biomass, an average of the biomass across other species within the order was applied as a proxy.
- Fulton's Condition factor (K) was calculated for fish as a measure of fish condition:

$$K = \frac{Weight}{Fork\ Length^3}\ x\ 10\text{^}2$$

- Delta_x = Post_x - Pre_x, where x = CF, FL_cm or Weight_g
- PropChangex = Delta_x/Pre_x, where x = CF, FL_cm or Weight_g

Data Table

Table name: Delta Smelt Diet
Table description: Delta Smelt Diet Composition

Column name	Description	Unit or code explanation or date format	Missing value code
Location	Location of cage deployment	DWSC = Deepwater Shipping Channel, RV = Rio Vista	NA
Date	Date	mm/dd/yyyy	NA
Cage	Cage ID		NA
Tag	Fish tag ID		NA
ContentsWeight	Weight of stomach contents	Gram	NA

Column name	Description	Unit or code explanation or date format	Missing value code
Fullness	Stomach fullness		NA
Digestion	Degree of digestion	0 = nothing identifiable or empty; 3 = 25% or less identifiable; 4 = 25-50% identifiable; 5 = 50-75% identifiable; 6 = no digestion; all prey identifiable	NA
PreyTaxa	Prey taxa	1 = no prey; empty stomach, 2 = trace of prey, 3 = 25% or less full, 4 = 25-50% full, 5 = 50-75% full, 6 = full stomach	NA
LHStage	Life stage	Adult, copepodid, egg, eggs, juvenile, larva, nauplius, numph, pupae, resting egg, undetermined	NA
Count	Count	number	NA
TaxonomicGrouping	Higher taxonomic grouping		NA
Comments	Comments		NA

Table name: Delta Smelt Growth and Condition Factor
Table description: Delta Smelt Growth and Condition Factor

Column name	Description	Unit or code explanation or date format	Missing value code
Location	Location of cage deployment	DWSC = Deepwater Shipping Channel, RV = Rio Vista	
Cage	Cage ID		
Enclosure	Enclosure ID. Same as Mesh but ID matches manuscript notation	A = small mesh, B = large mesh, C = wrap mesh	
Mesh	Mesh type		
Pre_FL_cm	Fork length before deployment	centimeter	NA
Post_FL_cm	Fork length after deployment	centimeter	NA
PropChange_FL	Proportional fork length change after deployment	dimensionless	NA
Pre_Weight_g	Weight before deployment	gram	NA
Post_Weight_g	Weight after deployment	gram	NA

Column name	Description	Unit or code explanation or date format	Missing value code
PropChange_Weight	Proportional weight change after deployment	number	NA
Pre_CF	Fulton's condition factor before deployment	gramsPerCubicCentimeter	NA
Post_CF	Fulton's condition factor after deployment	gramsPerCubicCentimeter	NA
Delta_CF	Change in Fulton's condition factor	gramsPerCubicCentimeter	NA

Table name: Delta Smelt Survival
Table description: Delta Smelt Survival

Column name	Description	Unit or code explanation or date format	Missing value code
Location	Location of cage deployment	DWSC = Deepwater Shipping Channel, RV = Rio Vista	
Mesh	Mesh category	Large, small, mesh	
Cage	Cage ID		
Survived	Number of fish that survived	number	
n	Number of fish in cage	number	
rate	Rate of survival	percent	

Table name: Zooplankton Data
Table description: Zooplankton data associated with Delta Smelt enclosures

Column name	Description	Unit or code explanation or date format	Missing value code
Location	Location of cage deployment	DWSC = Deepwater Shipping Channel, RV = Rio Vista	
Date	Date date	mm/dd/yyyy	
Method	Tow method	Throw = net was thrown; tow = net was towed	
TowDistance	Zooplankton tow distance in meters	meter	NA
SetTime	Zooplankton set time in minutess	minutes	NA
FlowMeterStart	Zooplankton flowmeter start number	number	NA
FlowMeterEnd	Zooplankton flowmeter end number	number	NA

Column name	Description	Unit or code explanation or date format	Missing value code
Rotations	Number of flowmeter rotations	number	NA
MeshSize	Mesh size of net	micrometer	
RingSize	Ring size of net	centimeter	
TotalVolume	Total volume sampled	milliliter	
SubsampledVolume	Volume subsampled	milliliter	
Taxon	Taxonomic ID		
Count	Count	number	
nSubsamples	number of subsamples	number	
TaxonomicGrouping	Taxonomic grouping		
BiomassIndex	Biomass index	microgramCarbonPerIndividual	
TotalBiomass	Total biomass	gram	

Table name: Cage Velocity Data
Table description: Cage Velocity Data

Column name	Description	Unit or code explanation or date format	Missing value code
Location	Location of cage deployment	DWSC = Deepwater Shipping Channel, RV = Rio Vista	
Date	Date	mm/dd/yyyy	
Weather	Weather code	CLR = clear; RAN = rainy	
Tide	Tide stage	EBB = ebb tide; FLD = flood tide	NA
Cage	Cage ID		NA
Vel1	Velocity 1	footPerSecond	NA
Vel2	Velocity 2	footPerSecond	NA
Vel3	Velocity 3	footPerSecond	NA
AvgVel	Average Velocity	footPerSecond	
Time	Time	hh:mm, clock time	
WaterTemp	Water temperature	celsius	
DO	Dissolved Oxygen	milligramPerLiter	
SpCond	Specific Conductance	microSeimensPerCentimeter	
EC	Electrical Conductivity	microSeimensPerCentimeter	
pH	pH	dimensionless	
Turb1	Turbidity 1	nephelometricTurbidityUnit	
Turb2	Turbidity 2	nephelometricTurbidityUnit	
Turb3	Turbidity 3	nephelometricTurbidityUnit	
AvgTurb	Average Turbidity	nephelometricTurbidityUnit	
ZooplanktonCollected	Whether or not zooplankton was collected		

Column name	Description	Unit or code explanation or date format	Missing value code
PlatesDeployed	Whether or not plates were deployed		
Notes	Notes		

Table name: Deployment and Retrieval Information
Table description: Information associated with deployment and retrieval of fish

Column name	Description	Unit or code explanation or date format	Missing value code
Location	Location of cage deployment	DWSC = Deepwater Shipping Channel, RV = Rio Vista	
Action	Deployment or retrieval		
Date	Date	mm/dd/yyyy	
Cage	Cage ID		
MeshType	Cage mesh type		
nFish	Number of fish in cage	number	NA
Time	Time	hh:mm; clock time (DST starting March 3)	
B1_WaterTemp	Temperature in bucket 1	celsius	NA
B1_DO	DO in bucket 1	milligramPerLiter	NA
B2_WaterTemp	Temperature in bucket 2	celsius	NA
B2_DO	DO in bucket 2	milligramPerLiter	NA
Cage_WaterTemp	Temperature in cage	celsius	NA
Cage_DO	DO in cage	milligramPerLiter	NA
Notes	Notes		

Table name: Field Data
Table description: Field data associated with daily checks

Column name	Description	Unit or code explanation or date format	Missing value code
Location	Location of cage deployment	DWSC = Deepwater Shipping Channel, RV = Rio Vista	
Date	Date	mm/dd/yyyy	
Time	Time	hh:mm; clock time (DST starting March 3)	NA
Weather	Weather Code	CLD = cloudy; CLR = clear; FOG = foggy; RAN = rainy; WND = windy	
Secchi	Secchi depth	meter	NA

Column name	Description	Unit or code explanation or date format	Missing value code
WaterTemp	Temperature	celsius	
DO	Dissolved Oxygen	milligramPerLiter	
SpCond	Specific Conductance	microSeimensPerCentimeter	
EC	Electrical Conductivity	microSeimensPerCentimeter	
pH	pH	number	
Tide	Tide stage	EBB = ebb tide; FLD = flood tide; LOW = low tide	NA
MicrocystisRank	Microcystis rank	1 = no Microcystis	
Turb1	Turbidity 1	nephelometricTurbidityUnit	
Turb2	Turbidity 2	nephelometricTurbidityUnit	
Turb3	Turbidity 3	nephelometricTurbidityUnit	
AvgTurb	Average Turbidity	nephelometricTurbidityUnit	
Vel1	Velocity 1	footPerSecond	NA
Vel2	Velocity 2	footPerSecond	NA
Vel3	Velocity 3	footPerSecond	NA
AvgVel	Average Velocity	footPerSecond	NA
ZooplanktonCollected	Whether or not zooplankton was collected	N = no; Y = yes	
FlowmeterSpeed	Flowmeter speed	REG = regular speed	NA
SetTime	Set time	minutes	NA
FlowMeterStart	Flowmeter start number	number	NA
FlowMeterEnd	Flowmeter end number	number	NA
Rotations	Number of flowmeter rotations	number	NA
ZoopNotes	Zooplankton Notes		NA
Damage_A	Whether cage A was damaged	N = no; Y = yes	NA
Damage_B	Whether cage B was damaged	N = no; Y = yes	NA
Damage_C	Whether cage C was damaged	N = no; Y = yes	NA
Damage_D	Whether cage D was damaged	N = no; Y = yes	NA
Damage_E	Whether cage E was damaged	N = no; Y = yes	NA
Damage_F	Whether cage F was damaged	N = no; Y = yes	NA
DamageNotes	Notes on cage damage		NA
Biofoul_A	Rank of biofouling on cage A	1 = clean; 2 = partial blockage; 3 = significant blockage	NA
Biofoul_B	Rank of biofouling on cage B	1 = clean; 2 = partial blockage; 3 = significant blockage	NA

Column name	Description	Unit or code explanation or date format	Missing value code
Biofoul_C	Rank of biofouling on cage C	1 = clean; 2 = partial blockage; 3 = significant blockage	NA
Biofoul_D	Rank of biofouling on cage D	1 = clean; 2 = partial blockage; 3 = significant blockage	NA
Biofoul_E	Rank of biofouling on cage E	1 = clean; 2 = partial blockage; 3 = significant blockage	NA
Biofoul_F	Rank of biofouling on cage F	1 = clean; 2 = partial blockage; 3 = significant blockage	NA
Biofoul_Notes	Biofouling notes		NA
PlatesCollected	Whether or not plates were collected	Y = Yes; N = No	NA
Mortality_A	Number of mortalities in cage A	number	NA
Mortality_B	Number of mortalities in cage B	number	NA
Mortality_C	Number of mortalities in cage C	number	NA
Mortality_D	Number of mortalities in cage D	number	NA
Mortality_E	Number of mortalities in cage E	number	NA
Mortality_F	Number of mortalities in cage F	number	NA
FishNotes	Notes on fish		NA
MiscNotes	Miscellaneous notes		NA

Table name: Stations
Table description: Station locations

Column name	Description	Unit or code explanation or date format	Missing value code
StationCode	Code for station	DWSC = Deepwater Shipping Channel, RV = Rio Vista	
StationName	Longer station name		
Longitude	Longitude of sample location	numericDegree	
Latitude	Latitude of sample location	numericDegree	

Scripts/code (software)

Processing scripts are located on GitHub at [Smelt-cages/smelt_2019_winterspring at main · EMRR-DISE/Smelt-cages (github.com)](). See v1.0.0.

Notes and Comments

Versioning History

Version number	Date created	Description of changes	Justification for change	Version editor(s)	Contact info
V1.0	*11/1/2022*	*First version*		*Catarina Pien, Nicole Kwan*	*cpien@usbr.gov; Nicole.kwan@water.ca.gov*

-END OF DOCUMENT-