FISH ASSEMBLAGE AND POPULATION BETWEEN DON PEDRO DAM AND LA GRANGE DAM
STUDY REPORT
DON PEDRO PROJECT
FERC NO. 2299



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MID
Modesto Irrigation District

Prepared for:
Turlock Irrigation District – Turlock, California
Modesto Irrigation District – Modesto, California

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Fish Assemblage and Population Between Don Pedro and La Grange Dam Study Report

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List of Acronyms

ac .....acres

ACEC .....Area of Critical Environmental Concern

AF .....acre-feet

ACOE.....U.S. Army Corps of Engineers

ADA .....Americans with Disabilities Act

ALJ.....Administrative Law Judge

APE .....Area of Potential Effect

ARMR.....Archaeological Resource Management Report

BA .....Biological Assessment

BDCP .....Bay-Delta Conservation Plan

BLM .....U.S. Department of the Interior, Bureau of Land Management

BLM-S .....Bureau of Land Management – Sensitive Species

BMI .....Benthic macroinvertebrates

BMP .....Best Management Practices

BO .....Biological Opinion

CalEPPC .....California Exotic Pest Plant Council

CalSPA.....California Sports Fisherman Association

CAS.....California Academy of Sciences

CCC.....Criterion Continuous Concentrations

CCIC .....Central California Information Center

CCSF .....City and County of San Francisco

CCVHJV .....California Central Valley Habitat Joint Venture

CD .....Compact Disc

CDBW.....California Department of Boating and Waterways

CDEC .....California Data Exchange Center

CDFA .....California Department of Food and Agriculture

CDFG .....California Department of Fish and Game (as of January 2013, Department of Fish and Wildlife)

CDMG.....California Division of Mines and Geology

CDOF .....California Department of Finance

CDPH .....California Department of Public Health

CDPR .....California Department of Parks and Recreation
CDSOD.....California Division of Safety of Dams
CDWR.....California Department of Water Resources
CE .....California Endangered Species
CEII.....Critical Energy Infrastructure Information
CEQA.....California Environmental Quality Act
CESA .....California Endangered Species Act
CFR.....Code of Federal Regulations
cfs.....cubic feet per second
CGS.....California Geological Survey
CMAP .....California Monitoring and Assessment Program
CMC.....Criterion Maximum Concentrations
CNDDB.....California Natural Diversity Database
CNPS.....California Native Plant Society
CORP .....California Outdoor Recreation Plan
CPUE .....Catch Per Unit Effort
CRAM.....California Rapid Assessment Method
CRLF.....California Red-Legged Frog
CRRF .....California Rivers Restoration Fund
CSAS.....Central Sierra Audubon Society
CSBP.....California Stream Bioassessment Procedure
CT .....California Threatened Species
CTR.....California Toxics Rule
CTS .....California Tiger Salamander
CVRWQCB .....Central Valley Regional Water Quality Control Board
CWA .....Clean Water Act
CWHR.....California Wildlife Habitat Relationship
Districts.....Turlock Irrigation District and Modesto Irrigation District
DLA .....Draft License Application
DPRA.....Don Pedro Recreation Agency
DPS .....Distinct Population Segment
EA .....Environmental Assessment
EC .....Electrical Conductivity

EFH.....Essential Fish Habitat
EIR.....Environmental Impact Report
EIS.....Environmental Impact Statement
EPA.....U.S. Environmental Protection Agency
ESA.....Federal Endangered Species Act
ESRCD.....East Stanislaus Resource Conservation District
ESU.....Evolutionary Significant Unit
EWUA.....Effective Weighted Useable Area
FERC.....Federal Energy Regulatory Commission
FFS.....Foothills Fault System
FL.....Fork length
FMU.....Fire Management Unit
FOT.....Friends of the Tuolumne
FPC.....Federal Power Commission
ft/mi.....feet per mile
FWCA.....Fish and Wildlife Coordination Act
FYLF.....Foothill Yellow-Legged Frog
g.....grams
GIS.....Geographic Information System
GLO.....General Land Office
GPS.....Global Positioning System
HCP.....Habitat Conservation Plan
HHWP.....Hetch Hetchy Water and Power
HORB.....Head of Old River Barrier
HPMP.....Historic Properties Management Plan
ILP.....Integrated Licensing Process
ISR.....Initial Study Report
ITA.....Indian Trust Assets
kV.....kilovolt
m.....meters
M&I.....Municipal and Industrial
MCL.....Maximum Contaminant Level
mg/kg.....milligrams/kilogram

mg/L .....milligrams per liter
mgd .....million gallons per day
mi .....miles
mi^2 .....square miles
MID.....Modesto Irrigation District
MOU .....Memorandum of Understanding
MSCS.....Multi-Species Conservation Strategy
msl.....mean sea level
MVA .....Megavolt Ampere
MW .....megawatt
MWh .....megawatt hour
mya.....million years ago
NAE .....National Academy of Engineering
NAHC .....Native American Heritage Commission
NAS.....National Academy of Sciences
NAVD 88 .....North American Vertical Datum of 1988
NAWQA .....National Water Quality Assessment
NCCP .....Natural Community Conservation Plan
NEPA .....National Environmental Policy Act
ng/g .....nanograms per gram
NGOs .....Non-Governmental Organizations
NHI .....Natural Heritage Institute
NHPA.....National Historic Preservation Act
NISC .....National Invasive Species Council
NMFS.....National Marine Fisheries Service
NOAA .....National Oceanic and Atmospheric Administration
NOI .....Notice of Intent
NPS .....U.S. Department of the Interior, National Park Service
NRCS .....National Resource Conservation Service
NRHP .....National Register of Historic Places
NRI.....Nationwide Rivers Inventory
NTU .....Nephelometric Turbidity Unit
NWI.....National Wetland Inventory

NWIS .....National Water Information System
NWR .....National Wildlife Refuge
NGVD 29 .....National Geodetic Vertical Datum of 1929
O&M .....operation and maintenance
OEHHA.....Office of Environmental Health Hazard Assessment
ORV .....Outstanding Remarkable Value
PAD.....Pre-Application Document
PDO.....Pacific Decadal Oscillation
PEIR.....Program Environmental Impact Report
PGA.....Peak Ground Acceleration
PHG.....Public Health Goal
PM&E .....Protection, Mitigation and Enhancement
PMF.....Probable Maximum Flood
POAOR.....Public Opinions and Attitudes in Outdoor Recreation
ppb.....parts per billion
ppm .....parts per million
PSP.....Proposed Study Plan
QA.....Quality Assurance
QC.....Quality Control
RA.....Recreation Area
RBP.....Rapid Bioassessment Protocol
Reclamation .....U.S. Department of the Interior, Bureau of Reclamation
RM .....River Mile
RMP .....Resource Management Plan
RP.....Relicensing Participant
RSP .....Revised Study Plan
RST .....Rotary Screw Trap
RWF.....Resource-Specific Work Groups
RWG .....Resource Work Group
RWQCB.....Regional Water Quality Control Board
SC.....State candidate for listing under CESA
SCD.....State candidate for delisting under CESA
SCE .....State candidate for listing as endangered under CESA

SCT .....State candidate for listing as threatened under CESA

SD1 .....Scoping Document 1

SD2 .....Scoping Document 2

SE.....State Endangered Species under the CESA

SFP.....State Fully Protected Species under CESA

SFPUC .....San Francisco Public Utilities Commission

SHPO .....State Historic Preservation Office

SJRA .....San Joaquin River Agreement

SJRGA .....San Joaquin River Group Authority

SJTA .....San Joaquin River Tributaries Authority

SPD .....Study Plan Determination

SRA.....State Recreation Area

SRMA .....Special Recreation Management Area or Sierra Resource Management Area (as per use)

SRMP.....Sierra Resource Management Plan

SRP .....Special Run Pools

SSC .....State species of special concern

ST.....California Threatened Species under the CESA

STORET .....Storage and Retrieval

SWAMP.....Surface Water Ambient Monitoring Program

SWE .....Snow-Water Equivalent

SWRCB.....State Water Resources Control Board

TAC.....Technical Advisory Committee

TAF .....thousand acre-feet

TCP .....Traditional Cultural Properties

TDS.....Total Dissolved Solids

TID.....Turlock Irrigation District

TMDL .....Total Maximum Daily Load

TOC.....Total Organic Carbon

TRT.....Tuolumne River Trust

TRTAC .....Tuolumne River Technical Advisory Committee

UC.....University of California

USDA.....U.S. Department of Agriculture

USDOC .....U.S. Department of Commerce
USDOI .....U.S. Department of the Interior
USFS .....U.S. Department of Agriculture, Forest Service
USFWS .....U.S. Department of the Interior, Fish and Wildlife Service
USGS .....U.S. Department of the Interior, Geological Survey
USR.....Updated Study Report
UTM.....Universal Transverse Mercator
VAMP .....Vernalis Adaptive Management Plan
VELB .....Valley Elderberry Longhorn Beetle
VRM .....Visual Resource Management
WPT .....Western Pond Turtle
WSA.....Wilderness Study Area
WSIP .....Water System Improvement Program
WWTP .....Wastewater Treatment Plant
WY .....water year
µS/cm .....microSeimens per centimeter

1.0 INTRODUCTION

1.1 General Description of the Don Pedro Project

Turlock Irrigation District (TID) and Modesto Irrigation District (MID) (collectively, the Districts) are the co-licensees of the 168-megawatt (MW) Don Pedro Project (Project) located on the Tuolumne River in western Tuolumne County in the Central Valley region of California. The Don Pedro Dam is located at river mile (RM) 54.8 and the Don Pedro Reservoir formed by the dam extends 24-miles upstream at the normal maximum water surface elevation of 830 ft above mean sea level (msl; NGVD 29). At elevation 830 ft, the reservoir stores over 2,000,000 acre-feet (AF) of water and has a surface area slightly less than 13,000 acres (ac). The watershed above Don Pedro Dam is approximately 1,533 square miles (mi^2).

Both TID and MID are local public agencies authorized under the laws of the State of California to provide water supply for irrigation and municipal and industrial (M&I) uses and to provide retail electric service. The Project serves many purposes including providing water storage for the beneficial use of irrigation of over 200,000 ac of prime Central Valley farmland and for the use of M&I customers in the City of Modesto (population 210,000). Consistent with the requirements of the Raker Act passed by Congress in 1913 and agreements between the Districts and City and County of San Francisco (CCSF), the Project reservoir also includes a "water bank" of up to 570,000 AF of storage. CCSF may use the water bank to more efficiently manage the water supply from its Hetch Hetchy water system while meeting the senior water rights of the Districts. CCSF's "water bank" within Don Pedro Reservoir provides significant benefits for its 2.6 million customers in the San Francisco Bay Area.

The Project also provides storage for flood management purposes in the Tuolumne and San Joaquin rivers in coordination with the U.S. Army Corps of Engineers (ACOE). Other important uses supported by the Project are recreation, protection of the anadromous fisheries in the lower Tuolumne River, and hydropower generation.

The Project Boundary extends from approximately one mile downstream of the dam to approximately RM 79 upstream of the dam. Upstream of the dam, the Project Boundary runs generally along the 855 ft contour interval which corresponds to the top of the Don Pedro Dam. The Project Boundary encompasses approximately 18,370 ac with 78 percent of the lands owned jointly by the Districts and the remaining 22 percent (approximately 4,000 ac) is owned by the United States and managed as a part of the U.S. Bureau of Land Management (BLM) Sierra Resource Management Area.

The primary Project facilities include the 580-foot-high Don Pedro Dam and Reservoir completed in 1971; a four-unit powerhouse situated at the base of the dam; related facilities including the Project spillway, outlet works, and switchyard; four dikes (Gasburg Creek Dike and Dikes A, B, and C); and three developed recreational facilities (Fleming Meadows, Blue Oaks, and Moccasin Point Recreation Areas). The location of the Project and its primary facilities is shown in Figure 1.1-1.

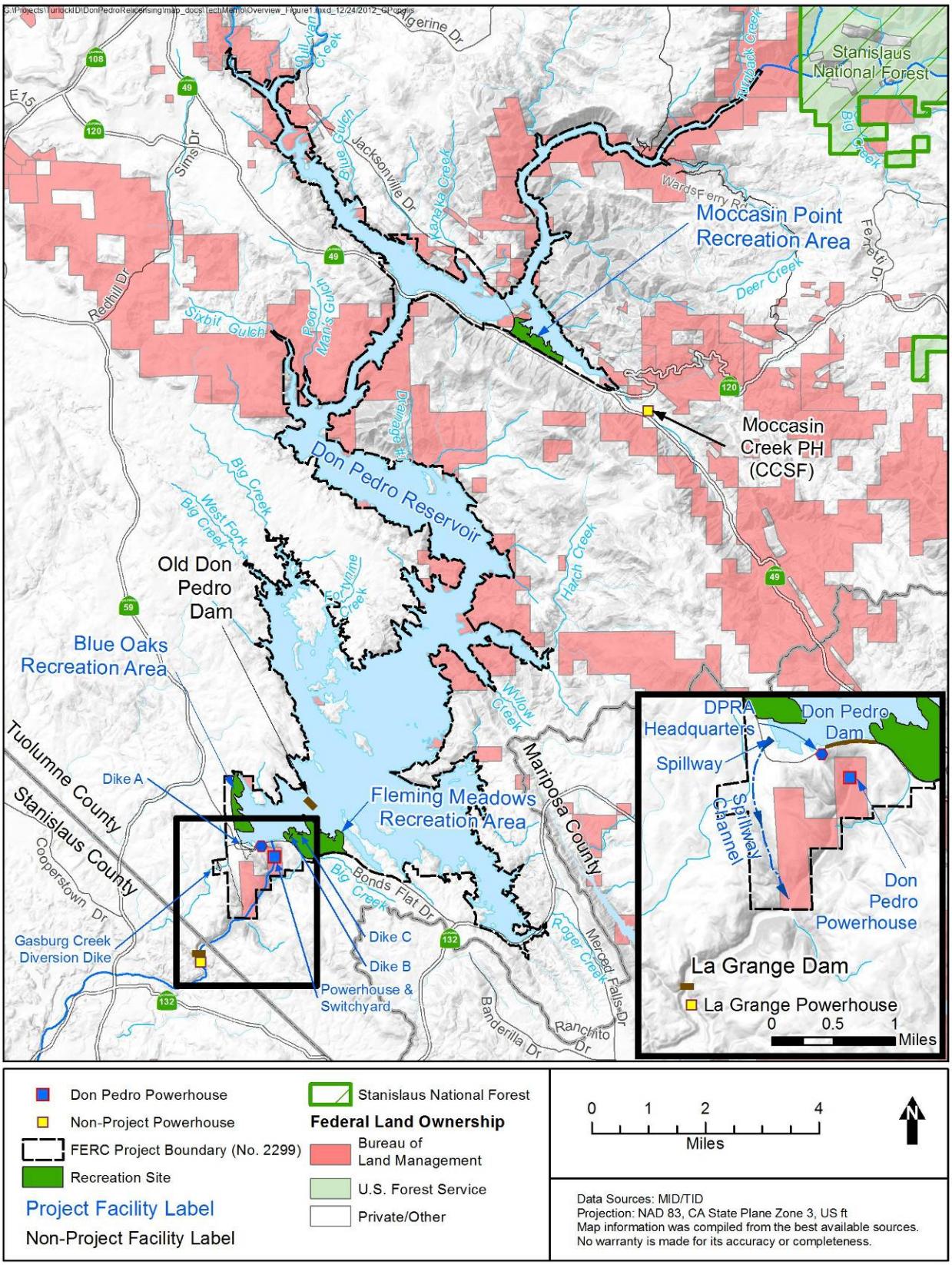

Figure 1.1-1. Don Pedro Project location.

1.2 Relicensing Process

The current FERC license for the Project expires on April 30, 2016, and the Districts will apply for a new license no later than April 30, 2014. The Districts began the relicensing process by filing a Notice of Intent and Pre-Application Document (PAD) with FERC on February 10, 2011, following the regulations governing the Integrated Licensing Process (ILP). The Districts' PAD included descriptions of the Project facilities, operations, license requirements, and Project lands as well as a summary of the extensive existing information available on Project area resources. The PAD also included ten draft study plans describing a subset of the Districts' proposed relicensing studies. The Districts then convened a series of Resource Work Group meetings, engaging agencies and other relicensing participants in a collaborative study plan development process culminating in the Districts' Proposed Study Plan (PSP) and Revised Study Plan (RSP) filings to FERC on July 25, 2011 and November 22, 2011, respectively.

On December 22, 2011, FERC issued its Study Plan Determination (SPD) for the Project, approving, or approving with modifications, 34 studies proposed in the RSP that addressed Cultural and Historical Resources, Recreational Resources, Terrestrial Resources, and Water and Aquatic Resources. In addition, as required by the SPD, the Districts filed three new study plans (W&AR-18, W&AR-19, and W&AR-20) on February 28, 2012 and one modified study plan (W&AR-12) on April 6, 2012. Prior to filing these plans with FERC, the Districts consulted with relicensing participants on drafts of the plans. FERC approved or approved with modifications these four studies on July 25, 2012.

Following the SPD, a total of seven studies (and associated study elements) that were either not adopted in the SPD, or were adopted with modifications, formed the basis of Study Dispute proceedings. In accordance with the ILP, FERC convened a Dispute Resolution Panel on April 17, 2012 and the Panel issued its findings on May 4, 2012. On May 24, 2012, the Director of FERC issued his Formal Study Dispute Determination, with additional clarifications related to the Formal Study Dispute Determination issued on August 17, 2012.

This study report describes the objectives, methods, and results of the Fish Assemblage and Population Study (W&AR-13) as implemented by the Districts in accordance with FERC's SPD and subsequent study modifications and clarifications. Documents relating to the Project relicensing are publicly available on the Districts' relicensing website at www.donpedro-relicensing.com.

1.3 Study Plan

FERC's Scoping Document 2 identified potential effects of the Project on fish resources. The Districts' continued operation and maintenance (O&M) of the existing Project has the potential to affect the fish assemblage and fish populations between Don Pedro Dam and La Grange Dam. In order to evaluate potential effects on fish populations, the Districts identified the need for additional baseline information on the fish community in this reach of the Tuolumne River and developed the Fish Assemblage and Population between Don Pedro Dam and La Grange Dam Study Plan.

In response to a U.S. Fish and Wildlife Service (USFWS) request for a genetic study of the salmonid fish population upstream of Don Pedro Dam, the Districts agreed to take fin clips of Chinook salmon and rainbow trout (*Oncorhynchus mykiss*) in the Tuolumne River upstream of La Grange Dam as part of this and other relevant proposed studies. In accordance with FERC's SPD, the Districts obtained fin clips of salmonids as part of this fish resources survey.

2.0 STUDY GOALS AND OBJECTIVES

The goal of this study is to characterize the fish assemblage and populations between Don Pedro Dam and La Grange Dam. Fish assemblage and population information is very limited for this section of river and is based on a single known sampling event occurring in 2008 (Stillwater Sciences 2009). No known angler harvest or stocking data exist for these waters. The Districts undertook this study to provide baseline information for determining potential effects from Project operations. The four objectives of the study were:

(1) characterize fish species composition, relative abundance (e.g., catch per unit effort [CPUE]), and size, length and weight) between Don Pedro Dam and La Grange Dam;

(2) characterize the functional habitat in the reach as either riverine or lacustrine;

(3) characterize fish condition factor of species present; and

(4) collect tissue samples (fin clips) from salmonids.

3.0 STUDY AREA

The study area is the reach of the Tuolumne River between La Grange Dam and Don Pedro Dam located at RM 52.2 and 54.8, respectively (Figure 3.0-1). The approximate length of the study reach is 2.3 mi (La Grange Dam to the Don Pedro powerhouse located approximately 0.3 mi downstream from Don Pedro Dam).

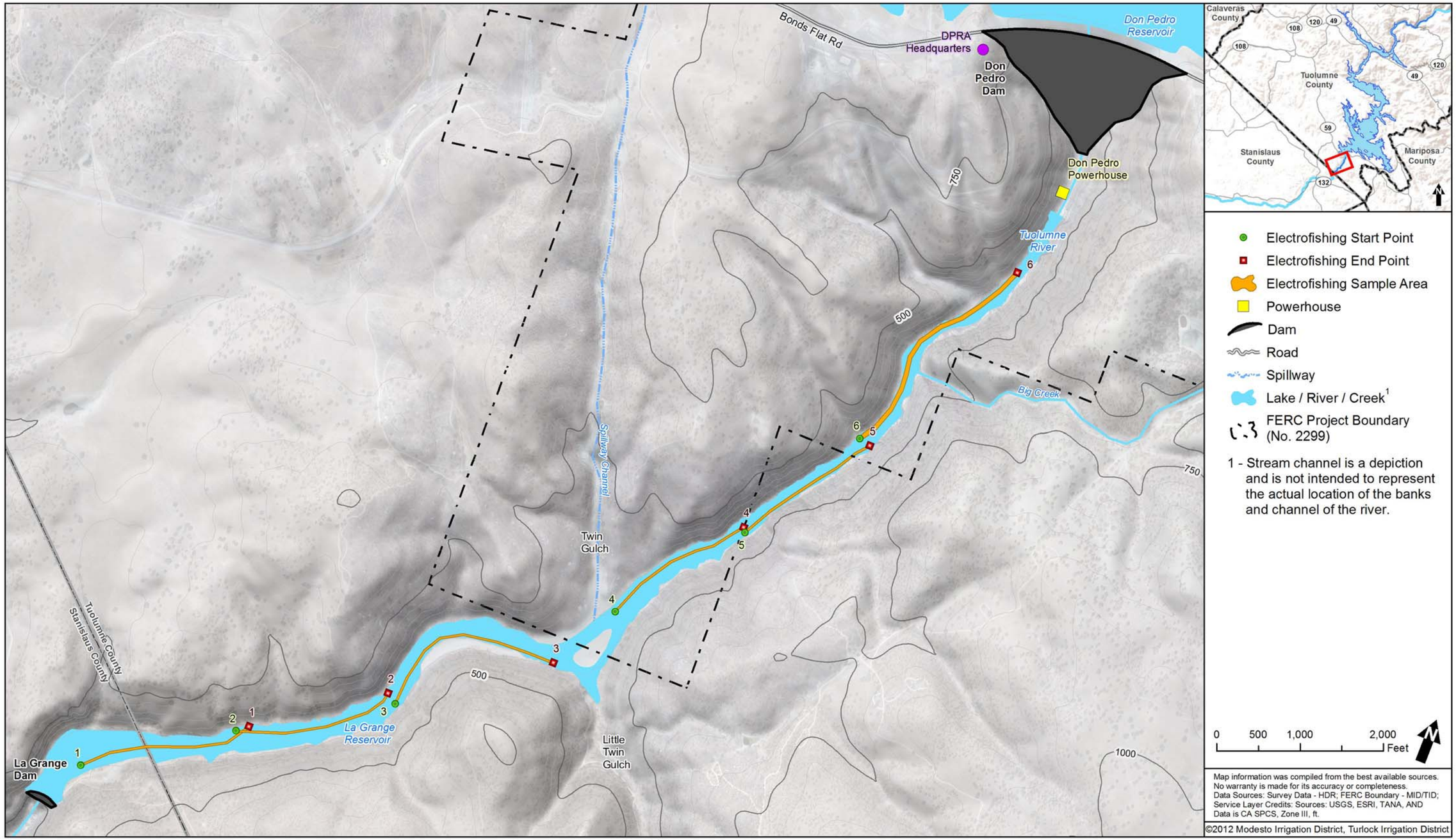

Figure 3.0-1. Study reaches.

4.0 METHODOLOGY

4.1 Field Reconnaissance

To develop an appropriate sampling design, reconnaissance surveys were conducted on February 20 and October 25, 2012 to evaluate the existing habitat, identify the number of potential sampling reaches that would sufficiently represent the study area, and identify those areas where each of the proposed four sampling techniques (i.e., gillnetting, seining, boat electrofishing, and backpack electrofishing) might be most effectively employed. During field reconnaissance, sampling stations were designated on orthophotographs of the study reach and documented using a Global Positioning System (GPS). Sites were determined so that they were spatially separated to prevent any potential influences on catch. The reconnaissance surveys concluded that boat electrofishing would be the most efficient method to sample fish populations within all available habitat types within the study area. Furthermore, the range of depths in the study area was not complimentary to backpack electrofishing and gillnetting was restricted per the fish sampling permit issued by the California Department of Fish and Game (CDFG).

4.2 Fish Sampling and Habitat Approach

Fish sampling sites were selected throughout the study area to represent the diversity of identified near-shore habitats. The approximate locations and boundaries of each sampling site were determined using GPS coordinates which were recorded during the sampling of each site. General information recorded included location, crew member names, a qualitative habitat characterization (e.g., qualitative description, riverine or lacustrine, etc.), weather conditions, and air temperature. Mean water depths and water chemistry at approximate fish sampling location (i.e., water temperature, dissolved oxygen, and conductivity) were also recorded.

Daily water surface elevation information for the sampling period were acquired at two locations; the Don Pedro tailrace (representative of the riverine reach below Don Pedro Dam) and just upstream of La Grange Dam as measured by TID water level equipment. The measurement frequency was every 15 minutes over a 24-hour period.

Boat electrofishing was implemented using standard methods (Reynolds 1996). One or two electrode booms were employed, and the booms and boat were outfitted with standard non-conductive material in appropriate places for safety. Electrofisher "time on" was recorded for each sampling site and a consistent effort and pace was employed while sampling all sites. Electrofishing was conducted in a direction parallel to the shoreline.

At each sampling location, all fish captured were enumerated, identified to species, measured to the nearest mm (total length), and weighed by electronic scale to the nearest gram. All fish captured during sampling were identified, where possible, as to origin; hatchery or wild stock (i.e., basic visual identification, such as a clipped adipose fin). Scale and tissue samples were collected on all salmonids captured. Mortalities were recorded. After biological data collection was completed, all fish were released within or near the sampling site.

Field data was entered into an excel database. The database was organized per the metrics discussed above and subjected to quality assurance/quality control procedures. Data was analyzed graphically and summarized species composition, length frequency distribution, and location. The relative abundance of fish species captured at each site was calculated to identify composition and distribution patterns throughout the study area. Catch-per-unit-effort (CPUE) for each fish species was also calculated per all sampling sites. Fish size and weight was summarized by fish species and site.

Weight and length data were used to calculate condition factors for individual species. These data were used to compute Kn, a relative condition factor, where:

$$Kn = W/W'$$

where W equaled individual fish weight and W' equaled length-specific weight from the weight-length relationship. The individual fish weight can also be determined as a function of length, specifically:

$$W = a(FL)b$$

where a and b are population specific coefficients (Anderson and Gutreuter 1983).

Relative condition factor provides a general indication of the fish condition and health, where a value of Kn greater than or equal to 1.0 indicates fish of average or better condition. The condition factor was calculated by pooling length-weight data for all collected fish of a species.

Age composition and growth information on salmonids within the study area were determined using collected scales as described by DeVries and Fries (1996) which states the relationship between annuli radii and fish length represents the individual's size at annulus formation.

Tissue samples (fin clips) were taken from all salmonids captured during sampling. Preservation methods included air drying of fin clips and individual placement of each fin clip into prescribed envelopes. All envelopes were cross-referenced to the relevant biological information collected for each fish. Tissue samples were provided to CDFG for archiving.

5.0 RESULTS

Field sampling was conducted on October 29 and 30, 2012. All field activity was conducted during daylight hours due to safety concerns. The estimated daily flow within the reach for these two days was approximately 315 cfs. Water surface elevations remained relatively stable during each of the two days of sampling. On October 29 and 30 the mean water level at the Don Pedro tailrace was approximately 296 ft and the mean water level at the La Grange Dam was approximately 294 ft.

Six sites were sampled throughout the study area (see previous Figure 3.0-1) with the start of site 1 occurring at the downstream end of the 2.3 mi reach near La Grange Dam and each subsequent sample site moving upstream toward the Don Pedro tailrace (i.e., site 6 being the furthest upstream sample location). Table 5.0-1 provides general information for each of the sample sites. The average site length for the six sites was approximately 0.30 mi. Five of the sites were approximately a quarter of a mile in length and the furthest upstream site (#6) was approximately 0.40 mi long (Table 5.0-1). Sample width for all sites ranged between 10-20 ft.

Table 5.0-1. Boat electrofishing sites between Don Pedro Dam and La Grange Dam in 2012.

Site No.	Site Length (Miles)	Field Width (feet)	UTM Start	UTM End
1	0.28	10	N37.67326W120.4436	N37.67579W120.43889
2	0.28	10	N37.67556W120.43924	N37.67791W120.43502
3	0.29	10	N37.67771W120.43468	N37.68021W120.43031
4	0.28	10	N37.68203W120.42903	N37.68530W120.42609
5	0.28	20	N37.68518W120.42599	N37.68847W120.42319
6	0.40	20	N37.68855W120.42359	N37.69407W120.42072

For both days of field sampling, the weather was clear with air temperatures ranging from 49-82°F and water temperatures were steady at 54°F (Table 5.0-2). Dissolved oxygen measurements ranged from 7.2 to 8.3 mg/L with the highest values at upstream sampling locations near Don Pedro Dam. Depths at each site ranged from 2 to 20 feet with an average site depth of eight feet (Table 5.0-2). The low specific conductivity measured at all sites (mean of 27.4 µS/cm) required electrofisher settings to be at their maximum safe settings to effectively capture fish. At all sites, electrofishing voltage was set between 25-30% and the frequency was set at 60DC Hz. Boat electrofishing efforts ranged from 1190 seconds to 1562 seconds for the six sites. The average effort per site was 1356 seconds or approximately 22 minutes (Table 5.0-2).

Table 5.0-2. Site conditions during boat electrofishing between Don Pedro Dam and La Grange Dam in 2012.

Site No.	Date of Survey	Weather	Average Depth (feet)	Air Temperature (^{o}F)	Water Temperature (^{o}F)	Specific Conductivity (µS/cm)	Dissolved Oxygen (mg/L)	Shock Time (min)
1	10/29/2012	Clear	6	54	53.8	24.9	7.2	1562
2	10/29/2012	Clear	6	75	54	24.9	7.2	1443
3	10/29/2012	Clear	2	82	54	24.9	7.2	1412
4	10/29/2012	Clear	9	82	54	24.9	7.2	1215
5	10/30/2012	Clear	20	49	54	32.4	8.3	1190
6	10/30/2012	Clear	5	68	54	32.4	8.3	1312

5.1 Fish Assemblage and Population

5.1.1 Species Composition

In total, 133 fish consisting of 86 rainbow trout (*Oncorhynchus mykiss*) and 47 prickly sculpin (*Cottus asper*) were collected during the boat electrofishing sampling effort conducted in the study area (Table 5.1-1). Rainbow trout made up 64.7 percent of the overall catch in the study area and lengths ranged from 85 mm to 344 mm with a mean length of 153.5 mm. Weights of rainbow trout ranged from 5.5 to 469.5g with a mean weight of 67.1g. Prickly sculpin made up 35.3 percent of the overall catch with lengths ranging from 48 mm to 110 mm and a mean length of 80.1 mm. Weights of sculpin ranged from 1.3g to 106.1g with a mean weight of 14.8g (Table 5.1-1).

Table 5.1-1. Summary of relative abundance, length, and weight of all fish species collected at all sites between Don Pedro Dam and La Grange Dam in 2012.

Species	N	%	Length (mm)			Weight (g)		
			Min	Max	Mean	Min	Max	Mean
Rainbow Trout (*O. mykiss*)	86	64.7	85	344	153.5	5.5	469.5	67.1
Prickly sculpin (*C. asper)*	47	35.3	48	110	80.1	1.3	106.1	14.8
Total	133	100						

Rainbow trout and prickly sculpin were captured during sampling at all sites (Table 5.1-2). Highest total catch for rainbow trout and prickly sculpin were at site 1 (34 fish) and site 6 (22 fish), respectively. Rainbow trout catch with greatest mean lengths were from site 2 whereas trout catch with greatest mean weights were from site 4. Prickly sculpin catch with greatest mean lengths and mean weights were from site 1.

Table 5.1-2. Summary of length and weight of all fish species collected at each individual site between Don Pedro Dam and La Grange Dam in 2012.

Site	Rainbow Trout Count	Length (mm)			Weight (g)		
		MIN	MAX	AVE	MIN	MAX	AVE
Site 1	34	93	275	168.8	8.8	250.5	69.0
Site 2	7	98	273	181.1	10.1	264.5	100.4
Site 3	16	87	344	124.3	6.6	469.5	44.0
Site 4	3	162	290	157.8	43.9	263.5	158.5
Site 5	3	87	114	100.7	9.5	18.9	13.4
Site 6	23	85	317	139.9	5.5	359.9	54.0

Site	Prickly Sculpin	Length (mm)			Weight (g)		
		MIN	MAX	AVE	MIN	MAX	AVE
Site 1	5	82	110	91.8	7.6	20	12.3
Site 2	2	84	84	84	8.1	12.1	10.1
Site 3	2	83	95	89	9.7	11.8	10.8
Site 4	4	79	95	86	7.6	12.3	10.3
Site 5	12	52	105	78.8	1.4	13.8	7.0
Site 6	22	48	96	76	1.3	11.8	6.4

5.1.2 Length-Frequency Distributions

Fish length data were used to develop length-frequency distributions for the two fish species collected (Figures 5.1-1 and 5.1-2). The rainbow trout length-frequency data (10 mm size categories) indicate four age classes may be present in the study area. These age classes included young-of-year (YOY) at age 0 and year 1, year 2 and year 3 classes and was also confirmed through age analysis using collected scales (section 5.1.4 below). The sculpin length-frequency data (5 mm size categories) indicate that three age classes for this species may exist in the study area. Presumably, these three age classes would consist of YOY, age 1, and age 2, however, no age analysis from scales was conducted for this species.

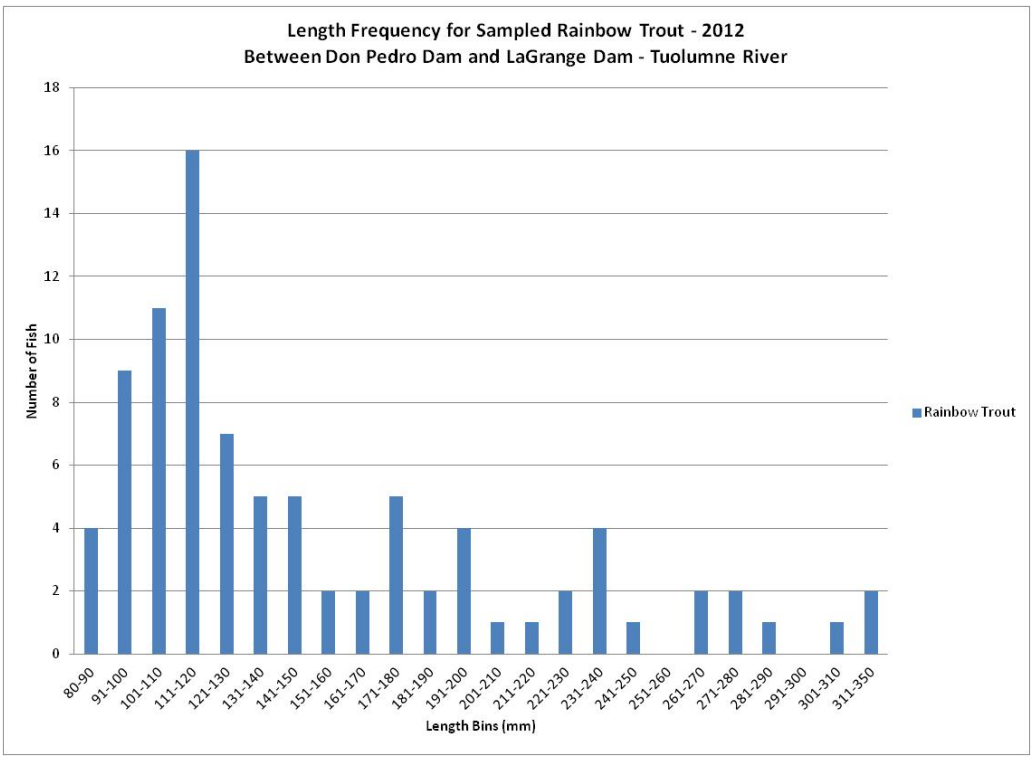

Figure 5.1-1. Rainbow trout length-frequency distributions for the Tuolumne River between Don Pedro and La Grange dams.

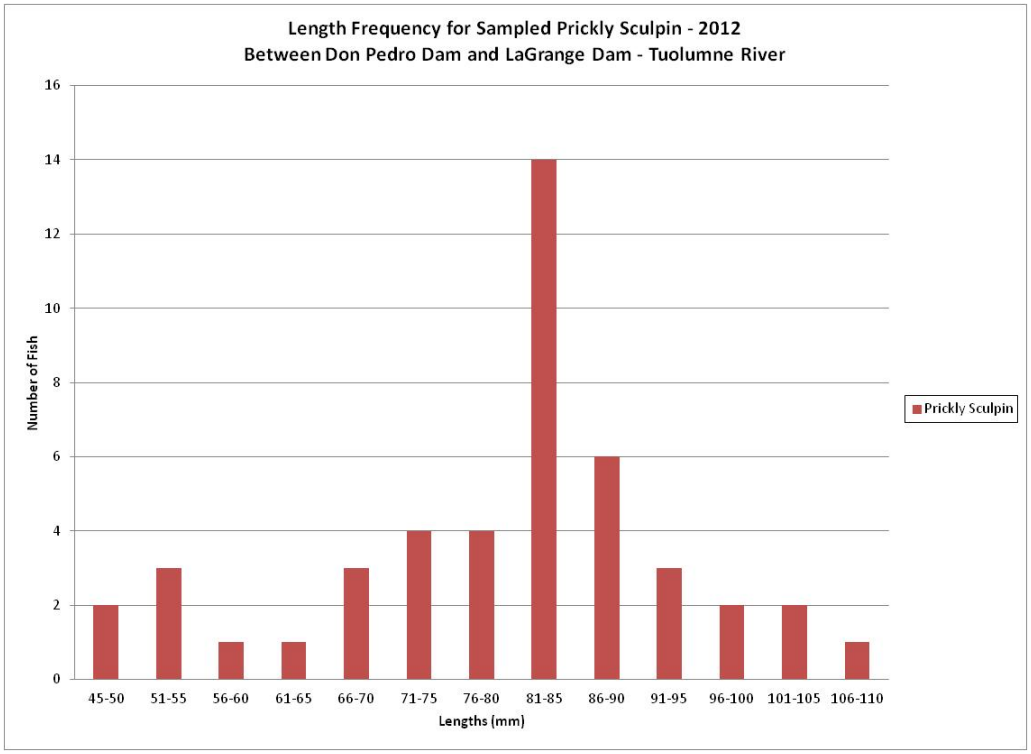

Figure 5.1-2. Prickly sculpin length-frequency distributions for the Tuolumne River between Don Pedro and La Grange dams.

5.1.3 Relative Abundance and CPUE

Relative abundance for the two fish species captured at each site was calculated using the number of fish of a species divided by the overall fish captured per site (Table 5.1-3). Relative abundance ranged from 0.20 to 0.89 for rainbow trout and 0.13 to 0.80 for prickly sculpin over the study area. Results indicate that rainbow trout are proportionally more abundant in the lower reaches of the study area (sites 1-3). Sculpin had higher relative abundance values in sites 4-5. In site 6, both species made up a near equal proportion of the catch. Overall, rainbow trout were more abundant in the catch by an approximate 2:1 ratio.

Table 5.1-3. Summary of relative abundance for all fish species collected between Don Pedro Dam and La Grange Dam in 2012.

Site	RBT #	PRS #	RA-trout	RA-sculpin
Site 1	34	5	0.87	0.13
Site 2	7	2	0.78	0.22
Site 3	16	2	0.89	0.11
Site 4	3	4	0.43	0.57
Site 5	3	12	0.20	0.80
Site 6	23	22	0.51	0.49
Total	**86**	**47**	**0.65**	**0.35**

CPUE for boat electrofishing is summarized below in Table 5.1-4 for each species, by sample site, and over the entire study area. CPUE is defined as the numbers of fish of a species captured divided by the time it took to sample them. CPUE for rainbow trout ranged from 0.15 to 1.31 fish per hour with CPUE highest and lowest and sites 1 and 5, respectively. CPUE for prickly sculpin ranged from 0.08 to 1.01 fish per hour with CPUE highest at site 6 and lowest at sites 2 and 3. Mean CPUE for boat electrofishing for rainbow trout and prickly scuplin overall all sites were 0.61 and 0.36, respectively.

Table 5.1-4. Summary of CPUE for all fish species collected between Don Pedro Dam and La Grange Dam in 2012.

Site	RBT CPUE (fish/hour)	PKS CPUE (fish/hour)
1	1.31	0.19
2	0.29	0.08
3	0.68	0.08
4	0.15	0.20
5	0.15	0.61
6	1.05	1.01
Mean CPUE/species	**0.61**	**0.36**

5.1.4 Age Composition and Growth

Age composition and growth analyses were done on a total of sixty-four rainbow trout scale samples that were collected from the six sites. The final number of scales analyzed was consistent with the approved study plan which stated that up to 10 fish for each 25 mm size group of salmonids would be sampled. The 3 smallest size groups included more than 10 samples each, totaling an extra 24 scales which were not analyzed. Several scale sample slides were not readable after mounting. Results indicated that multiple year classes (from YOY to

Age 3) exist within the reach and the majority of rainbow trout found in the reach are Age 1 fish. Information relating to lengths for the various age classes is presented in Table 5.1-5. The raw data is presented in Attachment A.

Table 5.1-5. Summary age composition for rainbow trout age groups collected between Don Pedro Dam and La Grange Dam in 2012.

	Rainbow Trout Age Groups			
	YOY	**1**	**2**	**3**
Number Captured	9	38	11	3
Minimum Length (mm)	85	99	225	310
Maximum Length (mm)	104	231	290	344
Average Length (mm)	93	153	252	324

Growth analyses, based on the average growth rates for each of the four age classes, indicated the rainbow trout population in this reach put on the greatest average length increase during the YOY stage. This annual mean growth rate was 93 mm for the nine YOY fish scales processed. Age 1 (38 individuals) and Age 3 (3 individuals) fish put on the next highest annual mean growth rate of 73 mm/year. Age 2 fish (11 individuals) had the lowest average annual growth rate at 69 mm. Table 5.1-6 presents the maximum, minimum, and mean growth rates for each rainbow trout age class.

Table 5.1-6. Summary age composition for rainbow trout age groups collected between Don Pedro Dam and La Grange Dam in 2012.

Growth by Year (mm)				
	YOY	**Age 1**	**Age 2**	**Age 3**
Minimum Growth (mm)	85	48	54	69
Maximum Growth (mm)	104	107	85	80
Average Growth (mm)	93	73	69	73

5.2 Functional Habitat of the Reach

Two types of habitat were identified in the study area: riverine and lacustrine. Riverine sites (#4, #5, and #6) were located at the upstream section of the reach above Twin Gulch. Observable currents, large substrate dominated by boulders and a lack of rooted macrophyte beds were common at these three sites. Very little habitat complexity was noted as bedrock cliffs were the dominant habitat types with sparse overhead vegetation at some limited shoreline locations. Large shallow areas dominated by boulders were common at site #6. The riverine habitat appears to extend downstream to below the Twin Gulch area. Below this location, the study reach becomes more lacustrine in nature due to influences of La Grange Dam. Figure 5.1-3 shows the typical habitat below the Don Pedro powerhouse.

Sites #1-3 were farther downstream of the Don Pedro Project and were identified as lacustrine by field crews. Observations at these three sites found a lack of observable currents. Smaller substrate including cobbles and gravels were more common along with numerous boulders and the frequency of rooted macrophyte beds increased (mainly at site #1). Habitat complexity was again simple with bedrock cliffs and very limited observed overhead cover dominating the landscape. Figure 5.1-4 shows the typical habitat upstream of La Grange Dam.

Figure 5.1-3. Typical habitat (near site 6) below the Don Pedro tailrace area in the Tuolumne River.

Figure 5.1-4. Typical habitat (near site 1) above the La Grange dam area in the Tuolumne River.

5.3 Fish Condition Factor for Species Collected

Relative condition (Kn) was calculated for all fish captured. For rainbow trout, Kn ranged from 0.60 to 1.29. For the rainbow trout "population" in the study reach, mean Kn was 0.99 which indicates that the fish condition and health of this population is average.

For prickly sculpin caught during the study, Kn ranged from 0.71 to 1.44. For the prickly sculpin "population" in the study reach, mean Kn was 0.99 which indicates that the fish condition and health of this population is average.

5.4 Tissue Sample Collection

During the study, tissue samples (fin clips) were taken from eighty-six rainbow trout, preserved and forwarded along with scale samples to CDFG for archiving.

6.0 DISCUSSION AND FINDINGS

The study results indicate this reach of the Tuolumne River is limited to two fish species; rainbow trout and prickly sculpin with both species having distributions that span the entire reach. The current trout population exhibits multiple age classes (4) likely indicating that some successful natural reproduction is ocurring in the reach. No known stocking has occurred in this reach. Highest rainbow trout abundance was observed at sites 1 and 6 which were characterized as lacustrine and riverine reaches, respectively, suggesting that rainbow trout are able to effectively occupy the range of available habitat within the study area. Condition factors for the rainbow trout captured in this reach ranged from poor to above average. Overall, the fish condition and health of the species in the study area is average (Kn=0.99).

Data suggests that the prickly sculpin population also exhibits multiple age classes (potentially 3). The presence of YOY fish indicates that successful natural reproduction may be ocurring in the study area. Highest scuplin abundance were observed in sample sites that were characterized as riverine (i.e., upstream sampling sites). Relative condition for prickly sculpin in this reach ranged from poor to above average. Similar to rainbow trout, the overall fish condition and health of prickly sculpin in the study area is average (Kn=0.99).

7.0 STUDY VARIANCES

Two variances from the final study plan are described below.

The final study plan indicated four sampling methods would be employed including boat and backpack electrofishing, seining, and gill nets to collect fish. The study team did not use all proposed methods due to permit limitations (on use of gill nets) and reconnaissance results which indicated that boat electrofishing would be an effective sampling method for all available habitat types within the study reach.

The final study plan states that upon habitat documentation as part of the field reconnaissance surveys, the Districts would notify relicensing participants of the area and extent to which each method would be utilized. Notification of relicensing participants did not occur as it was determined that only one method, boat electrofishing, would be an effective method over the entire study reach.

8.0 REFERENCES

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STUDY REPORT W&AR-13
FISH ASSEMBLAGE AND POPULATION

ATTACHMENT A

SCALE SAMPLE COLLECTION, AGE, AND GROWTH DATA

Table 1. Growth rate analysis for rainbow trout collected in La Grange Reservoir, 2012.

ID #	Fish length (mm) at capture (TL)	Number of annuli (filename)			Age	Radius of scale (in pixels)	Distance: Nucleus to annuli (in pixels)				Radius of scale (mm)	Distance: Nucleus to annuli (in mm)			Calculated length of fish at annuli (in mm)			Growth by year (in mm)		
		Scale sample 1	Scale sample 2	Scale sample 3			1	2	3	4		1	2	3	1	2	3	1	2	3
78	85	0 (s78sc9)	0 (s78sc8)	0 (s78sc6)	YOY	251					0.301									
47	87	0 (s47sc1)	0 (s47sc14)	0 (s47sc15)	YOY	320					0.384									
61	87	0 (s61sc2)	0 (s61sc6)	0 (s61sc9)	YOY	338					0.405									
83	90	0 (s83sc5-7)	0 (s83sc5-7)	0 (s83sc2)	YOY	388					0.465									
86	92	0 (s86sc2)	0 (s86sc3)	0 (s86sc10)	YOY	310					0.372									
52	95	0 (s52sc_mid_btm)	0 (s52sc8)	0 (s52sc7)	YOY	352					0.422									
85	97	0 (s85sc_btm_lft)	0 (s85sc1)	0 (s85sc4)	YOY	450					0.539									
79	99	1 (s79sc2)	1 (s79sc9)	1 (s79sc11)	1	406	343				0.487	0.4			89			53		
82	99	1 (s82sc15)	1 (s80sc7)	1 (s82sc4)	1	455	380				0.545	0.5			89			52		
48	99	0 (s48sc3)	0 (s48sc_mid_lft)	0 (s48sc_mid)	YOY	385					0.462									
81	104	0 (s81sc2)	0 (s81sc5)	0 (s81sc_btm_rt)	YOY	391					0.469									
84	106	1 (s84sc11)	1 (s84sc7)	1 (s84sc5)	1	365	292				0.438	0.4			92			55		
76	109	1(s76sc10)	1 (s76sc13)	1 (s76sc15)	1	384	318				0.460	0.4			97			60		
63	114	1 (s63sc14)	1 (s63sc3)	1 (s63sc1)	1	563	410				0.675	0.5			93			56		
70	115	1 (s70sc11)	1 (s70sc8)	1 (s70sc5)	1	425	329				0.509	0.4			97			61		
80	116	1 (s80sc18)	1 (s80sc16)	1 (s80sc8)	1	449	304				0.538	0.4			90			54		
69	117	1 (s69sc17)	1 (s69sc5)	1 (s69sc19)	1	420	333				0.503	0.4			100			64		
72	117	1 (s72sc4)	1 (s72sc13)	1 (s72sc16)	1	462	330				0.554	0.4			94			57		
75	117	1 (s75sc3)	1 (s75sc9)	1 (s75sc10)	1	360	274				0.432	0.3			98			61		
73	123	1 (s73sc2)	1 (s73sc_btm)	1 (s73sc7)	1	444	366				0.532	0.4			108			71		
33	128	1 (s33sc_mid)	1 (s33sc_btm_lft)	1 (s33sc1)	1	450	236				0.539	0.3			85			48		
9	129	1 (s9sc18)	1 (s9sc7)	1 (s9sc2)	1	536	372				0.643	0.4			101			64		
41	130	1 (s41sc3)	1 (s41sc9)	1 (s41sc_btm_Rt)	1	509	327				0.610	0.4			97			60		
77	130	1 (s77sc3)	1 (s77sc1)	1 (s77sc4)	1	512	405				0.614	0.5			110			74		
38	132	1 (s38sc9)	1 (s38sc4)	1 (s38sc3)	1	460	293				0.551	0.4			97			61		
32	135	1 (s32sc2)	1 (s32sc16)	1 (s32sc_mid_btm)	1	592	343				0.710	0.4			94			57		
16	144	1 (s16sc6)	1 (s16sc1)	1 (s16sc3)	1	486	294				0.583	0.4			102			65		
39	144	1 (s39sc3)	1 (s39sc1)	1 (s39sclft)	1	495	350				0.593	0.4			113			76		
29	146	1 (s29sc_Rt)	1 (s29sc_last)	1 (s29sc1)	1	445	262				0.533	0.3			101			64		
68	149	1 (s68sc10)	1 (s68sc13)	1 (s68sc6)	1	544	294				0.652	0.4			97			61		
74	149	1 (s74sc1)	1 (s74sc2)	1 (s74sc10)	1	591	422				0.708	0.5			117			80		
71	154	1 (s71sc1)	1 (s71sc2)	na	1	868	564				1.041	0.7			113			76		
17	158	1 (s17sc6)	1 (s17sc7_flipped)	1 (s17sc6)	1	635	334				0.761	0.4			100			64		
58	162	1 (s58sc16)	1 (58sc12)	1 (s58sc2)	1	578	375				0.693	0.4			118			81		
11	170	1 (s11sc_mid)	1 (s11sc3)	1 (s11sc8)	1	638	313				0.765	0.4			102			65		
34	171	1 (s34sc3)	1 (s34sc5)	1 (s34sc9)	1	797	428				0.955	0.5			109			72		
7	172	1 (s7sc_btm_Rt)	1 (s7sc_btm_Lft)	1 (s7sc10)	1	647	353				0.776	0.4			110			74		
15	177	1 (s15sc8)	1 (s15sc2)	1 (s15sc1)	1	659	355				0.790	0.4			112			76		

Table 1. Growth rate analysis for rainbow trout collected in La Grange Reservoir, 2012.

ID #	Fish length (mm) at capture (TL)	Number of annuli (filename)			Age	Radius of scale (in pixels)	Distance: Nucleus to annuli (in pixels)				Radius of scale (mm)	Distance: Nucleus to annuli (in mm)			Calculated length of fish at annuli (in mm)			Growth by year (in mm)		
		Scale sample 1	Scale sample 2	Scale sample 3			1	2	3	4		1	2	3	1	2	3	1	2	3
3	180	1 (s3sc2)	1 (s3sc3)	na	1	755	402				0.905	0.5			113			76		
13	184	1 (s13sc5)	1 (s13sc4)	na	1	520	277				0.623	0.3			115			78		
14	187	1 (s14sc9)	1 (s14sc10)	1 (s14sc2)	1	604	301				0.724	0.4			112			75		
66	192	1 (s66sc5)	1 (s66sc10)	1 (s66sc1)	1	855	411				1.025	0.5			111			75		
24	198	1 (s24sc3)	1 (s24sc4)	1 (s24sc7)	1	623	323				0.747	0.4			120			84		
19	199	1 (s19sc2)	1 (s19sc1)	1 (s19sc3)	1	630	323				0.755	0.4			120			83		
1	205	1 (s1sc3)	1 (s1sc5)	1 (s1sc7_flipped)	1	757	431				0.907	0.5			133			96		
25	213	1 (s25sc16)	1 (s25sc11)	1 (s25sc5)	1	785	404				0.941	0.5			127			91		
6	225	2 (s6sc9_flipped)	2 (s6sc11)	na	2	902	340	632			1.081	0.4	0.8		108	169		71	61	
35	226	2 (s35Rsc5)	2 (sc35R11)	2 (s35Rsc4)	2	970	352	627			1.163	0.4	0.8		105	159		69	54	
67	231	1 (s67sc1)	1 (s67sc4)	1 (s67sc7)	1	780	407				0.935	0.5			138			101		
23	231	2 (s23Rsc1)	2 (s23Rsc2)	s23Rsc4)	2	864	358	653			1.036	0.4	0.8		117	184		81	66	
59	236	2 (s59sc4)	2 (s59sc7)	2 (s59sc10)	2	874	311	595			1.048	0.4	0.7		108	172		71	65	
2	240	2 (s2sc6)	2 (s2sc4)	na	2	1022	350	650			1.225	0.4	0.8		106	166		70	60	
18	244	2 (s18sc1)	2 (s18sc3)	2 (s18sc5)	2	970	438	767			1.163	0.5	0.9		130	201		94	70	
21	265	2 (s21sc3)	2 (s21sc4)	na	2	1348	480	933			1.616	0.6	1.1		118	195		81	77	
37	265	2 (s37Rsc1)	2 (s37Rsc2)	2 (s37sc3)	2	1109	472	844			1.329	0.6	1.0		134	210		97	77	
36	273	2 (s36Rsc1)	2 (s36Rsc2)	2 (s36Rsc4)	2	1155	394	763			1.385	0.5	0.9		117	193		81	76	
22	275	2 (s22Rsc6)	2 (s22Rsc7)	2 (s22Rsc8)	2	1070	418	800			1.283	0.5	1.0		130	215		93	85	
60	290	2 (s60Rsc6)	2 (s60Rsc4)	2 (s60Rsc8)	2	1111	470	769			1.332	0.6	0.9		144	212		107	68	
65	310	3 (s65sc7)	3 (s65sc1)	na	3	1295	463	779	1112		1.552	0.6	0.9	1.3	134	201	271	98	67	70
64	317	3 (s64sc4_flipped)	3 (s36sc5)	3 (s64sc2)	3	1421	376	767	1118		1.703	0.5	0.9	1.3	111	188	257	74	77	69
42	344	3 (s42sc10)	3 (s42sc3_flipped)	3 (s42sc5_flipped)	3	1486	364	674	1061		1.781	0.4	0.8	1.3	112	176	256	75	64	80