Suisun Marsh Fish Study Database Metadata 1980 - 2020

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FIELD SAMPLING METHODS

Geographic and Temporal Scope

All sampling has occurred in Suisun Marsh (Figure 1), mostly in subtidal sloughs. Sampling began in 1979, but standardized methods and stations were not implemented until 1980. Sampling has occurred monthly from January 1980 to the present at geographically fixed stations. Fixed stations have been necessary because snags preclude uninterrupted trawls in many sections of smaller sloughs. Originally, 48 stations were selected haphazardly that could be easily and safely sampled by boat and covered the breadth of Suisun Marsh to ensure capture of all variability in fish populations. However, the emphasis has been on sampling smaller sloughs because they exhibit greater variability in a smaller space than the marsh's two big sloughs (Suisun and Montezuma), and because only the big sloughs are sampled by other long-term monitoring projects such as California Fish and Wildlife's Fall Midwater Trawl. The 48 stations were sampled in 1980 and 1981. Water quality and catches were then compared across these stations to locate redundancies and thereby improve logistical efficiency while maximizing capture of variation by eliminating uninformative stations (Brown *et al*. 1981). Seventeen stations were then chosen and were continuously sampled from 1980 through 1993. Geographic scope was reassessed in 1994, when sampling was reinitiated in the northeast marsh in Denverton and Nurse sloughs at four stations (DV2, DV3, NS2, NS3; Figure 2), in part to look for dwindling fish species [*e.g.*, delta smelt (*Hypomesus transpacificus*), Sacramento splittail (*Pogonichthys macrolepidotus*)]. Catches in Nurse and Denverton sloughs were found to be unique (Matern *et al.* 2002); thereafter, those four stations have been included in the regular sampling, with a total of 21 stations. In 2014, to complement continuous water-quality sampling from the salinity control gates to the very top of Denverton Slough (Montgomery *et al.* 2015), three more stations as part of the UC Davis Arc Project were added to the 21 stations, resulting in 24 stations that are currently sampled monthly (Figure 2; Appendix). These three additional stations (DV1, NS1, and MZ6) have also been retained because (1) they better captured gradients in water-quality conditions less discernable with the four stations (Montgomery *et al.* 2015), and (2) they surround areas slated for tidal restoration, increasing baseline information needed to assess restoration actions. Additionally, the transect from the MZ1 station in Montezuma Slough to the DV1 station also allows assessment of the extent of the impact of the salinity control gates (Beakes *et al.* 2020) in the most valuable area of the marsh for fishes (Moyle *et al.* 2014). Many other stations were sampled intermittently for small ancillary projects to the Suisun Marsh Fish Study (Appendix).

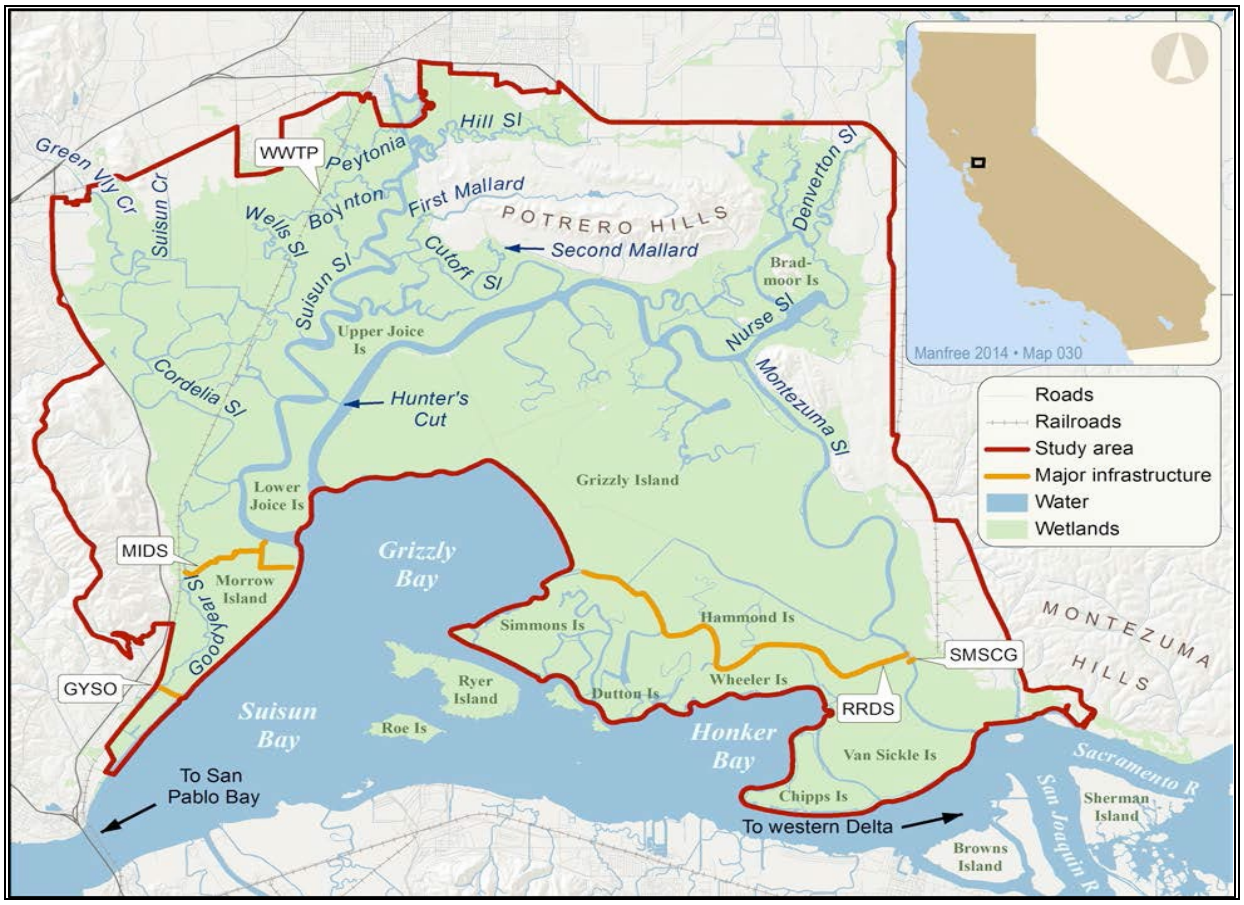
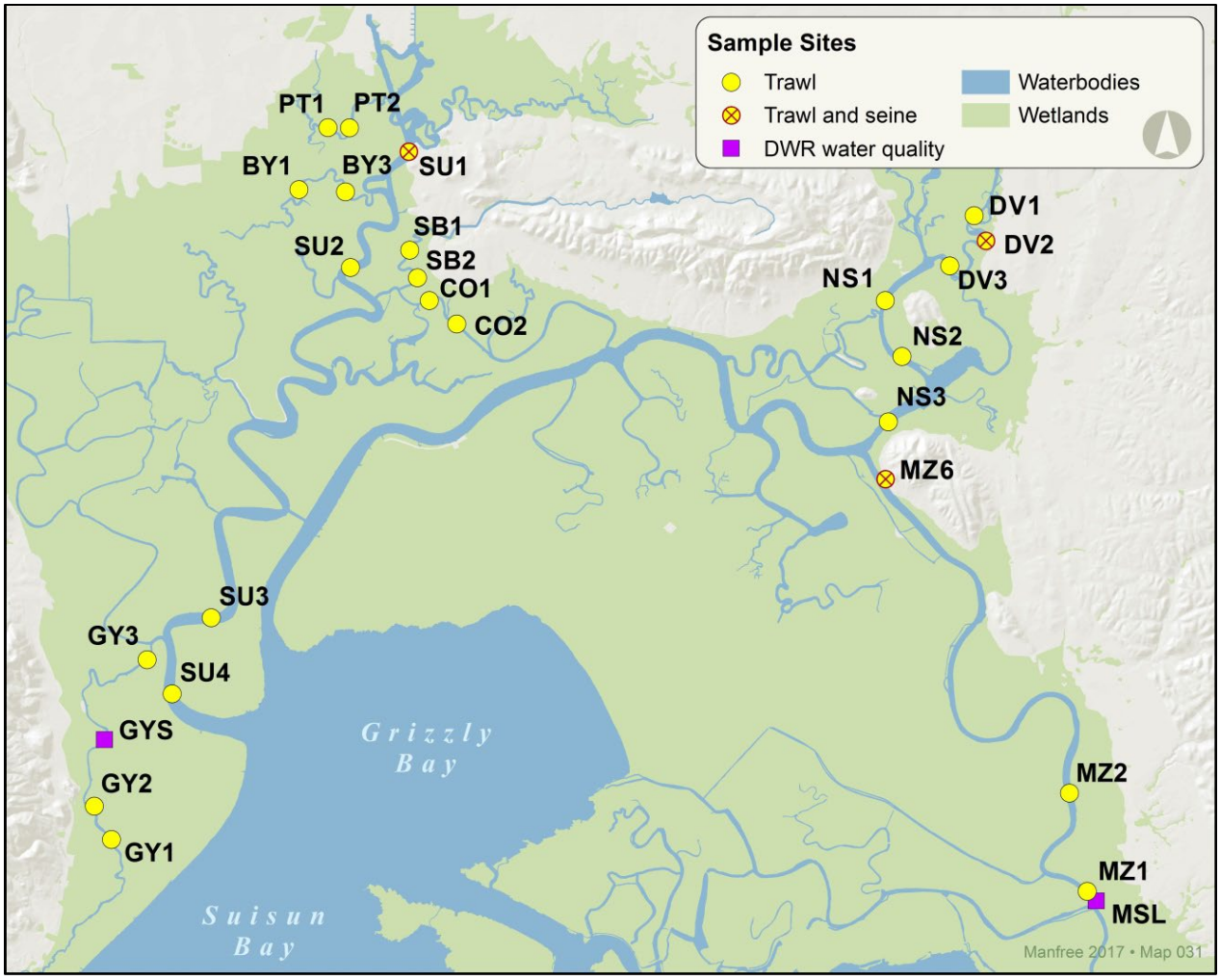


Figure 1. Suisun Marsh Fish Study sampling area (map: Manfree 2014).

Two dedicated people (Table 1) - the Principal Investigator and the Supervisor - have been the only ones paid on the study, with crews filled out with volunteers, generally graduate students but also undergraduate students, agency employees, or any other person interested in Suisun Marsh. Most supervisors have been graduate students of Peter Moyle. Most crews have consisted of three people, often four, and sometimes only two if both people are well-versed in all aspects of the sampling.

Table 1. Staff of the Suisun Marsh Fish Study.

Period	Principal Investigator	Supervisor
1979	Peter Moyle	Donald Baltz
1980 - 1982	Peter Moyle	Robert Daniels
1983 - 1988	Peter Moyle	Bruce Herbold
1989 - 1992	Peter Moyle	Lesa Meng
1993 - 1999	Peter Moyle	Scott Matern
2000 - 2005	Peter Moyle	Robert Schroeter/Alison Stover
2006 - 2007	Peter Moyle	John Durand/Alpa Wintzer
2008 -	John Durand/Peter Moyle	Teejay O'Rear



Sampling Gear

Four type of nets have been used as part of the Suisun Marsh Fish Study: otter trawls (=bottom trawl), midwater trawls, beach seines, and larval sleds (Table 2). Originally, several other gear types were assessed (*e.g.*, gill nets), but otter trawls and beach seines captured the most fishes over the greatest area in the least amount of time. As a result, only otter trawls and beach seines have been used for continuous sampling – midwater trawls and larval sleds were used for smaller studies added to the Suisun Marsh Fish Study for short periods (Meng *et al.* 2001, Wintzer *et al.* 2011).

Beginning in October 2009, we began hook-and-line surveys, primarily for assessing diets of adult striped bass (*Morone saxatilis*), the apex predatory fish in Suisun Marsh. We found the hook-and-line sampling to be the most selective and least harmful among gears for the targeted species (*e.g.*, adult striped bass), as well as the most efficient for acquiring samples (*e.g.*, we have often been able to collect five fish in five minutes, equivalent to the time necessary to deploy a gill net). Hook-and-line sampling has been opportunistic, occurring when time allows

between trawls and seines, usually when having to wait for an ideal tide for a sample (*e.g.,* mid-flood tide at the SU1 seine beach; Figure 1).

Table 2. Dimensions and specifications of nets used in the Suisun Marsh Fish Study.

Gear	Type	Physical Width (m)	Fishing width (m)	Height (m)	Length (m)	Diameter (m)	Main-body mesh (mm)	Main-body mesh type	Cod-end mesh (mm)	Cod-end mesh type	Main Supplier
beach seine	bagless, knotless	10	N/A	1.8	N/A	N/A	4.8	delta	N/A	N/A	Memphis Net
midwater trawl	four-seam	4.3	N/A	1.5	5.3	N/A	15.9	square	3.2	delta	Brunson Net
otter trawl	four-seam	4.3	3.9	1.5	5.3	N/A	15.9	square	3.2	delta	Brunson Net
larval sled	circular	N/A	N/A	N/A	3	0.68	0.5	square	N/A	N/A	N/A

Gear Deployment and Operation

Beach Seine

Two types of beach-seining techniques are used in Suisun Marsh: parallel beach seines ("P-seines") and "J-seines." P-seines are when the seine net remains parallel to shore during retrieval. J-seines are when the net remains perpendicular to shore during retrieval until being swept in during landing. J-seines are useful where the width of the landing beach is small. Procedures for fishing both seine types are similar:

1. One person for a J-seine, two people for a P-seine, wade from shore into deepest water possible without overtopping waders.
2. When seine is stretched out and tight (perpendicular to shore for J-seine, parallel to shore for P-seine), depths are recorded.
3. The two people pulling the seine walk the same speed, brails tipped back so lead line sweeps through sampling area before head rope.
4. Just before beaching the seine, the two people pulling the seines overlap the lead lines to create a bag, then haul it out of the water.
5. Fish are then quickly concentrated in the center of the net and then rolled out into a bucket of water.

Midwater Trawl (currently inactive method)

The midwater trawl's net and hardware were identical to the otter trawl's (Table 1) but with one exception: two wood runners were mounted to the top of the trawl doors to act as hydrofoils that caused the trawl to plane up into the water column. Midwater trawls were deployed into the water by hand and towed for five minutes at 8 km/hr. At five minutes, the boat was stopped and the trawl retrieved by hand. All material captured by the trawl was then emptied into a bucket of water.

Otter Trawl

Otter trawl operation is similar to that for midwater trawls. The otter trawl is deployed by hand into the water, with a mainline measuring more than three times the depth to ensure the

trawl remains on the bottom. Trawls are towed at 4 km/hr for five minutes in small sloughs and 10 minutes in large sloughs [tow times for the two slough sizes were determined from species-accumulation curves (Moyle, unpublished data)]. As for the midwater trawl, when the time is up, the boat is stopped, the trawl retrieved by hand, and all material captured by the trawl is emptied into a bucket of water.

Larval Sled (currently inactive method)

The larval sled was towed at the water's surface by means of a "horizontal chassis with runners" (Meng *et al.* 2001). The sled was deployed by hand and towed for either five or 10 minutes at 4 km/hr. At the end of the tow, the larval sled was retrieved by hand, and larval fishes were placed into containers and preserved with a 5% formaldehyde solution.

Hook and Line

Hook-and-line sampling occurs opportunistically between trawl and seine samples. A large tub of water equipped with aerators and shade cloth is prepared before sampling commences. A habitat type is selected (*e.g.*, managed-wetland outflow, subtidal-channel confluence), and lines are cast by appropriately sized gear (*e.g.*, relatively large rods for striped bass) into the habitat for a fixed period, usually with artificial lures but occasionally with live bait on barbless and/or circle hooks. Hooked fish are brought to the boat as quickly as possible, with hook removal occurring under water, either in the waterway itself or in the aerated tub, to minimize air exposure. Only "legal adult" size - 18 inches total length (TL; 46 cm) - striped bass are retained.

Sample Processing

Water Quality and Depth Data

Several water-quality constituents and depths are recorded, but, as for invertebrates (described below), not all recordings began at the same time (Table 4). Water quality has been measured mainly with Yellow Springs Instrument (YSI) handheld devices (YSI 30, YSI 85, and PRO2030), calibrated according to directions supplied by YSI. Currently, probes are refurbished about every six months. The probe is placed ~30 cm below the water surface until readings stabilize, and then values are written down on the sheet with the catch data. Secchi readings are taken by slowly lowering a 20-cm-diameter Secchi disk on the shaded side of the boat until the disk can no longer be seen by the naked eye. Depths are recorded from a depth-finder (currently a Humminbird Helix 9) during each otter trawl, once a minute for five-minute trawls, once every two minutes for 10-minute trawls. Tide stage – high, low, incoming, outgoing – are also noted on data sheets.

Salinity and conductivity measurements have had some discrepancies over the study's history. Prior to March 1997, all conductivity readings for otter trawls and beach seines were electrical conductivity; thereafter, all have been specific conductivity. The instruments and therefore the conductivity-salinity relationships were not very precise from the study's inception through 1995; thereafter, improvements in instruments resulted in much higher precision and tighter relationships between salinity and conductivity.

Table 4. Starting recording years for abiotic parameters.

Parameter	First Year of Consistent Records
water temperature	1980
salinity	1980
Secchi depth	1980
dissolved-oxygen concentration	2000
dissolved-oxygen saturation	2000
depths	2002
tide	1995

Net Surveys

For larval-fish tows, fish were taken back to the lab and identified according to Wang (1986).

Material captured by the beach seine and the otter/midwater trawls is processed in the field and recorded on water-resistant paper. Fishes are identified according to Moyle (2002) and Wang (1986), measured for standard length, and then released back to the area of capture. If more than 30 individuals of a fish species are captured in a sample and the individuals to be measured are pulled from the bucket without regard to size, only the first 30 individuals are measured for length – the remainder are only counted, not measured. (Thirty individuals of a species per sample has been sufficient to reflect the abundance of size ranges and thus age classes, rendering measuring more than 30 individuals unnecessary and not an effective use of time.) In most cases, the approximate size range or age class of the unmeasured fish has been noted on the data sheets. In cases where individuals from a certain species cannot be randomly selected for measurement (*i.e.*, large-bodied fishes with multiple age classes abundant in Suisun Marsh: Sacramento splittail, striped bass, white catfish, common carp), all fish of that species are measured. (This most commonly occurs with Sacramento splittail – frequently the larger, older fish are on top and block the smaller, younger fish, so the larger fish have to be removed before the smaller fish can even be accessed.) Occasionally, very small post-larval fish – mainly gobies and herrings – are iced, taken to the lab, and identified under a dissecting microscope, again following Wang (1986).

Invertebrates are assessed in two ways. Larger invertebrates – clams, shrimps, crayfish, jellyfish, and crabs - are identified following Carlton (2007) and Pennak (2001) and then counted. However, identifying and counting all species of large invertebrates in otter trawls and beach seines did not begin at the same time (Table 2). For smaller invertebrates – mysids, gammaroid amphipods, corophiid amphipods, isopods, and insects – a ranking is given rather than a count because counting each individual, when there can often be thousands, is a time sink, and our ranking system corresponds favorably with more detailed assessments (Meng *et al.* 1994, Feyrer *et al.* 2003, Schroeter 2008). Small invertebrates are only ranked in trawls and not in beach seines because tides do not allow enough time to assign an accurate rank for seines. Similar to larger invertebrates, ranks for smaller invertebrates did not begin to be recorded at the same time for all groups (Table 3). As of April 2021, only mysids had been entered into the database.

Beginning in April 2014, type and estimated volume of non-animal material has been recorded (*e.g.*, mud, detritus from emergent-aquatic and terrestrial plants, aquatic weeds, wood).

Table 2. Records for large invertebrates for otter trawl and beach seines.

Species (common name)	Species (Latin name)	First Year of Consistent Records in Trawls	First Year of Consistent Records in Seines
Black Sea jellyfish	*Maeotias marginata*	1981	2008
overbite clam	*Potamocorbula amurensis*	1986	2008
Asian clam	*Corbicula fluminea*	2006	2008
Siberian prawn	*Palaemon modestus*	2002	2008
California bay shrimp	*Crangon franciscorum*	1980	2008
Oriental shrimp	*Palaemon macrodactylus*	1980	2008
red swamp crayfish	*Procambarus clarkii*	2017	2013
soft-shell clam	*Macoma petalum*	2011	2011

Table 3. Records for small invertebrates for otter trawl.

Group (common name)	Latin name	First Year of Consistent Records in Trawls
opossum shrimp	Mysida	1980
scuds	Gammaroidea	2014
scuds	Corophioidea	2014
pillbugs	Isopoda	2014
aquatic insects	Insecta	2014

Hook and Line Surveys

All fishes other than adult striped bass are immediately measured and released. When water temperature exceeds 18°C, striped bass longer than 66 cm TL are measured immediately and released, to minimize mortality. Similarly, any adult striped bass behaving as if severely stressed or injured (*e.g.*, bleeding, inability to maintain upright posture, lethargic) or hooked in the throat or gills (a rarity with the artificial lures) is either immediately released or killed and dissected for gut contents. Striped bass destined for gut-pumping are given at least 10 minutes to recuperate in the shade-cloth-covered, aerated tub. No more than five striped bass are kept in the tub.

When sufficiently recovered from the capture, striped bass are gut-pumped for diet items. A fish is selected, carefully and quickly removed from the water with wet hands, a deck-hose-powered copper tube with a silicone sheath on the tip is gently inserted into the fish's gut, and the pump is then turned on for 10 seconds, with the gut contents washed onto rectangular D-net. Two people are generally needed to support fish larger than 63 cm TL during the procedure. Most fish are then quickly submerged back into the waterway, head facing into current, held by the tail with one hand and supported by the belly with the other hand. Once the fish begins to swim vigorously, it is released. A small subset of fish is killed to verify complete flushing of gut contents by the gut pump; if possible, these fish are also sexed. Rarely a fish is killed that clearly

has a diet item that cannot be removed by the gut pump, typically large crawdads or large spiny-rayed fishes (*e.g.*, striped bass).

Gut contents are immediately identified to the lowest-possible taxonomic level and, if a fish, measured for standard length. Decapods were measured for rostrum-telson length from October 2009 to November 2019 but thereafter for carapace length, to be comparable to a companion study in the North Delta (the Arc Project; Durand *et al.* 2020). (All rostrum-telson lengths should be converted to carapace lengths by 2022.) Severely digested fish and invertebrates are only counted. Numbers of smaller invertebrates eaten (*e.g.*, amphipods, isopods, mysids) are also only counted. If five fish are captured during one sample and the first three gut-pumped have very similar diets, the remaining two fish are only measured and returned to the waterway because we found early in the study that the information gained from gut-pumping the remaining two fish was negligible and thus not worth either the additional stress for the fish or the time spent processing the diet items (*e.g.*, a GY1 sample in January 2021 where fish #1 had eaten 42 threespine sticklebacks, fish#2 had eaten 33 threespine sticklebacks, and fish#3 had eaten 18 sticklebacks, with the sticklebacks from each fish being in the same size range; subsequently, a fourth fish was just measured and released). Only the first 15 individuals of a species is measured for standard length, with the remainder counted, to account for time constraints. All diet items are returned to the water.

Diets of striped bass were first recorded in October 2009. Data for hook-and-line sites that were sampled but yielded no fish were first recorded in April 2015. Until October 2017, striped bass smaller than 46 cm TL were not measured; thereafter, all striped bass regardless of size captured by hook-and-line were measured, but only adult-sized fish were gut-pumped.

DATABASE METHODS

Data Entry

Sampling most commonly occurs Monday – Thursday, with data entered into a Microsoft Access database the following Monday. During data entry, any unusual values are compared to values collected by other studies and, if the Suisun Marsh Fish Study's values are deemed inaccurate, are then corrected accordingly. For example, in July 2019, water temperature recorded by a YSI PRO2030 seemed unusually high for Suisun Marsh. The fish study's values were then compared to values recorded by continuous water-quality stations maintained by the California Department of Water Resources (DWR) and located at our sampling stations. The fish study's values were found to be 1.65ºC higher than the DWR stations. Further comparisons in lab with another PRO2030 as well as a YSI EXO sonde also showed the same difference in temperature. Therefore, 1.65ºC was deducted from each water temperature reading taken in July 2019 before data entry. Such adjustments are noted on the Excel spreadsheet used for the annual reports (described below). Once all data for the month have been entered, it is noted in the database name: "SuisunMarshFishYYYY_MM_DD_YY.accdb," where YYYY = the last year either new tables/complex queries were added, and MM_DD_YY = the last time data were entered/altered.

Data Storage

The Suisun Marsh Fish Study uses the principle of having data stored on several media types and in several locations. Data exist in three formats: on hardcopy data sheets, the Access database, and Excel spreadsheets, the latter of which are created each year to support annual reports (example: https://watershed.ucdavis.edu/library/suisun-marsh-fish-study-trends-fish-and-invertebrate-populations-suisun-marsh-january-2017). Original hard-copy data sheets are stored in binders in Room 1336 of the Academic Surge building on the UC Davis campus. Copies of hard-copy data sheets from 1999 to the present are stored in binders in Room 2101 of the Center for Watershed Sciences building. The database is stored in several areas: (1) the hard drive of a desktop computer in Room 2101; (2) an external hard drive in Room 2101; (3) on Google Drive; (4) an off-campus laptop; and (5) a continually maintained server in the Center for Watershed Sciences building. Excel spreadsheets for each year's reports are stored on the external hard drive and the off-campus laptop.

Database Quality Control

Database quality control occurs in three steps:

1. **Database Versus Hardcopy Datasheets.** The week after sampling, every record on the hard-copy data sheets for that week is compared to the database's data in the data-entry tables. Once a sample's data in the database matches the hard-copy data sheet perfectly, a box is checked that allows that sample's data to be transferred to the "permanent tables" where they are available for pre-written queries and data analysis.

2. **Accuracy of Data Transferred from Database to Flat File.** Once the week's data have been checked against the hard-copy data sheets and transferred to permanent tables, they are then copied into an Excel spreadsheet and then scanned for any unusual numbers for all organisms (*e.g.*, a Mississippi silverside measuring 500 mm standard length, a dissolved-oxygen concentration measuring 20 mg/L) and for all water-quality measurements. Plots are created for each water-quality parameter, and, where appropriate, regressions are created to identify errors. Suspect values are then double-checked both against the database and hard-copy data sheets, and, if consistent with the database and the hard-copy data sheet, are then compared to similar data taken by other studies (described next).

3. **Data Comparison to Other Data Sources.** Similar to the example described above in *Data Entry*, several water-quality values are compared to continuous water-quality stations (maintained by DWR and the Natural Estuarine Research Reserve System) that overlap the fish study's stations. Comparisons between data from DWR stations (Figure 2) and data from the fish study have been plotted and promulgated via the annual reports since 2013 (*e.g.*, Figure 5 and 8 of the report found here: https://watershed.ucdavis.edu/library/suisun-marsh-fish-study-trends-fish-and-invertebrate-populations-suisun-marsh-january-2013).

Concurrent with evaluating data quality after completion of the sampling year is updating this metadata document to report any changes to the study, which is noted in the file name by the years covered.

Data Accessibility/Promulgation

Once the data have gone through the three steps of quality control, they are then deemed appropriate for distribution. The data can be accessed through myriad routes: (1) the database can be attained by contacting the fish study's supervisor (currently Teejay O'Rear; taorear@ucdavis.edu; 530-304-0860) and also through the fish study's website on the Center for Watershed Sciences' website (https://watershed.ucdavis.edu/project/suisun-marsh-fish-study); (2) data can be directly plotted and downloaded onto a flat file at https://ucdstripedbassproject.shinyapps.io/IntegratedVisualizer/; and (3) station information can be found on the California Department of Fish and Wildlife website (https://map.dfg.ca.gov/metadata/ds1964.html).

Database Components

Database Tables

This section gives a brief description of the Access database's commonly used tables and thus also descriptions of data in flat files (*e.g.*, .csv, .xlsx) derived from the database.

AgesBySizeMonth

Age classification determined by size at time of capture; based on Manfree (2014*a*).

Catch

This table contains the organism (whether fish, shrimp, clam, detritus, etc) captured, the length (if a fish), the number caught at that size, and several other data types that are rarely, if ever, measured. Key is that these are quality-controlled data - they've been checked for accuracy against the hard-copy datasheets.

Column	Description	Units
OrganismCode	organism shorthand; code definitions in OrganismLookUp table	N/A
StandardLength	fish length from tip of jaw to end of vertebral column	millimeters
Dead	if fish captured was live or dead (rarely used)	N/A
Weight	mass (rarely used)	grams
Sex	male or female (rarely used)	N/A
Count	catch	number of individuals or rank (for smaller invertebrates such as mysids)
CatchComments	comments for specific organims	N/A
Volume	self-explanatory	milliliters
AgeClassforUnmeasuredFish	age class for unmeasured fish based on Manfree (2014)	N/A

Catch_Entry

This table contains the same data as the Catch table, but none of these data have been checked against the hard-copy datasheets.

Depth

These are the depths for the otter trawl; like the Catch/Catch_Entry tables, there's a Depth_Entry table that contains entered but not QC'd depths. Depth units are in meters.

GearDetailsLookUp

Contains records for measurements of our different sampling gear such as the otter trawl and larval sled (Table 2).

MethodsLookUp

Contains the sampling-method types, the corresponding codes, and whether that method type is currently active.

MethodCode	MethodName
BSEIN	beach seine
HKLN	hook and line
MWTR	midwater trawl
OTR	otter trawl
SLED	larval sled

OrganismsLookUp

This table contains the codes and all taxonomic information for any organism we may catch.

Predator

This table contains all information accompanying the capture of a fish with hook-and-line.

Column	Description	Units
FishNum	number of individuals of a species captured at that size	number of individuals
TL_in	fish length from tip of jaw to end of caudal fin tip	inches
Pumped	whether fish was gut-pumped	N/A
Dissected	whether fish was dissected for gut contents	N/A
TimeLanded	time fish was captured	hh:mm

Column	Description	Units
LureBaitSize	size of hook-and-line gear used	N/A
LureBaitCode	type of lure/bait used in sample	N/A
WaterSurface	water-surface condition when fish was captured	N/A
Weather	weather conditions when fish was captured	N/A
Tide	tide stage when fish was captured	N/A
Habitat	habitat type where fish was hooked	N/A
Angler	initials of person who caught the fish	N/A
Killed?	whether fish was killed for gut contents	N/A

Sample

This table contains the QC'd water-quality data, as well as the sample type, the date/time the sample was taken; the Sample_Entry table contains non-QC'd data.

Column	Description	Units
MethodCode	sample-type shorthand; codes in MethodsLookUp table	N/A
StationCode	station shorthand; codes in StationsLookUp table	N/A
SampleDate	self-explanatory	mm/dd/yyyy
SampleTime	self-explanatory	hh:mm:ss AM/PM
QADone	denotes whether data have been checked against hard-copy data sheet	N/A
GearID	basically equivalent to MethodCode; unused	N/A
WaterTemperature	measured ~30 cm below water surface	degrees Celsius
Salinity	measured ~30 cm below water surface	parts per thousand
DO	dissolved-oxygen concentration; measured ~30 cm below water surface	milligrams per liter
PctSaturation	DO percent saturation; measured ~30 cm below water surface	percent
Secchi	water clarity	centimeters
SpecificCond	measured ~30 cm below water surface	microSiemens
TideCode	tide phase at time of sampling (flood, ebb, high, low)	N/A
UserName	person who entered data	N/A
ElecCond	measured ~30 cm below water surface	microSiemens

Prey Table

This table contains the diet items of fish captured by hook-and-line and then gut-pumped and/or dissected for stomach contents.

Column	Description	Units
FoodCode	prey-ID shorthand; code definitions in OrganismLookUp table	N/A
PreyNum	number of individuals for given prey type	number of individuals
StdLen	fish length from tip of jaw to end of vertebral column; for decapods, rostrum-telson length	millimeters

Column	Description	Units
Comments	comments specific to prey type in same row	N/A

SeineEffort

This table contains the depths, seine types, lengths, and widths of the beach seines; all measurements in meters.

SledEffort

Contains the distances the larval sleds were towed as recorded by a General Oceanics mechanical flowmeter.

StationsLookUp

Contains codes and descriptions of sample stations.

TransferLog

Records when data were moved from the Xxxx_Entry tables to the Xxxx (*i.e.*, "permanent") tables.

Trawl Effort

Contains duration of midwater and otter trawls (in minutes) and distances covered (mainly for midwater trawls), as measured by the same flowmeter used for larval sleds.

UnitsLookUp

Provides information on what unit each data number is in.

VariableCodesLookUp

Contains additional descriptors of each sample, such as tide type and beach-seine type.

VariablesLookUp

Explains many of the codes we use.

Database Queries

Catch Zero+

Combines data from Catch, Sample, TrawlEffort, and a depth query to relate all organisms to water-quality data, effort, and average depths. Includes zeroes for each species not

caught in a sample. Note that for fish, fish of same species and length for a sample are summed in the "Count" column.

Catch Zero+ AgeClass

Same as Catch Zero+ query but also includes age class for each fish record.

Catch Zero+ AgeClass Expansion

Same as CatchZero+ AgeClass query but creates a field for each fish caught. For example, in the Catch Zero+ query, if three striped bass measuring 50 mm standard length are caught in the same trawl, all three striped bass are collapsed into one record, with the number of fish denoted in the "Count" column – in this case, three. In the Catch Zero+ AgeClass Expansion query, however, all three striped bass measuring 50 mm caught in the same trawl are each given their own unique record, so that there are three records, each with a value of 1 in the "Count" column. Note that this does not apply to invertebrates.

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