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IEP Aquatic Ecology Section
Yolo Bypass Screw Trap Meta Data

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I. Contact Information

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II. Study Elements and Objectives

Largely supported by the Interagency Ecological Program (IEP), DWR has operated a fisheries and invertebrate monitoring program in the Yolo Bypass since 1998. The project has provided a wealth of information regarding the significance of seasonal floodplain habitat to native fishes. The basic objectives of the project are to collect baseline data on lower trophic levels (phytoplankton, zooplankton, and invertebrate drift), juvenile and adult fish, hydrology, and physical conditions within the Yolo Bypass. As the Yolo Bypass has been identified as a high restoration priority by the US Fish and Wildlife Service and National Marine Fisheries Service biological opinions for Delta Smelt (*Hypomesus transpacificus)* and winter and spring-run Chinook Salmon (*Oncorhynchus tshawytscha*), and by California EcoRestore, these baseline data are critical for evaluating the success of future restoration projects. In addition, the data have already served to increase our understanding of the role of the Yolo Bypass in the life history of native fishes, and its ecological function in the San Francisco Estuary. Key findings include: (1) Yolo Bypass is a major factor regulating year class strength of splittail, *Pogonichthys macrolepidotus* (Sommer et al., 1997; Feyrer et al., 2006; Sommer et al., 2007a); (2) Yolo Bypass is a key migration corridor for adult fish of several listed and sport fish (Harrell and Sommer 2003); (3) it is one of the most important regional rearing areas for juvenile Chinook Salmon (Sommer et al., 2001a; 2005); (4) Yolo Bypass is a source of phytoplankton to the food web of the San Francisco Estuary (Jassby and Cloern 2000; Schemel et al., 2004; Sommer et al., 2004); and (5) Inundation of the Yolo Bypass enhances the quantity and quality of phytoplankton carbon to the downstream estuary (Lehman et al. 2007).

The screw trap is one element of the Aquatic Ecology Section's (AES), Yolo Bypass Fish Monitoring Program's (YBFMP) juvenile fish outmigration monitoring that is conducted under the IEP umbrella. Screw traps are sturdy, relatively easy to move, relatively easy to operate and maintain, and are able to capture fish without harm in fast-moving water. A trap is installed at the lower end of the Yolo Bypass Toe Drain and operated weekdays during January through June. The screw trap project objectives are to (1) examine species composition of juvenile outmigrants and resident small-bodied fishes; (2) identify general salmonid emigration attributes such as timing, abundance, life stage composition, condition, and investigate the influence of the factors initiating downstream migration such as flow, tidal cycle, time of day, turbidity, and water temperature; (3) to compare fish species composition and densities in the Yolo Bypass Toe Drain and floodplain; and, (4) develop an estimate of juvenile salmon residence time using Coded Wire Tags (CWT).

Key findings to date: http://www.water.ca.gov/aes/pubs/ and http://www.water.ca.gov/aes/pubs/reports.cfm

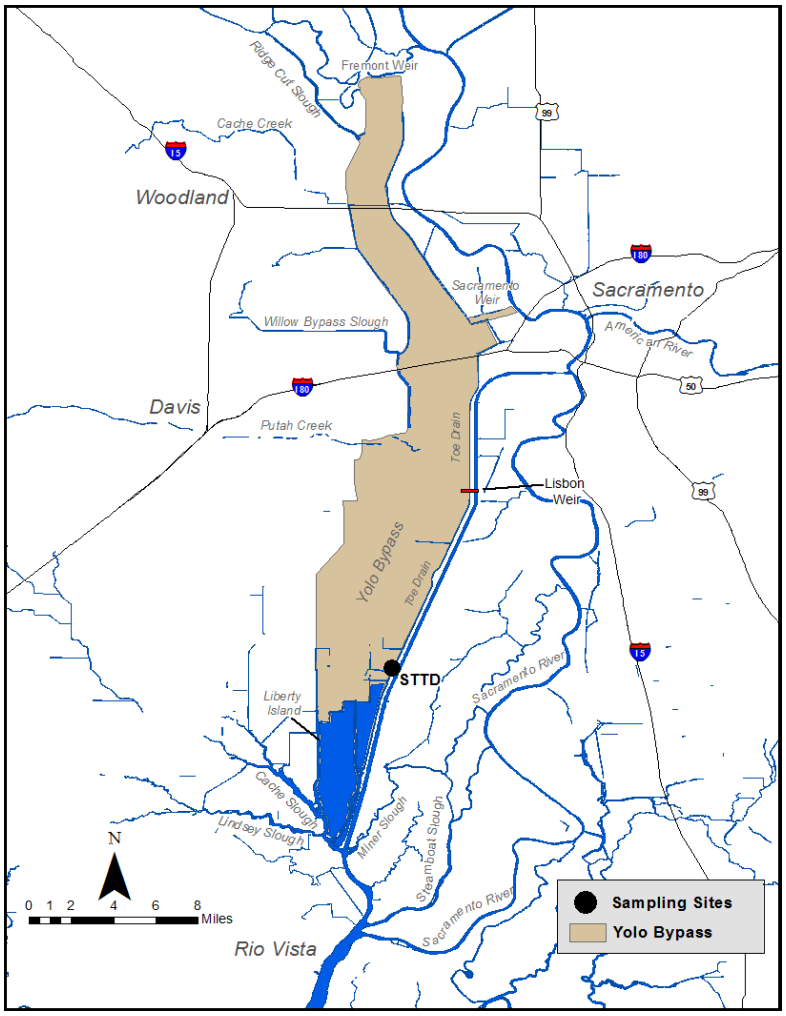
III. Study Area and Sample Sites

A. General Information

A single rotary screw trap is deployed at levee mile 14.5 near the base of the Yolo Bypass Toe Drain. The trap site has been selected based on the following criteria for installation, operation, and maintenance: (1) suitable depth: greater than six feet at minimum flow and low tide; (2) suitable velocity: greater than two feet per second (fps) at minimum flow on an ebb tide; (3) suitable anchoring points; and, (4) limited public access. Once installed, the trap is reached by truck via the Sacramento Deep Water Ship Channel/East Yolo Bypass levee. The trap is accessed using a small boat with an outboard motor during high flow or paddles during lower flow periods.

B. Name and Location of Current Sampling Site

Station Code	Latitude	Longitude
STTD	38.353383	-121.643181



IV. Period of Record

Rotary screw trap operation began in 1998, deployment generally occurs from December/January through June, and that period of months has been sampled relatively consistently every year of the monitoring program. Throughout the history of the program there have sometimes been two rotary screw traps in place (1998 and 1999), the screw trap has been installed one moth early to capture winter flooding events (December 2012), and operational challenges have augmented its sampling frequency (see explanation below).

V. Sampling Frequency

Currently, a single rotary screw trap is fished and checked daily during the months of January through June. The trap is generally set on Monday, checked Tuesday through Thursday, and then pulled on Friday. In the past, the trap was serviced every day or two on weekdays, but generally not visited on weekends unless the Bypass floods or there are high fish densities and debris loads. The trap may also only be operated during day-time hours for multiple one to four hour long sets during periods of high flows, heavy debris loads or high catches of ESA listed species.

Year	# of Sampling Events	Operation Hours	Notes
1998	162	2087	
1999	133	5077	
2000	89	3339	
2001	78	4108	
2002	79	4079	
2003	74	3673	
2004	66	3717	
2005	74	3696	
2006	69	2005	
2007	63	3490	
2008	82	3343	
2009	110	2568	
2010	128	1761	
2011	105	1992	Damage due to high debris loads resulted in several weeks of no operation in late March and April
2012	172	1715	High catches of ESA listed species resulted in shorter daytime only sets intermittently from January through March

2013	118	2109	
2014	116	2174	
2015	120	2216	
2016	155	1807	High catches of ESA listed species resulted in shorter daytime only sets intermittently for one month (March 29th through April 26th)

VI. Field Collection Methods

The screw trap operates using downstream flow as water strikes the angled baffles on the inside of the trapping cone. This force causes the cone to rotate and fish enter the upstream end of the rotating trapping cone, becoming trapped inside the trapping cone, and then fish are carried rearward into the livebox. Upon checking or pulling the trap fish are then collected using dipnets.

The handling and sub-sampling protocol follows California Department of Fish and Wildlife (CDFW) (1997) to minimize impacts to salmon, particularly endangered winter-run Chinook. Juvenile Chinook salmon are quickly sorted between winter-run and juveniles of other races based on visual culling using Fisher's daily length-at-date criteria. Any winter-run sized salmon will be immediately transferred to a separate bucket and processed. During periods of Delta Smelt presence, all Delta Smelt are prioritized and carefully identified to differentiate between Delta and Wakasagi Smelt (*Hypomesus nipponensis*). Then all other fish are identified and counted: fork length is measured to the nearest millimeter on a wetted measuring board for up to 50 of each species. Any juvenile fish that cannot be field identified are preserved in formalin and examined at our West Sacramento office. Any adipose fin-clipped salmon are euthanized in MS-222, bagged individually in whirl-pack bags marked with information on sampling location, date, gear type, fork length, and time, then placed on ice in a cooler until transferred to our West Sacramento office to be weighed and placed in a deep freeze. Captured salmonids are inspected for characters such as presence of yolk sac, parr marks, silvery appearance, and deciduous scales to determine life stage and/or degree of smolting. A simple life stage designation is determined for each fish measured:

1.) clearly parr = a darkly pigmented fish with characteristic dark, oval- to round-shaped parr marks on its sides

2.) between parr and smolt = the fish is not clearly parr, but is not yet clearly a smolt either

3.) clearly a smolt = highly faded parr marks, or lacking them completely, bright silver or nearly white color, and deciduous scales.

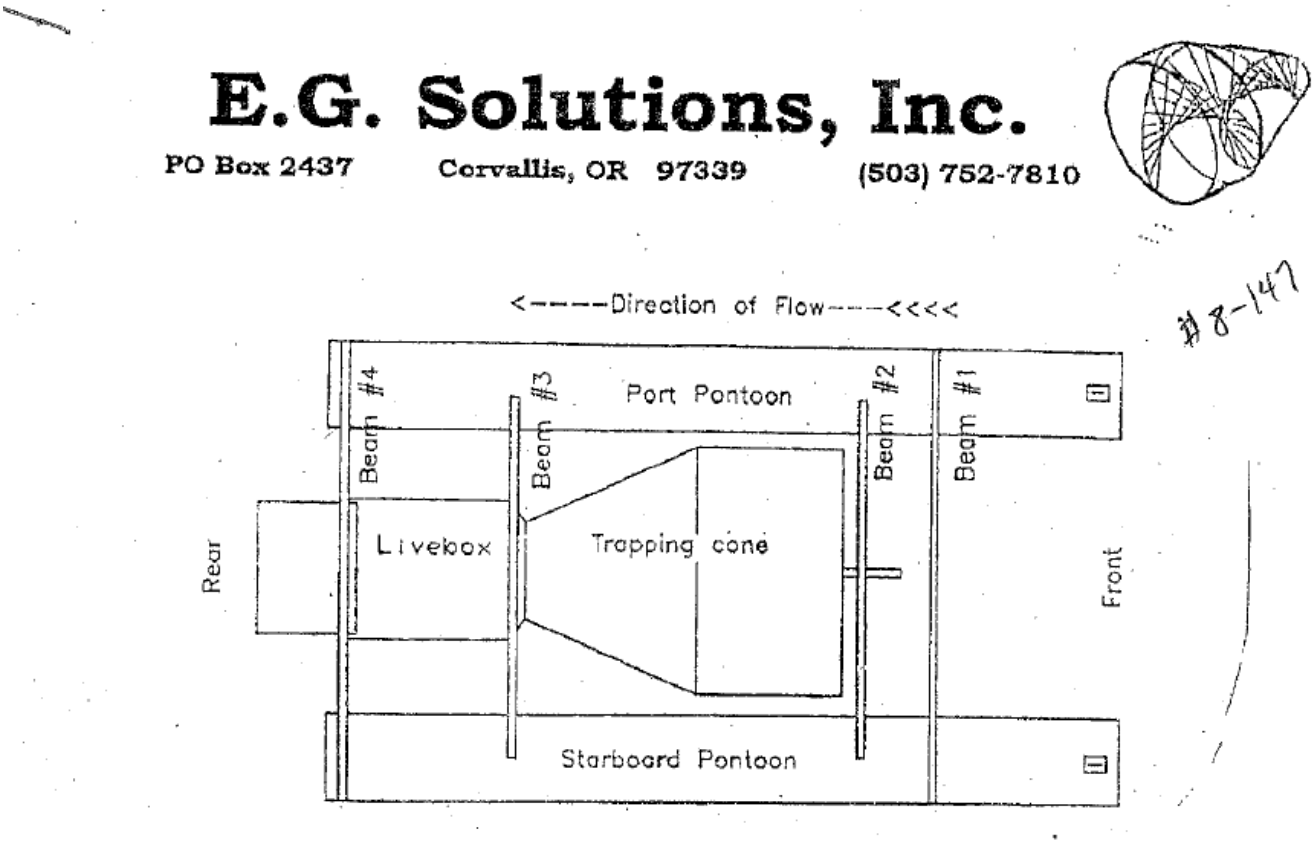
A. Screw Trap

The screw trap cone is eight foot diameter and designed by EG Solutions screw trap (Corvallis, Oregon).The trap configuration is as follows:

- Length: 22.5 ft
- Width: 12 ft
- Weight: 1300 lbs
- Cone: 8 ft diameter and 9 ft length with 2 ft on each end for shaft (total of 13 ft)
- Livebox: 4 ft by 5 ft with a 25 ft^3 volume
- Pontoon: 22.5 ft length and 20 in. width, with 9 ft between pontoons

During operation the trap is attached to a ¾” overhead cable originally installed December 2003 (replaced in 2011 after damage during a flood) with two ½” guide cables attached to each pontoon to align the trap in the center of the channel. The overhead cable is strung between two large trees, each with two ¼” guy cables connected to concrete T anchors. The trap has a rear boat anchor to maintain the traps position during low flow periods and strong flood tides.

A revolution counter was installed on the main shaft of the screw trap in March 2013.



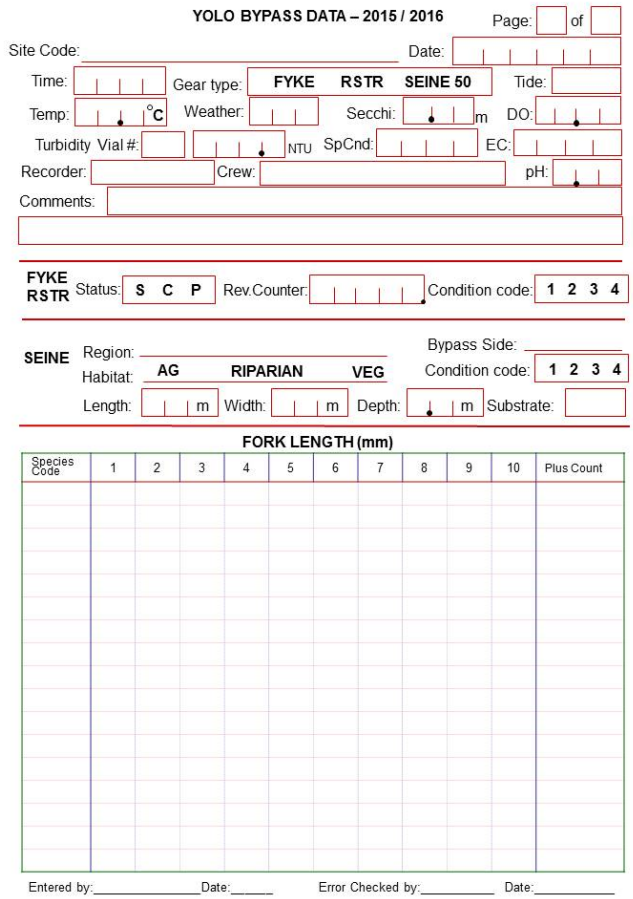
VII. Data Management and Quality Assurance/Quality Control

A. Field Data

Data is recorded using data sheets based on a "standard" Interagency Ecological Program forms that have been modified slightly to include salmon life stage and other factors. For the salmon codes, the first four characters identify race (“CHNF”, “CHNW”,”CHNL”, “CHNT”, or “CHNS”) and a fifth character identifies life stage (“P”-parr, “X”-transitional, or “S”-smolt). In addition to catch, water quality parameters are recorded when the sample is collected. Tide stage, weather, and trap condition are observed and temperature (C), electrical conductivity (uS/cm), dissolved oxygen (mg/L), turbidity (NTU), pH, and Secchi depth (cm) are measured.

Data QA/QC is a four stage process. First, the data sheets are error checked at the end of each day by the crew leader. Data is then entered into a Microsoft Access form with automatic error-checking and data validation. Third, a separate data entry

person compares the original data sheets to the electronic database. Finally, each data field is sorted and/or summarized based on unique records to highlight erroneous outliers.



YOLO BYPASS DATA – 2015 / 2016 Page: ___ of ___

Site Code: ___ Date: ___

Time: ___ Gear type: FYKE RSTR SEINE 50 Tide: ___

Temp: ___ °C Weather: ___ Secchi: ___ m DO: ___

Turbidity Vial #: ___ ___ NTU SpCnd: ___ EC: ___

Recorder: ___ Crew: ___ pH: ___

Comments: ___

FYKE RSTR Status: S C P Rev.Counter: ___ Condition code: 1 2 3 4

SEINE Region: ___ Bypass Side: ___

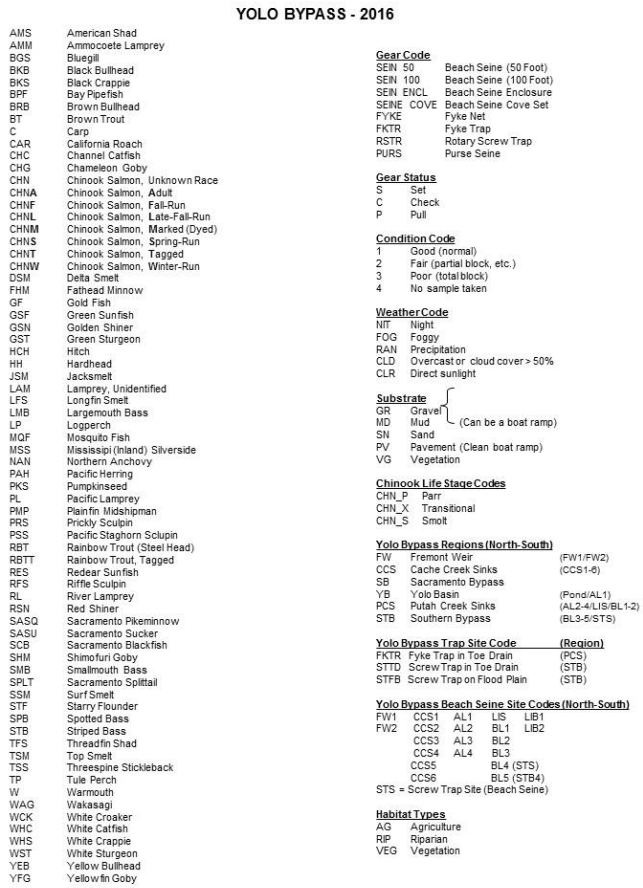
Habitat: AG RIPARIAN VEG Condition code: 1 2 3 4

Length: ___ m Width: ___ m Depth: ___ m Substrate: ___

FORK LENGTH (mm)

Species Code	1	2	3	4	5	6	7	8	9	10	Plus Count

Entered by:_____ Date:_____ Error Checked by:_____ Date:_____



YOLO BYPASS - 2016

AMS	American Shad
AMM	Ammocoete Lamprey
BGS	Bluegill
BKB	Black Bullhead
BKS	Black Crappie
BPF	Bay Pipefish
BRB	Brown Bullhead
BT	Brown Trout
C	Carp
CAR	California Roach
CHC	Channel Catfish
CHG	Chameleon Goby
CHN	Chinook Salmon, Unknown Race
CHNA	Chinook Salmon, Adult
CHNF	Chinook Salmon, Fall-Run
CHNL	Chinook Salmon, Late-Fall-Run
CHNM	Chinook Salmon, Marked (Dyed)
CHNS	Chinook Salmon, Spring-Run
CHNT	Chinook Salmon, Tagged
CHNW	Chinook Salmon, Winter-Run
DSM	Delta Smelt
FHM	Fathead Minnow
GF	Gold Fish
GSF	Green Sunfish
GSN	Golden Shiner
GST	Green Sturgeon
HCH	Hitch
HH	Hardhead
JSM	Jacksmelt
LAM	Lamprey, Unidentified
LFS	Longfin Smelt
LMB	Largemouth Bass
LP	Logperch
MQF	Mosquito Fish
MSS	Mississipi (Inland) Silverside
NAN	Northern Anchovy
PAH	Pacific Herring
PKS	Pumpkinseed
PL	Pacific Lamprey
PMP	Plainfin Midshipman
PRS	Prickly Sculpin
PSS	Pacific Staghorn Sculpin
RBT	Rainbow Trout (Steel Head)
RBTT	Rainbow Trout, Tagged
RES	Redear Sunfish
RFS	Riffle Sculpin
RL	River Lamprey
RSN	Red Shiner
SASQ	Sacramento Pikeminnow
SASU	Sacramento Sucker
SCB	Sacramento Blackfish
SHM	Shimofuri Goby
SMB	Smallmouth Bass
SPLT	Sacramento Splittail
SSM	Surf Smelt
STF	Starry Flounder
SPB	Spotted Bass
STB	Striped Bass
TFS	Threadfin Shad
TSM	Top Smelt
TSS	Threespine Stickleback
TP	Tule Perch
W	Warmouth
WAG	Wakasagi
WCK	White Croaker
WHC	White Catfish
WHS	White Crappie
WST	White Sturgeon
YEB	Yellow Bullhead
YFG	Yellowfin Goby

Gear Code

SEIN 50	Beach Seine (50 Foot)
SEIN 100	Beach Seine (100 Foot)
SEIN ENCL	Beach Seine Enclosure
SEINE COVE	Beach Seine Cove Set
FYKE	Fyke Net
FKTR	Fyke Trap
RSTR	Rotary Screw Trap
PURS	Purse Seine

Gear Status

S	Set
C	Check
P	Pull

Condition Code

1	Good (normal)
2	Fair (partial block, etc.)
3	Poor (total block)
4	No sample taken

Weather Code

NIT	Night
FOG	Foggy
RAN	Precipitation
CLD	Overcast or cloud cover > 50%
CLR	Direct sunlight

Substrate

GR	Gravel	(Can be a boat ramp)
MD	Mud	
SN	Sand	
PV	Pavement (Clean boat ramp)	
VG	Vegetation	

Chinook Life Stage Codes

CHN_P	Parr
CHN_X	Transitional
CHN_S	Smolt

Yolo Bypass Regions (North-South)

FW	Fremont Weir	(FW1/FW2)
CCS	Cache Creek Sinks	(CCS1-6)
SB	Sacramento Bypass	
YB	Yolo Basin	(Pond/AL1)
PCS	Putah Creek Sinks	(AL2-4/LIS/BL1-2)
STB	Southern Bypass	(BL3-5/STS)

Yolo Bypass Trap Site Code		(Region)
FKTR	Fyke Trap in Toe Drain	(PCS)
STTD	Screw Trap in Toe Drain	(STB)
STFB	Screw Trap on Flood Plain	(STB)

Yolo Bypass Beach Seine Site Codes (North-South)

FW1	CCS1	AL1	LIS	LIB1
FW2	CCS2	AL2	BL1	LIB2
	CCS3	AL3	BL2	
	CCS4	AL4	BL3	
	CCS5		BL4 (STS)	
	CCS6		BL5 (STB4)	

STS = Screw Trap Site (Beach Seine)

Habitat Types

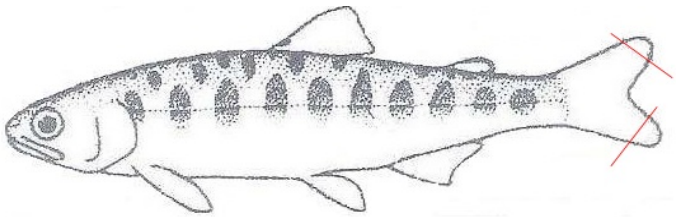
AG	Agriculture
RIP	Riparian
VEG	Vegetation

B. Lab Data

1.) Juvenile Chinook Salmon Genetic Collection

Sterilization: DNA cross-contamination is always a potentially serious issue that can compromise results from molecular studies. To avoid cross-contaminating DNA specimens we use alcohol swabs to clean scissors and forceps between each individual.

Collect fin clip: We cut a small piece of fin tissue from the caudal fin of a live fish using clean scissors. Hands of the collector should be cleaned of mucus and scales between handling fish, and scissors/knife should be sterilized between samples. Before 2016, tissue size was required to be a minimum 5 sq. mm., and if the adequate sized tissue sample could not be taken without serious damage to the fish then the fish was euthanized and saved whole to obtain a large enough sample. After 2016, archived tissue samples were no longer required and tissue sample size could be reduced to avoid lethal take.



1. We then place the fin clip into pre-filled 2 ml eppendorf plastic vial containing high strength (95%) EtOH using forceps. The ethanol will preserve the tissue and the DNA at room temperature.

2. We label each vial with an EtOH safe marker/or Pencil on both the lid and side of the vial and place a corresponding inner label within the tube. Each unique label corresponds exactly to information in the field data record sheets. The alphanumeric code includes the year, fish number and run (e.g. 2013-001CHNF (Fall-Run), 2013-001CHNS (Spring-Run)).
3. Any euthanized salmon are bagged individually in whirl-pack bags marked with information on sampling location, date, gear type, fork length, and time, then placed on ice in a cooler until transferred to our West Sacramento office to be weighed and placed in a deep freeze.
4. Each vial is closed securely and placed in an eppendorf vial box for storage.

Recording data: The sample ID, date of collection, site code, weight, collection method, species, run, fork length, and adipose clip, is written on a genetic data sheet separate from the field data sheets.

2.) Delta Smelt and Longfin Smelt Collection

We keep only Delta Smelt or Longfin Smelt that perish during collection. **WE DO NOT KEEP OR SACRIFICE LIVE DELTA OR LONGFIN SMELT.**

1. Deceased fish are measured to fork length and weight in grams.
2. We package each fish individually in 10 ml or 50 ml sample tubes prefilled with 95% ETOH. Then place fish and label into vial, top off with fresh 95% ETOH and screw on lid.
3. Fish are then brought back to the laboratory at DWR, West Sacramento, and further examined under a dissecting microscope to determine the absence or presence of chromatophores on the isthmus.
4. We complete a label with a unique identification number (e.g. 2013-001S to for DSM, 2013-001L for Longfin), survey identification (Yolo Bypass), gear type (Beach Seine or RSTR), date, time, and site code in pencil. Then record an assigned number on DSM take log in the clipboard.
5. Each collected fish is stored at room temperature in an assigned cabinet in the laboratory at DWR, West Sacramento.
6. Samples are later archived in DWR laboratory freezers for long term storage.

3.) Wakasagi Collection: Keep all sampled Wakasagi.

1. Fish are measured to fork length and weight in grams is recorded in the field.
2. We package each fish individually in 10 ml or 50 ml sample tubes prefilled with 95% ETOH. Place fish and label into vial, top off with fresh 95% ETOH and screw on lid.
3. Fish are to be brought back to the laboratory at DWR, West Sacramento and further examined under a dissecting microscope to determine the absence or presence of chromatophores on the isthmus.
4. We complete a label with a unique identification number (e.g. 2013-001W), survey identification (Yolo Bypass), gear type (Beach Seine or RSTR), date, time, and site code in pencil.
5. Each collected fish is stored at room temperature in assigned cabinet in the laboratory at DWR, West Sacramento.
6. Samples are later archived in DWR laboratory freezers for long term storage.

VIII. Chain of Custody and Sample Handling

Storing samples: Samples are kept out of extreme sun/heat (e.g. dashboards, hot warehouses).

Delivering samples: at the end of every field season, Chinook Salmon tissue samples are delivered to the Genomic Variation Laboratory Tissue Archive (previous to 2016 samples were also archived with CDFW). We include a chain of custody with all the field data associated with the samples.

CDFW Tissue Archive
Lea Koerber

Central Valley Salmonid Tissue Archive
8175 Alpine Avenue, Suite F
Sacramento, CA 95826
Lea.Koerber@wildlife.ca.gov, (916) 227-6398
UC Davis Genomic Variation Laboratory
Mariah Meek and Andrea Schreier

Meyer Hall, Department of Animal Science
1 Shields Avenue
Davis, CA 95616
amdrauch@ucdavis.edu, (530) 752-0664

IX. Implications of sampling design, Tips and Data Quirks when considering analyses

- In 2000-2009, the rotary screw trap was often set over weekends and checked every 1-2 days. In 2010, the operation of the trap was changed to daily checks and only set on weekends during some flooding events.
- All fish sampling must be adjusted under different velocity and flooding levels because of debris, permitting, and safety issues. However, the influence of flows and flooding is not straightforward because discharge, tidal inundation and seasonal short-duration flooding impact the feasibility of any one site. Additionally, because sampling is meant to be repeatable all sampling methods are proportionally sampling less when available habitat increases with over-bank flows. For example, it is likely that trap efficiency may be quite low during drought conditions because tidal velocities are correspondingly low, so the rotary screw trap only samples efficiently during a small portion of the day. We assume during low flow the trap only operates on ebb tide. In wetter years, analyses of rotary screw trap data do not support the hypothesis that trap efficiency is a primary driver of Chinook Salmon catch trends in Yolo Bypass (Sommer et al. 2005), however during flooding events the trap samples proportionally less of the available habitat.
- When ESA listed fish are caught, some operational flexibility is required, for example shorter day-time only sets are fished when we near the lethal take limit for Delta Smelt, winter-run Chinook salmon and Steelhead/Rainbow Trout (*Oncorhynchus mykiss*). High debris loads can also mandate shorter sets, which have been as short as one hour in some instances.
- Volume cannot be measured because there is no flow-meter in place; effort is generally reported in trap operation hours. However “set”, “check” and “pull” dates and times were not always reported, and therefore operation hours must be calculated as an estimate using the fish capture events in some years. As of March 2013 catch per unit effort can be reported as catch per rotation with the revolution counter data.

A. Example photographs of Seasonally Variable Conditions that affect Trap Operation: Flooding

B. Example photographs of Seasonally Variable Conditions that affect Trap Operation: Water Hyacinth

3. 2. 2001