TECHNICAL MEMORANDUM 3-8

Stream Fish Populations Upstream of Englebright Reservoir

Yuba River Development Project
FERC Project No. 2246

November 2013

TECHNICAL MEMORANDUM 3-8

EXECUTIVE SUMMARY

In 2012 and 2013, the Yuba County Water Agency (YCWA) conducted fish population assessments in stream reaches upstream of the United States Army Corps of Engineers' (USACE's) Englebright Reservoir that are potentially affected by YCWA's Yuba River Hydroelectric Project (Project).

Fish population assessments were focused on two goals. The first goal was to document rainbow trout (*Oncorhynchus mykiss*) fry emergence through fisheries sampling and back-calculation from water temperature data. The second goal was to document the population characteristics of resident fish. Population sampling, via quantitative electrofishing and snorkeling, was used to develop statistical metrics of fish populations, including detailed information on the density, biomass, relative composition, spatial distribution, population size and age-class structure, and fish condition. Additionally, qualitative electrofishing was conducted in the stream margins of quantitatively snorkeled sites to support the development of a condition factor for species by basin.

The fry emergence assessment was conducted from March through June 2012. During this period, water temperature was monitored. Snorkeling or electrofishing was conducted to collect data on emergent rainbow trout fry in Oregon Creek upstream of Log Cabin Diversion Dam and in the Middle Yuba River upstream of Our House Diversion Dam. A total of 146 fry was observed in the Middle Yuba River and 434 fry was observed in Oregon Creek. Fish exceeding 2 inches in length could not unequivocally be considered emergent fish and thus were excluded from emergent trout analyses. The first emergent rainbow trout in the Middle Yuba River and Oregon Creek were observed in May and June 2012, respectively. Back-calculations using Daily Temperature Units[1] indicated that the fish had spawned between April 12 and May 19, 2012 on the Middle Yuba River and between May 6 and May 19, 2012 on Oregon Creek. Emergence was calculated to have occurred between May 30 and June 20, 2012 on the Middle Yuba River and between June 11 and June 20, 2012 on Oregon Creek.

Fish population sampling was conducted at 11 sites. Study sites were located in four sub-basins that included Oregon Creek, Middle Yuba River, North Yuba River, and Yuba River. Sampling occurred from September through November 2012, and in September 2013. In 2012, a total of 426 fish was collected by quantitative electrofishing and a total of 656 fish was observed during quantitative snorkeling based on mean pass-abundance for three-pass snorkel surveys, representing seven species. In 2013, a total of 303 fish was collected by quantitative electrofishing and a total of 499 fish was observed during quantitative snorkeling based on mean pass-abundance for three-pass snorkel surveys, also representing seven species. Shoreline qualitative electrofishing to accompany quantitative snorkel surveys included collection of 75 fish of three species in 2012, and 64 fish of four species in 2013. One additional fish species was

[1] Each degree Fahrenheit over 32 degrees of the daily average water temperature is equal to 1 Daily Temperature Unit.

observed incidentally in 2012 during field work related to YCWA's relicensing Study 3.12, *New Colgate Powerhouse Ramping*.

No fish species listed as threatened or endangered under the federal Endangered Species Act or the California Endangered Species Act, or otherwise considered special-status, was found.

Overall, species composition was dominated by rainbow trout for both electrofished and snorkeled sites. Rainbow trout was found at every sample site (though not always in both years) and ranged from 16 to 2,267 fish per mile (fish/mi) in density, when present and 1 to 24 pounds per acre (lbs/acre), both samples from Oregon Creek. The only other salmonids found was brown trout (*Salmo trutta*), documented in 2012 in the Yuba River below New Colgate Powerhouse (i.e., 8 fish/mi) and Middle Yuba River above Our House Diversion Dam (incidental catch during YCWA relicensing Study 3-11, *Entrainment*), and an incidental observation of a kokanee (*Oncorhynchus nerka;* no density estimate) below New Colgate Powerhouse. Smallmouth bass (*Micropterus dolomieu*) was found throughout the sampled stream reaches, but was absent at the furthest upstream sites on the North Yuba River, Oregon Creek, and Middle Yuba River. Smallmouth bass had the second greatest abundance with densities at two sites in the Middle Yuba River exceeding 2,297 fish/mi recorded in 2012. Sacramento sucker (*Catostomus occidentalis*) was also common in catches and found in all sub-basins. The North Yuba River had the highest Sacramento sucker density of 3,203 fish/mi in 2012. Sacramento pikeminnow (*Ptychocheilus grandis*) was found in low abundance (13–131 fish/mi), but were collected in each sub-basin. In the North Yuba Site, a single speckled dace (*Rhinichthys osculus*) was captured.

All of the species collected in 2012 and 2013 are generally common to Sierra Nevada streams at similar elevations. Little historical information was available for Oregon Creek, the North Yuba River, and the mainstem Yuba River above Englebright Dam, but the species composition is typical of the general study area (Gast et al. 2005). Data from recent sampling on the Middle Yuba River showed that all historically documented species were accounted for in the area, but not present at every site (Gast et al. 2005; NID and PG&E 2010).

Sampling also occurred above and below YCWA facilities. In Oregon Creek, the density of rainbow trout was 2,267 fish/mi below Log Cabin Diversion Dam and 72 fish/mi above it in 2012. Sampling above Our House Diversion Dam on the Middle Yuba River resulted in documentation of rainbow trout at a density of 409 fish/mi (in 2012), while sites were variable below the dam (155 to 613 fish/mi in 2012). On the Yuba River, sampling at two sites above New Colgate Powerhouse, which is not a diversion or passage barrier, resulted in documentation of rainbow trout at a density of 108 to 488 fish/mi above the powerhouse and, 323 fish/mi below the powerhouse (Data from 2012). The relative proportion of fish density was similar at most sites in 2013.

Only a single historical fish density sampling site (i.e., multi-pass snorkeling) allowed for direct comparison with historical conditions of fish populations. On the Middle Yuba River in 2008 and 2009 (NID and PG&E 2010), sampling efforts documented similar results as the current effort. The nearest 2008–2009 sampling location to 2012-2013 sites occurred at RM 13.6 where rainbow trout (273–375 fish/mi), Sacramento pikeminnow (0–68 fish/mi), and Sacramento

sucker (318–1,885 fish/mi) were documented. In 2012, sampling occurred at RM 13.3 where rainbow trout density was estimated at 409 fish mi, Sacramento pikeminnow density at 131 fish/mi, and Sacramento sucker density at 917 fish/mi. Comparison of historical fish densities and species assemblies are discussed in this report. Additional direct comparisons were not possible as historic sites did not overlap spatially nor did sampling efforts follow similar methodology. Regardless, other downstream sites sampled in 2012 on the Middle Yuba River also had similar density and species composition. Historical density estimates were not found for other stream basins.

Fish handled in 2012 and 2013 during electrofishing efforts were in good condition. The majority had robust bodies, were free of visible disease, parasites, and lesions, showed reasonable growth rates for the region, and exhibited normal behavioral patterns. Multiple age-classes of fish were collected at many population sample sites, indicating regular recruitment of juvenile fish to these populations, though not all sites appeared to be producing age-0 fish.

In the fall of 2012 YCWA conducted fishing efforts to collect and implant rainbow trout with passive internal transmitters (pit tags). Fish were collected in the Middle Yuba River upstream of Our House Dam and Oregon Creek upstream of Log Cabin Dam for YCWA's relicensing Study 3.11, *Entrainment*. In the Middle Yuba River, 160 rainbow trout and 1 brown trout were implanted with pit tags. 379 rainbow trout were implanted with pit tags in Oregon Creek. All rainbow trout collected in 2013 were scanned for pit tags but none were detected.

This study was conducted according to the Federal Energy Regulatory Commission (FERC)-Approved Study 3.8, *Stream Fish Populations Upstream of Englebright Reservoir,* with one variance. The FERC-approved study plan included 11 sampling locations. During the site selection process, YCWA and Relicensing Participants agreed to not sample the North Yuba River immediately downstream of New Bullards Bar Reservoir because this site had only minimal access to open water and was primarily composed of interstitial flow through a car-sized boulder field. The site was collaboratively replaced by an additional site on the Middle Yuba River, below Yellow Jacket Creek.

The study is complete.

Page Left Blank

Table of Contents

Table of Contents (continued)

List of Figures

List of Figures (continued)

List of Figures (continued)

List of Tables

List of Tables (continued)

List of Tables (continued)

List of Attachments

Page Left Blank

TECHNICAL MEMORANDUM 3-8

STREAM FISH POPULATIONS UPSTREAM OF ENGLEBRIGHT RESERVOIR[2]

The Yuba County Water Agency's (YCWA) continued operation and maintenance (O&M) of the Yuba River Development Project (Project), Federal Energy Regulatory Commission (FERC) Project No. 2246, has the potential to affect fish in streams upstream of the normal maximum water surface elevation (NMWSE) of the United States Army Corps of Engineers' (USACE's) Englebright Reservoir.[3]

1.0 Goals and Objectives

The goal of the study was twofold: first, to provide information on rainbow trout (*Oncorhynchus mykiss*) fry emergence timing; and second, to provide information on fish populations in Project-affected streams.

To meet the goals of the study, site specific information was gathered in the following areas of interest: 1) salmonid fry emergence timing; 2) characterization of stream fish communities; 3) species composition and relative spatial distribution; 4) total or relative abundance of fish by species; 5) analysis of fish population size-structure and age-class structure; and 6) physical condition factor of stream fishes.

2.0 Methods

The methodology of this study included work in four categories, each of which is described in detail below.

[2] This technical memorandum presents the results for Study 3.8, *Stream Fish Upstream of Englebright Reservoir*, which was included in Yuba County Water Agency's August 17, 2011 Revised Study Plan for Relicensing of the Yuba River Development Project, and approved by the Federal Energy Regulatory Commission (FERC) in its September 30, 2011 Study Plan Determination and subsequently modified by FERC's September 30, 2011 Resolution of Study Disputes Determination. There were no modifications to Study 3.8 subsequent to FERC's December 30, 2011 Determination. YCWA and Relicensing Participants collaboratively agreed upon additional changes captured in a letter filed with FERC on September 20, 2013.

[3] Englebright Reservoir is formed by Englebright Dam. The dam is about 260 feet high, was constructed by the California Debris Commission in 1941, and is owned by the United States, and the dam and reservoir is not included as a Project facility in FERC's license for the Yuba River Development Project. When the California Debris Commission was decommissioned in 1986, administration of Englebright Dam and Reservoir was passed to the United States Army Corps of Engineers. The primary purpose of the dam is to trap and contain sediment derived from extensive historic hydraulic mining operations in the Yuba River watershed. Englebright Reservoir is about 9 miles long with a surface area of 815 acres. When the dam was first constructed in 1941, it had a gross storage capacity of 70,000 ac-ft; however, due to sediment capture, the gross storage capacity today is approximately 50,000 ac-ft (USGS 2003).

2.1 Study Area

The study area included four sub-areas: 1) Oregon Creek from 1 mile upstream of the Log Cabin Diversion Dam impoundment to the confluence with the Middle Yuba River; 2) the Middle Yuba River from 1 mile upstream of Our House Diversion Dam impoundment to the confluence with the North Yuba River; 3) the North Yuba River from New Bullards Bar Dam to the confluence with the Middle Yuba River; and 4) the portion of the Yuba River from the confluence of the North Yuba and Middle Yuba rivers to the confluence with the NMWSE of the Englebright Reservoir. Table 2.1-1 indicates the upstream and downstream extents of Project-affected reaches by sub-basin, upstream of Englebright Reservoir. Figures 2.1-1 and 2.1-2 provide an aerial overview of the study area and position of sampling sites.

Table 2.1-1. Stream reaches affected by the Project by sub-basin.

Reach Name	Upstream Terminus	Downstream Terminus	Length (mi)	Gradient (%)
NORTH YUBA RIVER				
New Bullards Bar Dam Reach	Base of New Bullards Bar Dam (RM 2.4, El. 1,320 ft)	North Yuba River Confluence with Middle Yuba River (RM 0.0, El. 1,124 ft)	2.4	2.2
OREGON CREEK, A TRIBUTARY TO THE MIDDLE YUBA RIVER				
Log Cabin Diversion Dam Reach	Base of Log Cabin Diversion Dam (RM 4.3, El. 1,965 ft)	Oregon Creek Confluence with Middle Yuba River (RM 0.0, El. 1,442 ft)	4.3	2.5
MIDDLE YUBA RIVER				
Our House Diversion Dam Reach	Base of Our House Diversion Dam (RM 12.6, El. 1,970 ft)	Middle Yuba River Confluence with Oregon Creek (RM 4.7, El. 1,442 ft)	7.9	1.4
Oregon Creek Reach	Middle Yuba River Confluence with Oregon Creek (RM 4.7, El. 1,442 ft)	Middle Yuba River Confluence with North Yuba River (RM 0.0, El. 1,124 ft)	4.7	1.3
YUBA RIVER				
Middle/North Yuba River Reach	Confluence of North and Middle Yuba rivers (RM 40.0, El. 1,124 ft)	New Colgate Powerhouse (RM 34.2, El. 543 ft)	5.8	1.9
New Colgate Powerhouse Reach	New Colgate Powerhouse (RM 34.2, El. 543 ft)	USACE's Englebright Reservoir Normal Maximum (RM 32.7, El. 542 ft)	1.7	0.1

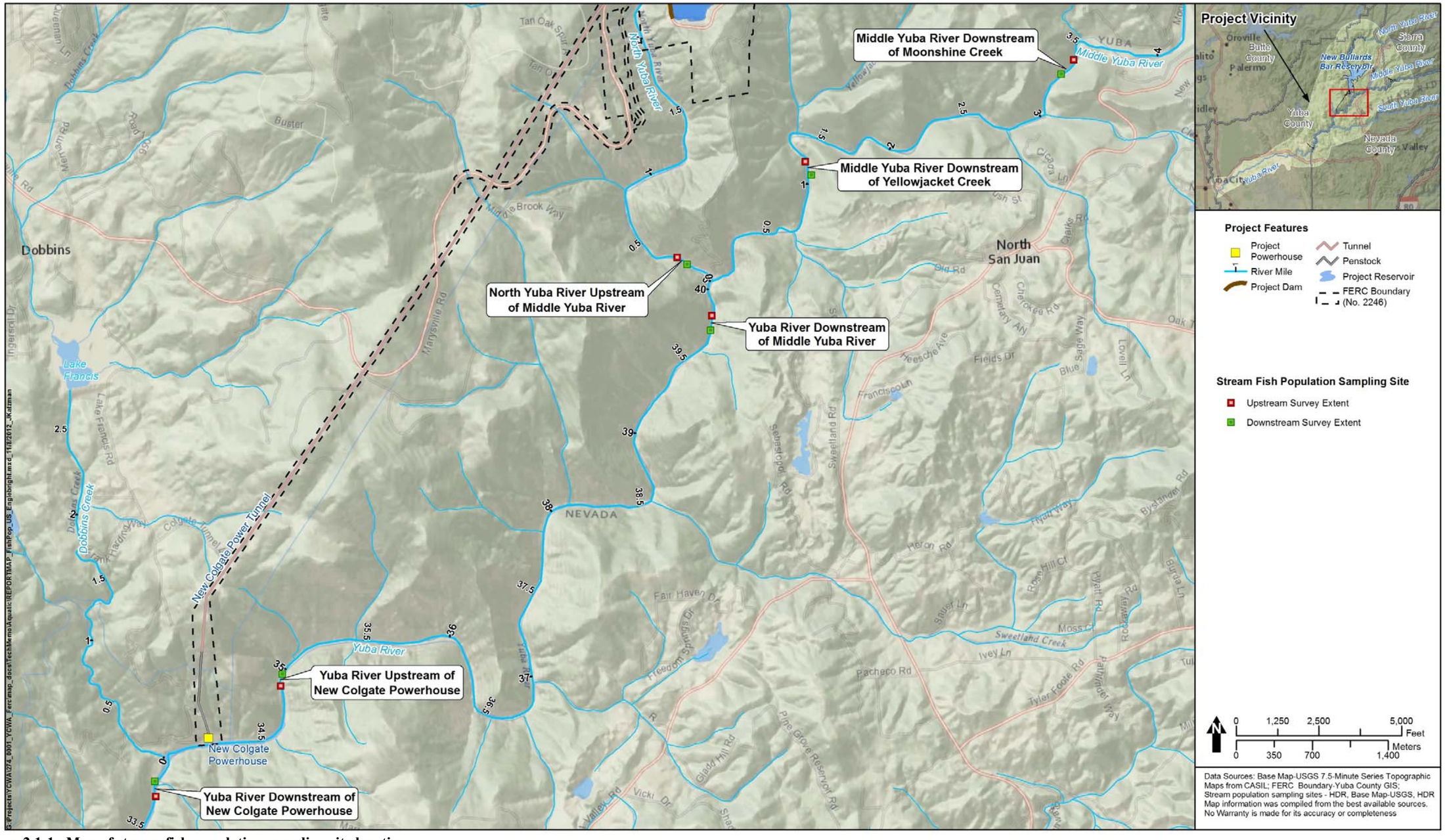

Figure 2.1-1. Map of stream fish population sampling site locations.

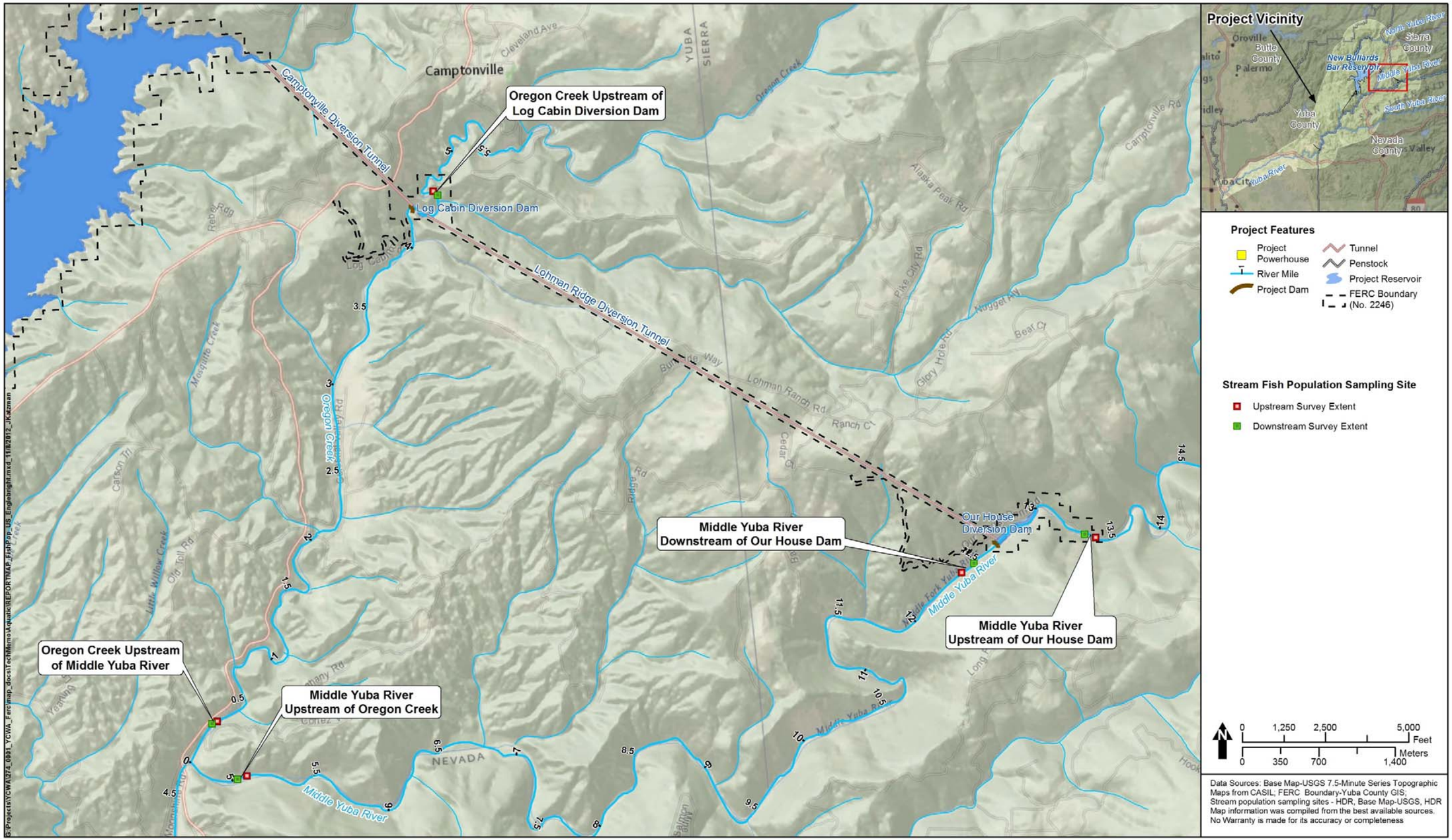

Figure 2.1-2. Map of stream fish population sampling site locations on the Yuba River.

2.2 Data Collection

2.2.1 Sampling Sites

Two sampling efforts were conducted in subsequent years. The first effort was the fry emergence that occurred in 2012 within 1mile upstream of Our House Diversion Dam on the Middle Yuba River and within 1 mile upstream of Log Cabin Diversion Dam on Oregon Creek. This emergence sampling did not occur at one specific site but was generally distributed over the 1 mile area. The second effort was the stream fish population sampling that occurred at 11 sites, described in Table 2.2-1 and delineated in Figures 2.2-1 and 2.2-2. Stream fish population sampling occurred in 2012 and 2013.

Table 2.2-1. Sample site location, sampling method, and proximity to Project facility or major upstream tributary.

Stream	Site	Dates Sampled	Method of Sampling[1]		Location (RM)	Average Site Length (ft)	Nearest Upstream Facility/Tributary		Nearest Downstream Facility	
							Name	Distance Upstream from Site (miles)	Name	Distance Downstream from Site (miles)
Oregon Creek	Upstream of Log Cabin Dam	9/24/2012 9/10/2013	E-fish	--	4.5	287	No Facility	--	Log Cabin Diversion Dam	0.2
Oregon Creek	Upstream of Middle Yuba River	9/10/2012 9/11/2013	E-fish	--	0.3	230	Log Cabin Diversion Dam	4.0	New Colgate Powerhouse	10.8
Middle Yuba River	Upstream of Our House Dam	10/2/2012 9/4/2013	E-fish	--	13.3	327	Nevada Irrigation District's Milton Diversion Dam	31.5	Our House Diversion Dam	0.7
Middle Yuba River	Downstream of Our House Dam	9/15/2012 9/12/2013	--	Snorkel	12.5	474	Our House Diversion Dam	0.1	New Colgate Powerhouse	18.3
Middle Yuba River	Upstream of Oregon Creek	9/12/2012 9/5/2013	E-fish	--	5.0	363	Our House Diversion Dam	7.6	New Colgate Powerhouse	10.8
Middle Yuba River	Downstream of Moonshine Creek	9/17/2012 9/9/2013	--	Snorkel	3.3	607	Our House Diversion Dam	9.3	New Colgate Powerhouse	9.1
Middle Yuba River	Downstream of Yellowjacket Creek	9/11/2012 9/6/2013	E-fish	Snorkel	1.0	351	Our House Diversion Dam	11.6	New Colgate Powerhouse	6.8
North Yuba River	Upstream of Middle Yuba River	9/13/2013 9/7/2013	--	Snorkel	0.2	391	New Bullards Bar Reservoir	2.2	New Colgate Powerhouse	6.0
Yuba River	Downstream of Middle Yuba River	9/13/2012 9/8/2013	--	Snorkel	39.6	412	Middle Yuba River	0.1	New Colgate Powerhouse	5.7
Yuba River	Upstream of Colgate Powerhouse	9/16/2012 9/13/2013	--	Snorkel	35.0	341	Middle Yuba River	5.0	New Colgate Powerhouse	0.8
Yuba River	Downstream of Colgate Powerhouse	11/10/12 9/14/2013	--	Snorkel	33.7	659	New Colgate Powerhouse	0.5	United States Army Corps of Engineers' Englebright Dam	9.4

[1] E-fishing represents backpack electrofishing only and does not include any other electrofishing method (e.g., barge or boat).

2.2.2 Data Collection

2.2.2.1 Electrofishing

YCWA's preferred sampling method was three-pass-depletion electrofishing during daylight. At least three passes were made using backpack electrofishing units (until depletion was achieved) at each site where electrofishing was feasible. Target length for sample sites ranged from 100 to 300 meters (m). In the case of the two Oregon Creek sites YCWA and Relicensing Participants collaboratively agreed that shorter sites would be appropriate given the small size of the stream and the variety of habitat available.

Upstream and downstream ends of each site were either blocked with fine mesh nets (approximately 3/8-inch [in]) or a natural fish passage barrier was utilized (e.g., waterfall or velocity chute). Block nets spanned the full width and depth of the stream. Salt blocks were not needed during the field sampling effort, as near optimal conditions existed for good fish taxis while electrofishing. YCWA's goal in determining site length was to have adequate area to include sufficient, usable fluvial habitat representative of the reach as a whole (e.g., riffle, pool, and glide). Exact site length was determined in the field by the sampling team and Relicensing Participants.

Field crews consisted of at least two netters for each shocker. YCWA followed the protocols described by Temple and Pearsons (2007), who recommend one backpack electrofishing crew for streams less than 7.5 m wide and two crews for streams 7.5–15 m wide. In wadeable streams wider than 15 m, the number of electrofishing crews was expanded as necessary, to ensure effective and accurate sampling.

Captured fish were retained in aerated buckets and/or live cars until each pass was completed. Fish were temporarily sedated according to current protocols, as necessary to collect required measurements, and with appropriate approvals. All rainbow and brown trout collected in 2013 were scanned for pit tags to determine if any fish tagged during sampling for Study 3.11, *Entrainment*, were in the catch.

All fish captured were identified to species, counted, measured for length, and weighed. Length measurements were made to the nearest millimeter (mm fork length [FL] for forked-tail fish and mm total length [TL] for all other fish); and weight was measured by digital scale to the nearest 0.1 gram (g) or spring scale to the nearest gram. Fish were examined for signs of disease and parasites, and photographs were taken to help identify any that were found.

Scale samples were taken on a subsample of larger, less abundant, select fish (i.e., rainbow trout [*Oncorhynchus mykiss*], and brown trout [*Salmo trutta*]) for validating age-length indices. Scales from rainbow trout collected in both years were analyzed in October 2013 and corroborated the expectation that salmonids over 200 m should be classified as aged 2 years or older with the exception of one very large fish (371 mm) that was age-3+, but still within the age-2+ fork length category.

All fish removed from the selected reach were held in live cars downstream of the sampling site and redistributed evenly across the sampling reach following completion of the final pass for the survey. Mortalities, along with any damage to fish condition (e.g., spinal trauma and bruising) were noted and recorded prior to release. All efforts were made to ensure sampling activities in the field minimized potential injury or mortality to aquatic species.

General information and habitat/channel metrics were recorded at each sample site on a standardized electrofishing form. Information included site identification, turbidity (visually estimated as low, moderate, or high), discharge (measured prior to sampling, if a stream gage was not available), crew members, the number of shockers, date and time, air temperature, weather conditions, and global positioning system location (± 10 m). Water quality measurements were taken, using a factory calibrated YSI 2030 to measure water temperature (± 0.1°F), specific conductance (± 0.5% of reading + 0.001 *m*S/cm), and dissolved oxygen (DO) (±0/1 mg/L at <8 mg/L and ±0.2 mg/L at >8 mg/L). Metrics collected at each mesohabitat unit within the sample site included mesohabitat type (i.e., riffle, run, pool, glide), estimated average and maximum depth during sampling, estimated average wetted width during sampling, visual estimation of dominant cover type, and visual estimation of dominant and subdominant substrate. Additional fish habitat metrics collected included: large woody material (LWM) pieces (≥6 in diameter and ≥3 ft length); visual estimation of resident trout-appropriate spawning gravel in square feet (sq ft); and identification of barriers to resident trout greater than three vertical ft in height. Habitat metrics were consistent with those collected during habitat frequency mapping for YCWA's instream flow and geomorphic relicensing studies.

Prior to electrofishing a site that had been selected for sampling, YCWA walked the stream bank to directly observe the presence of any western pond turtles (*Actinemys marmorata*, WPT) or foothill yellow-legged frog (*Rana boylii*, FYLF). If a WPT or FYLF was observed, the observation was documented and YCWA relocated the survey site upstream or downstream to a location that included similar habitat types as the original site, and repeated the procedure. If WPT or FYLF were not observed, YCWA commenced the electrofishing protocols.

YCWA adhered to accepted decontamination guidelines for field gear to minimize the likelihood of transmitting diseases (USFWS 2005). All necessary permits for fish collection and handling were obtained prior to sampling.

2.2.2.2 Snorkeling

While YCWA's preferred sampling method for surveying fish populations was electrofishing, as described by O'Neal (2007), snorkeling is often feasible in places where electrofishing is not. For example, deep, clear water, with low conductivity makes quantitative electrofishing impossible. Species composition, presence/absence, relative abundance, general size class distribution, and habitat use information can be obtained with snorkeling techniques (Slaney and Martin 1987, O'Neal 2007).

Quantitative snorkeling was used by YCWA to replace electrofishing if the entire sampling site was too deep to electrofish, or when the method was collaboratively agreed upon, during site

selection with Relicensing Participants. Qualitative electrofishing occurred on the margins of quantitatively snorkeled sites following the snorkel assessment in an effort to capture enough representative fish specimens to provide length and weight data for the development of a condition factor for each species in the area.

When used, quantitative snorkeling techniques generally replicated those outlined by Thurow (1994), Dolloff et al. (1996), and O'Neal (2007). Surveys were conducted during midday in full sun, and in periods with low annual turbidity levels (late summer).

At quantitatively snorkeled sites, snorkel lanes were set up for the full length of each survey site. Upstream and downstream ends were blocked with fine mesh nets (approximately 3/8 in) that spanned the full width and depth of the stream. Generally, two to three snorkelers-depending on the wetted stream channel width at each site-simultaneously snorkeled the lanes and recorded species composition and abundance on waterproof slates. Fish were identified, counted and visually categorized into pre-defined length-classes (i.e., 0-2 in, >2–4 in, >4–6 in, >6–8 in, >8–10 in, >10–12 in, >12–14 in, etc.).

Observers calibrated their own estimation of fish lengths by viewing weighted fishing lures of various known lengths underwater prior to snorkel surveys. Visual estimates of length were made in English units (as a more familiar metric to field crews) and later converted to metric units to avoid error. Maximum sight distance for accurate determination of fish species was recorded on the field data form at each site.

All snorkelers were equipped with mask-integrated video cameras. Video was transferred to a USB flash memory card. Although the video was not edited or enhanced with special menus, each stream unit snorkeled began with a sign board indicating the date, time, and habitat unit number that corresponded with snorkeler's observation notes. In 2013, snorkelers were directed to verbally note any oddities perceived during their surveys. The video is available on request from YCWA.

Two to three replicate snorkel surveys were performed, using the same snorkeling team to obtain an estimate of survey variance, and to determine a level of confidence for use in abundance estimation (Slaney and Martin 1987, Hankin and Reeves 1988). Data were recorded on a standardized fish snorkeling survey form for the site. The same site information and habitat metrics collected for electrofishing were used for snorkeled sites. All snorkeling data were analyzed separately from the electrofishing data, as discussed below.

2.2.2.3 Rainbow Trout Fry Emergence Sampling

YCWA performed surveys of rainbow trout fry emergence upstream of Log Cabin Diversion Dam on Oregon Creek, and upstream of Our House Diversion Dam on the Middle Yuba River. The study area for the fry emergence data gathering extended no more than 1 mile upstream of each Project diversion. A qualitative assessment was completed during daylight using two to three biologists, depending on flow, utilizing backpack electrofishing or snorkeling in Oregon Creek and snorkeling only in the Middle Yuba. Snorkeling was the only method utilized in the

Middle Yuba River due to the prevalence of deep pools and swift water in that area. Snorkeling was conducted in Oregon Creek during high flow events when safety was a concern or in challenging habitat (i.e., undercut banks) where electrofishing would be ineffective. An effort was made to identify any redds that were visible from shore. Identified redd locations were marked with a Global Positioning System (GPS) unit and documented.

A total of eight sampling events occurred approximately every two weeks from March 15 to June 30, 2012. Sampling was continuous through the sample area and was not site-specific. Field technicians continuously sampled within one mi upstream of each diversion.

Data collection followed a similar methodology to that described above for electrofishing and snorkeling. An active collecting or searching qualitative approach was applied to locate fish. Collected fish (electrofishing) were identified to species and measured to the nearest millimeter (mm). Observed (snorkeling) fish were identified to species, and length was estimated in 0.5-in length bins then later converted to mm for reporting purposes.

2.3 Data Analysis

Fish catch numbers from three-pass electrofishing were analyzed in both MicroFish™ and Microsoft™ Excel. Visual snorkeling counts were analyzed in Excel. While all species were recorded, small sample sizes of some species limited statistical analyses. Data were analyzed to the statistical extent possible.

2.3.1 Fish Size, Condition Factor, and Stock Density

Fish size and weight data were summarized by species and by sample site. Standard scientific software outputs including minimum, maximum, and mean FL and weight were calculated. For sites where one section was electrofished and another section snorkeled, data were reported separately for the electrofishing and snorkeling sections. These sections were blocked off separately and represented two unique samples for the single site. Fish size data for snorkeled sites or sub-sections were reported as the minimum, maximum, and mean size classes (i.e., 2-in size classes).

Relative condition factor is useful for comparing the condition of fish because it compensates for allometric growth; that is, when fish shape changes as fish grow (Le Cren 1951). It also allows for comparisons of fish condition relative to a defined population or sampling universe. Length and weight data were used to compute a relative condition factor, $K_n = W/W'$, where W = individual fish weight, and W' = length-specific weight from the weight-length relationship, given by $W = a(FL)^b$, where a and b are population specific coefficients (Anderson and Gutreuter 1983). Relative condition factors near or above a value of 1.0 indicate more healthy (plump) individual fish. Fish were aggregated by species and reach to establish adequate sample size to calculate condition factors.

To provide an additional index of size structure, traditional relative stock densities (RSD) were calculated for each species by site. The RSD is presented on a percent scale of 0 to 100

(Anderson et al. 1996). RSD was calculated as the proportion of fish sampled that were greater than 6 in. The 6-in length was chosen because it is often used as the smallest size where fish are desired by anglers. A high RSD indicates that a greater proportion of the population consists of fish in the size class desirable to anglers. For electrofished sites, RSD was computed as the number of fish collected greater than 6-in divided by the total number of fish collected (see below). For snorkeled sites, RSD was computed by dividing the average number of fish counted greater than 6 in by the average total number of fish counted during replicate counts. These values were summed at sites where snorkeling and electrofishing were combined to compute a single RSD for the entire monitoring site.

$$\mathbf{RSD}_{efish} = \frac{(\text{\# fish} > 6\text{" collected})}{(\text{total \# fish collected})} \times 100$$

$$\mathbf{RSD}_{snorkel} = \frac{(\text{mean \# fish counted} > 6\text{"})}{(\text{mean total \# counted})} \times 100$$

2.3.2 Fish Species Populations and Biomass

Standing stock estimates, in terms of fish population numbers and biomass, were calculated by species for each site and further analyzed by age class. Electrofishing data were analyzed using the MicroFish™ 3.0 computer software package (Van Deventer and Platts 1989). Capture probabilities (i.e., the proportion of fish captured on a given electrofishing pass), size statistics, and biomass were generated for each sample site using fish capture data. Biomass was calculated based on the total weight measured for each species. Standing stock estimates were reported as: 1) total number and weight in grams (g) of fish by species per 100 m of stream; 2) numbers of fish by species per mile; 3) pounds of fish by species per acre of stream surface; and 4) kilograms of fish by species per hectare. Fish density in the actual site length was calculated, then the proportion of the site length was multiplied by the density estimate to extrapolate a fish per mile estimate, and fish per 100 m. Similar methodology was used to extrapolate the site area to acres and hectares.

Fish population descriptions by species also included an analysis by age-class. Length-frequencies were analyzed by species, site, and drainage. Age classes were determined using a length-frequency analysis for smaller, more abundant fish and augmented by scale-age analysis for the larger, usually less abundant, fish (i.e., >150 mm FL or TL). Length-frequency histograms were scrutinized and utilized to determine age-class bins based on expert review and opinion. Age-length indices are relatively accurate for smaller fish; however, confidence intervals broaden with larger fish due to greater size variability within age groups. Scales collected using the above-mentioned method, were examined under a microscope to assist in identifying age classes based on growth patterns. Scales used to identify age classes were cleaned, mounted between glass microscope slides and examined by two independent viewers. A third independent examination was performed when age determinations by the first two examiners were inconsistent.

Generally, length-frequency data were not sufficient to distinctly segregate cohorts older than age-2 (and older), and scale analysis indicated considerable length overlap among cohorts by age-2+. Therefore, three distinct age classes were used for this study: age-0 fish (i.e., young-of-the-year or YOY), age-1, and age-2+.

Since fish observed during snorkeling surveys were assigned to predefined 2-in bins, age-classes were identified within size bins most closely aligning with age-class frequencies observed during quantitative electrofishing within the Yuba River sub-basin, and were corroborated by Moyle (2002), who described growth rates in both warm and cold water stream habitats in the Sierra Nevada. For instance, 0 to 2-in fish and 2 to 4-in fish were identified as age-0; 4 to 6-in fish were identified as age-1; and 6-in and larger fish assigned to age-2+. The proportion of each age class was applied to the abundance estimate to obtain relative age class distributions for the entire estimated population.

For snorkeling sites, fish abundance for each species was estimated using the mean (and standard deviation) of the replicate fish counts from multiple survey passes.

Microfish 3.0™ output and snorkel count averages yield abundance estimates, which are a population metric that quantifies the number in a population. Abundance estimates were converted to density estimates (e.g., fish per unit distance of stream or fish per unit area of stream) to allow standardized comparisons among sites.

Biomass was only reported for electrofished sites. This metric, which included reporting of pounds per acre, grams per 100 m, and kilograms per hectare, was not estimated for snorkeled habitat because fish could not be collected for weight measurements. Interpolating fish weight and calculating biomass from snorkeling was not an acceptable approach to CDFW in other recent FERC relicensing studies in California and, thus, was not attempted here.

2.3.3 Fish Community Analysis

Fish community analysis included species composition and relative species abundance of the fish community (percent composition). The diversity of fish species was assessed in Project reaches as the data allowed. The condition of fish communities was evaluated based on the rigor of the collected data described above, at three levels of biological organization: 1) individual level; 2) population level; and 3) community level. Moyle et al. (1998) and Moyle and Marchetti (1998) provided the following descriptions of fish health at these levels:

- Individual Level. Most fish in a healthy stream should: 1) have a robust body; 2) be free of disease, parasites, and lesions; 3) demonstrate reasonable growth rates for the region; and 4) exhibit appropriate behavioral patterns.
- Population Level. Fish populations in healthy stream environments: 1) exhibit multiple age classes indicating that reproduction is regularly occurring; 2) achieve a viable population size (i.e., occur in adequate numbers to maintain a self-sustaining population and the long-term persistence of the population); and 3) consist of mostly healthy individuals.

- Community Level. Fish communities considered in good health: 1) are typically dominated by co-evolved species; 2) have a predictable structure as indicated by limited niche overlap among species and trophic levels; 3) are resilient in recovering from extreme events; 4) consist of a persistent species membership; and 5) are replicated geographically (i.e., can be found in similar habitats within the drainage or in other similar drainages).

2.3.4 Use of Fry Emergence Sampling Information

Trout fry emergence was assessed by collecting YOY fish and conducting a back-calculation using dates of first observations and recorded water temperatures. Trout egg development is primarily dependent on water temperature, so by recording the water temperature during the incubation period, either the date of spawning or emergence can be estimated, if one of the two event dates is known. Water temperature, however, is highly variable, so mean daily temperatures were used in this calculation. Each day with a measured temperature of one degree Fahrenheit over 32 degrees of the daily average water temperature is equal to 1 Daily Temperature Unit (DTU) (i.e., 55°F would equate to 55 – 32, or 23 DTU). These units are summed daily until they meet the species-specific criteria for hatching or emergence. For example, if water temperature was held constant at 55°F, it would take 24 days for hatching (i.e., if 552 DTU is the criterion for hatching, it would take: a) the 552 DTU required, divided by b) the 23 DTU measured per day, to estimate c) emergence at 24 days prior).

The DTU criteria outlined in Piper et al. (1982) and Senn et al. (1984) were used in this study and are displayed in Table 2.3-1. The end-products of the analyses were used to establish the timing of rainbow trout spawning and hatching in the Yuba River system.

Table 2.3-1. Daily Temperature Units (DTU) required from spawning to emergence in rainbow trout.

Average Incubation	Daily Temperature Units	Daily Temperature Units Required For
45°F	624	1,029
50°F	558	963
55°F	552	957

Source: Piper et al. 1982 and Senn et al.1984

Spawning periodicity was determined using the DTUs required for emergence in Table 2.3-1. Each average incubation temperature scenario and the corresponding DTUs required for emergence was used to back-calculate the spawning date. Emergence date was assumed to be the day prior to fry observation in the field. Only fry less than 50 mm were included in the analysis to determine periodicity. Mean daily water temperature was calculated for each average incubation temperature scenario, and the temperature that most closely matched a given scenario was chosen as the calculated average incubation temperature (CAIC). Using the CAIC and information from Table 2.3-1, a DTU required for emergence was extrapolated and spawning date was back-calculated from the known date of emergence.

A similar method for determining the DTUs required for hatching was calculated; this calculation began on the hypothetical spawn date to determine the CAIC. DTUs for hatching were calculated and used to determine hatch date.

2.4 Overall Data Quality Assurance

Quality control of fish population survey data occurred in three phases: 1) field preparation; 2) field data collection; and 3) data entry and review.

2.4.1 Field Preparation

Standardized field data forms were used to ensure that all required data were collected and recorded consistently. Prior to field work, each crew member was trained in field survey procedures and adherence to the study plan. Data forms were reviewed and data categories explained. Field crews were also trained in the identification of target fish species. At the beginning of each survey week, equipment was checked, and if necessary, calibrated. All equipment was inspected to ensure full functionality.

2.4.2 Data Collection

A checklist was followed to ensure maps, equipment, supplies, safety call-in procedures, and other necessary pre-field tasks were organized prior to leaving for the field. Measuring instruments were checked prior to use and frequently during the field day. In addition to data forms, field notes were kept that included descriptions of all photos, sites and habitats, unusual observations, etc. At the conclusion of a survey and before leaving the field site, each field data sheet was checked by a crew member for completeness, consistency, and legibility.

2.4.3 Data Entry and Review

All field notes were organized and checked for missing pages and then photocopied at the end of each field week. The originals and copies were kept in separate locations until the end of the week, when the originals were delivered for storage in a fireproof safe. All digital photos were downloaded weekly to a server that was regularly backed up and saved to disks at the end of the fieldwork period.

Following a quality assurance/quality control (QA/QC) review, data were entered into a spreadsheet and then checked for transcription errors. Entered data were reread line by line by a technician and confirmed visually by another technician reviewing the hard copy field data. Any discrepancies were corrected, and the original recorder was consulted, if there was any question about an entry.

3.0 Results

3.1 Fry Emergence

Field surveys of rainbow trout presence and mean daily water temperature were conducted on the Middle Yuba River and Oregon Creek in 2012. Data collected was used to calculate the timing of spawning, hatching, and emergence of rainbow trout.

3.1.1 Middle Yuba River

A total of 146 rainbow trout was observed during the rainbow trout periodicity surveys in the Middle Yuba River upstream of Our House Diversion Dam. All eight of the sampling efforts in the Middle Yuba River were completed using qualitative snorkeling surveys due to deep pools and swift water. Surveys were conducted from March 30, 2012 to June 21, 2012. Table 3.1-1 presents the lengths of rainbow trout observed during this effort.

Table 3.1-1. Rainbow trout observations in the Middle Yuba River upstream of Our House Diversion Dam from March through June 2012.

Date	Method	Rainbow Trout Fry Length (mm)				
		Emergent				Non-Emergent[1]
		0 – 13	13 – 25	25 – 38	38 – 50	> 50
3/30/2012	Snorkel	0	0	0	0	4
4/11/2012	Snorkel	0	0	0	0	0
4/20/2012	Snorkel	0	0	0	0	0
5/9/2012	Snorkel	0	0	0	0	0
5/16/2012	Snorkel	0	0	0	0	0
5/31/2012	Snorkel	45	63	10	0	3
6/11/2012	Snorkel	0	0	15	0	2
6/21/2012	Snorkel	0	1	2	0	1
Total		**45**	**64**	**27**	**0**	**10**

[1] Rainbow trout larger than 50 mm FL were considered unsuitable for determining emergence timing as it cannot be unequivocally stated that they are emergent fish; consequently, fish greater than 50 mm were excluded from the periodicity analysis.

Emergent rainbow trout were only observed during three of the survey events between May 31 and June 21. Figure 3.1-1 exhibits mean daily water temperature and fry observations during the sampling period in 2012.

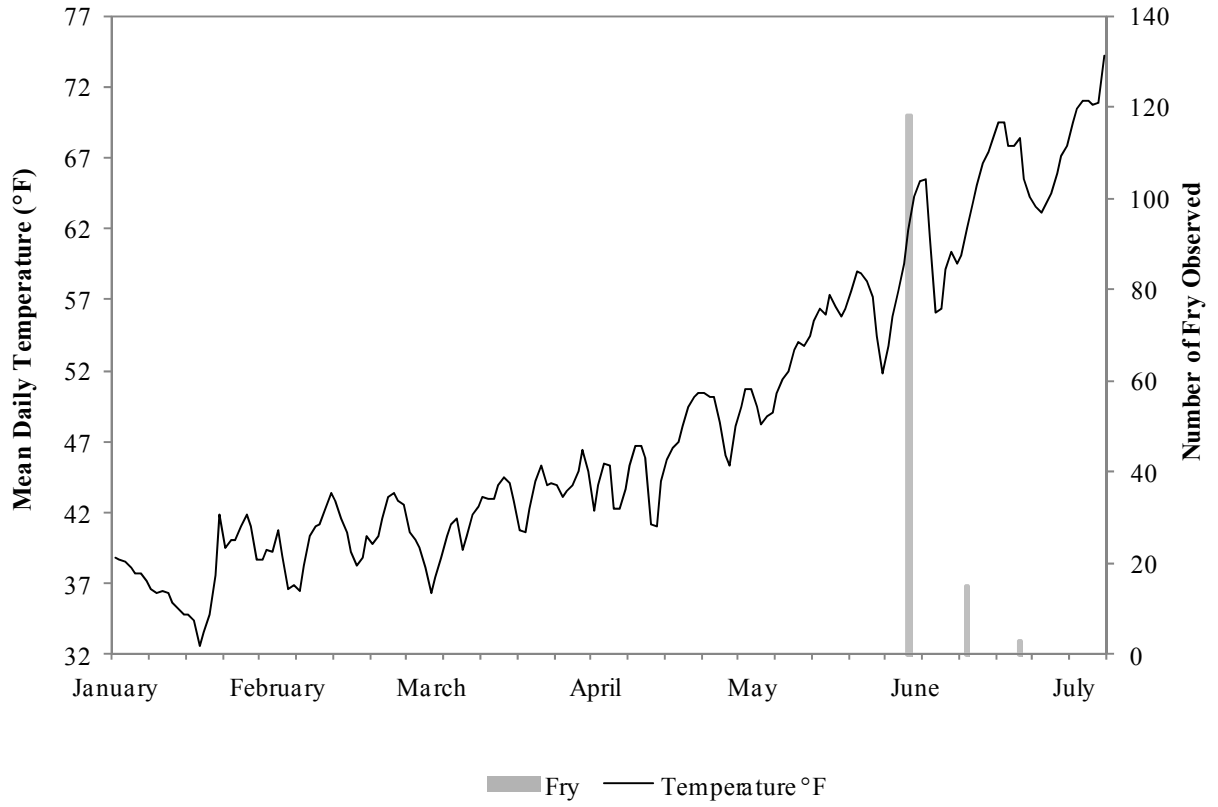

Figure 3.1-1. Mean daily water temperature and rainbow trout fry observations in the Middle Yuba River upstream of Our House Diversion Dam from March through June 2012.

Spawning dates were back-calculated from fry observations; date of emergence is assumed to be one day before observation. Table 3.1-2 presents calculated spawning and hatching dates.

Table 3.1-2. Calculated spawning and hatching dates and mean daily water temperature for each day for newly emerged rainbow trout fry in the Middle Yuba River upstream of Our House Diversion Dam in 2012.

Fry Observed	Calculated Spawn Date	Calculated Hatch Date	Emergence Date[1]
May 31 (61.9°F)	April 12 (41.2°F)	May 14 (56.3°F)	May 30 (59.5°F)
June 11 (62.1°F)	May 3 (48.2°F)	May 27 (53.8°F)	June 10 (60.1°F)
June 21 (68.4°F)	May 19 (56.3°F)	June 8 (60.4°F)	June 20 (67.8°F)

[1] Assumes emergence date is day before survey.

3.1.2 Oregon Creek

Electrofishing and snorkeling were used to sample Oregon Creek, depending on conditions and presence of FYLF. Eight surveys were conducted from March 29, 2012 to June 16, 2012, resulting in the observation of 434 rainbow trout. Table 3.1-3 presents the length frequency of rainbow trout encountered at this location during the study.

Table 3.1-3. Rainbow trout observations in Oregon Creek upstream of Log Cabin Diversion Dam from March through June 2012.

Date	Method	Rainbow Trout Fry (mm)				
		Emergent				Non-Emergent[1]
		0 – 13	13 – 25	25 – 38	38 – 50	> 50
03/29/12	E-Fish/Snorkel	0	0	0	0	6
04/10/12	E-Fish	0	0	0	0	11
04/19/12	Snorkel	0	0	0	0	0
05/01/12	E-Fish	0	0	0	0	0
05/15/12	Snorkel	0	0	0	0	134
05/30/12	Snorkel	0	0	0	0	129
06/12/12	Snorkel	0	0	15	0	123
06/21/12	Snorkel	0	4	1	0	11
Total		**0**	**4**	**16**	**0**	**414**

[1] Rainbow trout larger than 50 mm FL were considered unsuitable for determining emergence timing as it cannot be unequivocally stated that they are emergent fish; consequently, fish greater than 50 mm were excluded from the periodicity analysis.

Twenty rainbow trout fry smaller than 50 mm were observed between June 12 and June 21. Figure 3.1-2 displays mean daily water temperature and fry observations.

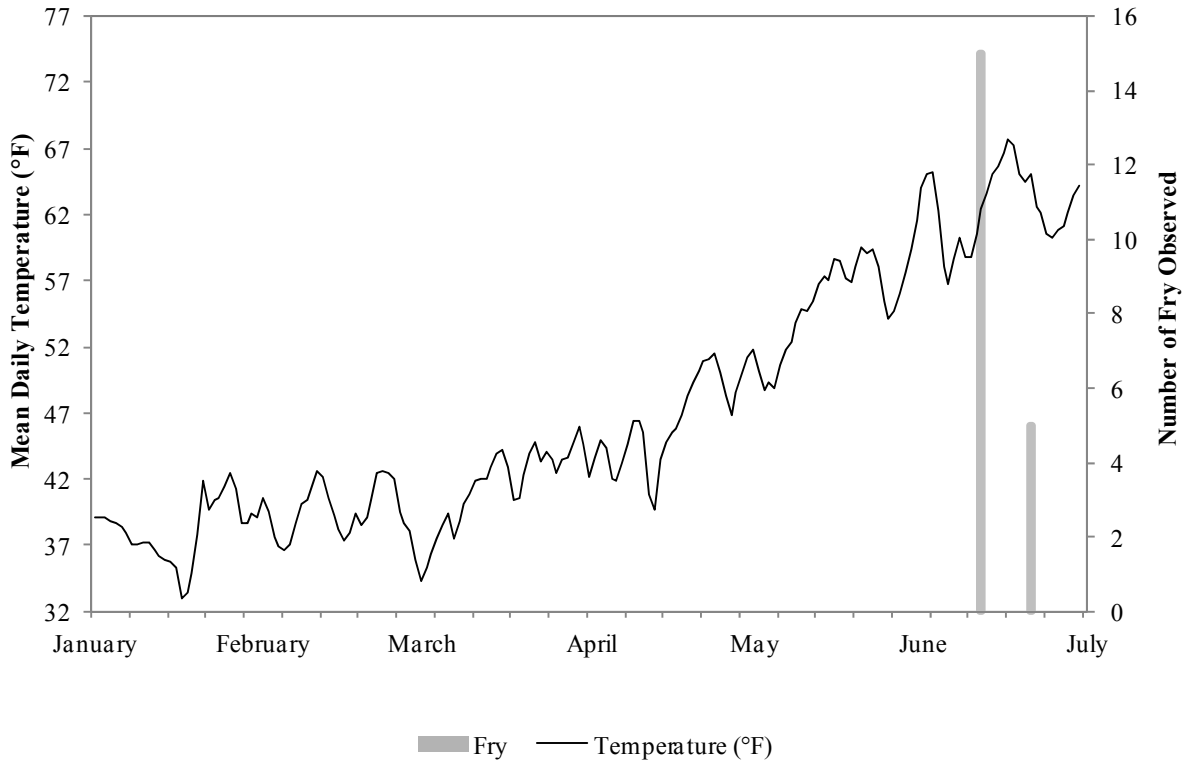

Figure 3.1-2. Mean daily water temperature and rainbow trout fry observations in Oregon Creek upstream of Log Cabin Diversion Dam from March through June 2012.

Spawning date was back-calculated from date of emergence. Table 3.1-4 presents calculated spawning and hatching dates.

Table 3.1-4. Calculated spawn and hatch dates and mean daily water temperature for each day for newly emerged rainbow trout fry in Oregon Creek upstream of Log Cabin Diversion Dam in 2012.

Fry Observed	Calculated Spawn Date	Calculated Hatch Date	Emergence Date[1]
June 12 (62.4°F)	May 6 (50.6°F)	May 28 (56.1°F)	June 11 (60.6°F)
June 21 (65.0°F)	May 19 (56.9°F)	June 7 (58.7°F)	June 20 (64.5°F)

[1] Assumes emergence date is day before survey.

3.2 Electrofishing and Snorkel Surveys

Fish population sampling was conducted at 11 sites in 2012 and 2013. Electrofishing and snorkel surveys were performed in four sub-basins that included Oregon Creek (two sites), Middle Yuba River (five sites), North Yuba River (one site), and Yuba River proper (three sites). Sampling occurred from September through November 2012, and in September 2013.

In 2012, a total of 426 fish were collected by quantitative electrofishing and 646 fish were observed during quantitative snorkeling based on mean pass-abundance for three-pass snorkel surveys, representing a total of six species observed. In 2013, a total of 303 fish were collected by quantitative electrofishing and a total of 499 fish was observed during quantitative snorkeling based on mean pass-abundance for three-pass snorkel surveys, representing a total of six species observed. One additional fish species (kokanee) was observed incidentally in 2012 during performance of YCWA's relicensing Study 3.12, *New Colgate Powerhouse Ramping*.

In addition, qualitative electrofishing was conducted in the stream margins of quantitatively snorkeled sites to support the development of a condition factor for fish by basin. In 2012, a total of 75 fish representing three common species was collected. In 2013, a total of 64 fish was collected representing the same three species, with the addition of one species.

All rainbow trout collected in 2013 were scanned for pit tags to determine if fish tagged during sampling for YCWA's relicensing Study 3.11, *Entrainment*, were in the catch. Pit tagged fish were not identified at any of the 11 sample sites. The results of these sample efforts are presented below by river.

Habitat and site characteristic information data collected over the 2 years of sampling did contain some minor variability. In many cases, the overall length of sampled sites varied due to the availability of trees, rocks, and other stream features used to secure block nets that had moved over the winter, or when flow conditions mandated that block nets be deployed at slightly different locations within 20 m of the original location. Another area where slight measurement differences occurred was the wetted width of stream channels, due to slightly different water elevation and different selection of transects for width measurements by field staff. There was greater variability at some sites relative to the documentation of spawning gravel and presence of LWM. In many cases, a combination of these habitat features changing between years due to flow events, and slight differences in field-crew interpretation of the habitat features can explain these minor differences. Overall, habitat measurements were fairly consistent over the two-year study, and any minor measurement differences did not introduce insurmountable statistical hurdles.

3.2.1 Oregon Creek

Oregon Creek is a 35.2 square mile (sq mi) watershed with one Project facility, the Log Cabin Diversion Dam, at RM 4.3. Two sampling sites were located on the creek, which included one site 0.4 mile upstream of the dam and one site 3.8 miles downstream of the dam. There are no water storage or diversion facilities above the upstream site. Tables 3.2-1 and 3.2-2 provide an overview of fish species collected by site as well as calculated population metrics.

Table 3.2-1. Overview of fish species captured during electrofishing surveys on Oregon Creek in 2012 and 2013.

Species		Oregon Creek Upstream of Log Cabin Diversion Dam (RM 4.5)	Oregon Creek Upstream of Middle Yuba River (RM 0.3)
Common Name	Scientific Name		
Rainbow trout	*Oncorhynchus mykiss*	•	•
Sacramento pikeminnow	*Ptychocheilus grandis*	•	–
Sacramento sucker	*Catostomus occidentalis*	•	•
Smallmouth bass	*Micropterus dolomieu*	--	•

• = species was captured.

Table 3.2-2. Overview of fish population metrics in Oregon Creek based on 2012 and 2013 sampling.[1]

Stream Site	Sample Year	Rainbow Trout		Sacramento Pikeminnow		Sacramento Sucker		Smallmouth Bass	
		Abund. (EF)	Biomass (EF)	Abund. (EF)	Biomass (EF)	Abund. (EF)	Biomass (EF)	Abund. (EF)	Biomass (EF)
		fish/mi	lbs/ac	fish/mi	lbs/ac	fish/mi	lbs/ac	fish/mi	lbs/ac
Oregon Creek Upstream of Log Cabin Diversion Dam (RM 4.5)	2012	72	0.9	18	0.6	919[2]	2.3	--	--
	2013	266	2.4	38	0.6	301	1.0	--	--
Oregon Creek Upstream of Middle Yuba River (RM 0.3)	2012	2,266	23.9	--	--	169	3.1	24	1.5
	2013	1,430	10.8	--	--	286	3.3	44	0.3

[1] EF = electrofished.
[2] Irregular depletion of Sacramento sucker in the second pass led to a poor 95 percent confidence interval and, therefore, the value of the estimated metric is improbable.

3.2.1.1 Oregon Creek Upstream of Log Cabin Diversion Dam

This site is upstream of the Project.

The Oregon Creek Upstream of Log Cabin Diversion Dam site is at an elevation (El.) of 1,981 ft. Sampling occurred on September 24, 2012 and September 10, 2013. Electrofishing was conducted throughout the entire site. Neither FYLF nor WPT were observed before electrofishing commenced. Table 3.2-3 summarizes habitat and site information. Site length and wetted width for the two sample periods averaged 287 ft long and 17 ft wide. The site was comprised of three habitat types: 1) low-gradient riffle; 2) run; and 3) pool. Streamflow was

similar over both years based on the Oregon Creek Below Log Cabin (LCB) gage (CDEC 2013). Cobble and gravel were the dominant and sub-dominant substrates. No fish passage impediments were observed. LWM and resident trout-sized spawning gravel were documented at the sampling site each year. Water temperature and DO remained similar between sampling events.

Table 3.2-3. Habitat and site information for Oregon Creek Upstream of Log Cabin Diversion Dam Site (RM 4.5).[1]

Sampling date		September 24, 2012	September 10, 2013
Weather	air temperature (°F)	72	92
	atmospheric conditions	sunny	sunny
Water quality	water temperature (°F)	58.6	61.3
	dissolved oxygen (mg/l)	9.18	8.05
	conductivity (µS/cm)	131.2	123.0
Site characteristics	elevation (ft msl)	1,981	1,981
	river mile	4.5	4.5
	site length (ft)	293	281
	average width (ft)	15.0	19.4
	average site depth	1.5	1.5
	average pool depth (ft)	3.5	3.0
	maximum pool depth (ft)	5.2	5.1
	flow (cfs)[2]	2	3
Habitat characteristics	dominant substrate	cobble	cobble
	sub-dominant substrate	gravel	gravel
	dominant cover type	wood	wood
	channel confinement	moderate	moderate
	fish passage impediments present	no	no
	no. large woody debris pieces	8	4
	suitable spawning gravel (total area in sq ft)	30	10
	low-gradient riffle (% of site length)	15	17
	high-gradient riffle (% of site length)	0	0
	run (% of site length)	14	14
	glide (% of site length)	0	0
	pool (% of site length)	72	69

[1] Coordinates: upstream easting-667243, northing- 4367588; downstream easting- 667285, northing- 4367554.
[2] Flow was determined from the LCB gage (CDEC 2013).

With the exception of the change in relative abundance, species composition at the site was the same in 2012 and 2013 (Figure 3.2-1). Sacramento sucker (*Catostomus occidentalis*) made up the majority of the catch numerically followed by rainbow trout and Sacramento pikeminnow (*Ptychocheilus grandis*) over both years of the survey.

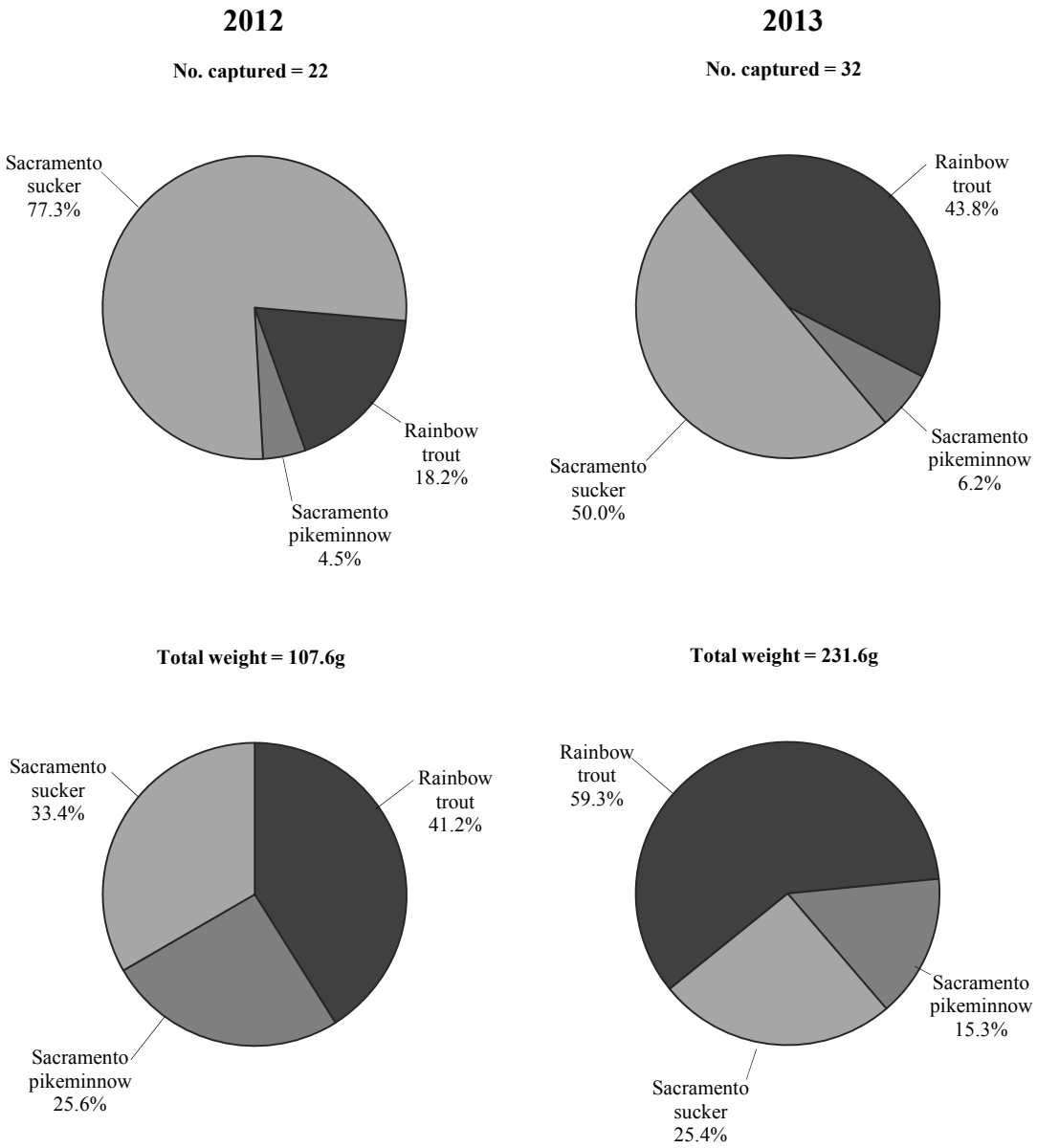

Figure 3.2-1. Proportion, by number and weight, of fish species sampled at the Oregon Creek Upstream of Log Cabin Diversion Dam Site in 2012 and 2013.

Given the irregular depletion of Sacramento sucker in the second pass of sampling, the 95 percent confidence interval calculated for Sacramento sucker abundance in 2012 (17-239 is not reliable and not discussed (Table 3.2-4). Alternately, the discussion of Sacramento sucker describes actual numbers of fish.

The total collection of rainbow trout more than tripled in 2013, while the catch of Sacramento sucker remained similar. Sacramento pikeminnow were caught in low numbers in both years.

The biomass of rainbow trout accounted for the majority of the total biomass of all species in both years with a three-fold increase in 2013. Although similar numbers of Sacramento sucker were captured in each year, biomass increased in 2013 due to a slightly higher individual mean weight. Condition factor for rainbow trout, calculated in 2013 only, ranged from 0.74 to 1.25. Sacramento sucker had condition factors ranging from 0.68 to 1.50 in 2012 and 0.53 to 1.17 in 2013. In general, all fish were vigorous and free of parasites.

Multiple age classes were present for rainbow trout with the majority categorized as age-0 in both years, signifying successful recruitment. A small number of age-1 fish and no age-2 fish were captured in 2012. The trend reversed in 2013 with limited numbers of age-2+ fish and zero age-1 fish captured. Sacramento sucker were primarily characterized as age-0 in both years with only one fish characterized as age-1 in 2012. All Sacramento pikeminnows encountered were age-1 fish. The length-frequency distributions for commonly caught species at this site are displayed in Figure 3.2-2.

Table 3.2-4. Summary of fish population information for the Oregon Creek upstream of Log Cabin Diversion Dam Site (RM 4.5).

Species		Rainbow trout		Sacramento pikeminnow		Sacramento sucker	
Year		2012	2013	2012	2013	2012	2013
Abundance	no. collected by pass (total)	4-0-0 (4)	7-5-2 (14)	0-1-0 (1)	1-1-0 (2)	3-11-3 (17)	13-3-0 (16)
	% of fish collected	18.2%	43.8%	4.5%	6.3%	77.3%	50.0%
	estimated section abundance	4	14	1	2	51	16
	95% confidence interval	4-4	14-16	1-1	2-4	17-239[1]	16-16
	Relative Stock Density	n/a	14	n/a	n/a	n/a	n/a
	fish/100m	4	16	1	2	57	19
	fish/mi	72	263	18	38	919	301
Fork length (mm)	mean (range)	92 (67-143)	83 (54-158)	140 (140)	125 (111-129)	46 (30-115)	62 (40-96)
Biomass	weight of fish collected (g)	44	137	28	35	36	59
	mean weight (g) (range)	11.1 (2.5-34.4)	9.8 (1.5-38.0)	27.5 (27.5)	17.7 (12.6-22.8)	2.1 (0.1-20.8)	3.7 (0.4-11.3)
	estimated section biomass (g)	44.4	137.3	27.5	35.4	107.1	58.9
	g/100m	49.7	160.3	30.8	41.3	119.9	68.8
	lbs/ac	0.9	2.4	0.6	0.6	2.3	1.0
	kg/ha	1.1	2.7	0.7	0.7	2.5	1.2
Condition factor	relative condition range	n/a	0.74-1.25	n/a	n/a	0.68-1.50	0.53-1.17
Age class frequency in fish/mile (% of total)	0	54 (75.0%)	207 (78.6%)	0 (0.0%)	0 (0.0%)	865 (94.1%)	263 (87.5%)
	1	18 (25.0%)	0 (0.0%)	18 (100.0%)	38 (100.0%)	54 (5.9%)	38 (12.5%)
	2 and older	0 (0.0%)	56 (21.4%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)

[1] Irregular depletion of Sacramento sucker in the second pass led to a poor 95 percent confidence interval and therefore results of estimated metrics are improbable.

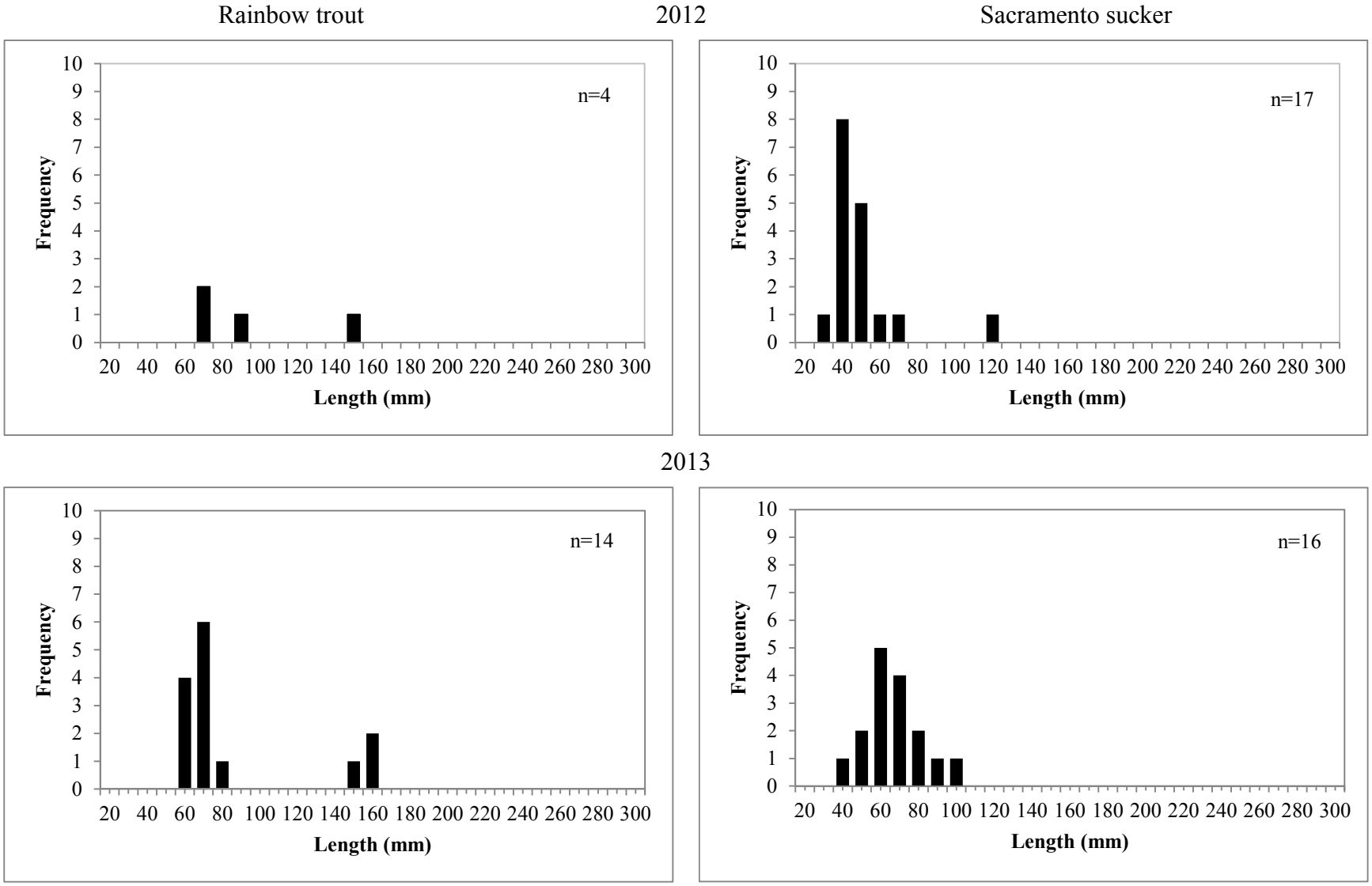

Figure 3.2-2. Length-frequency distribution of rainbow trout and Sacramento sucker collected by electrofishing in Oregon Creek upstream of Log Cabin Diversion Dam in 2012 and 2013.

During YCWA's relicensing Study 3.11, *Entrainment*, YCWA conducted backpack electrofishing along with hook and line sampling for rainbow and brown trout in the Log Cabin Diversion Dam impoundment and upstream of the impoundment approximately 1.7 mi. The eight-day sampling effort took place from September 24 to October 5, 2012. The effort resulted in the capture of 437 rainbow trout representing all age-classes (Figure 3.2-3).

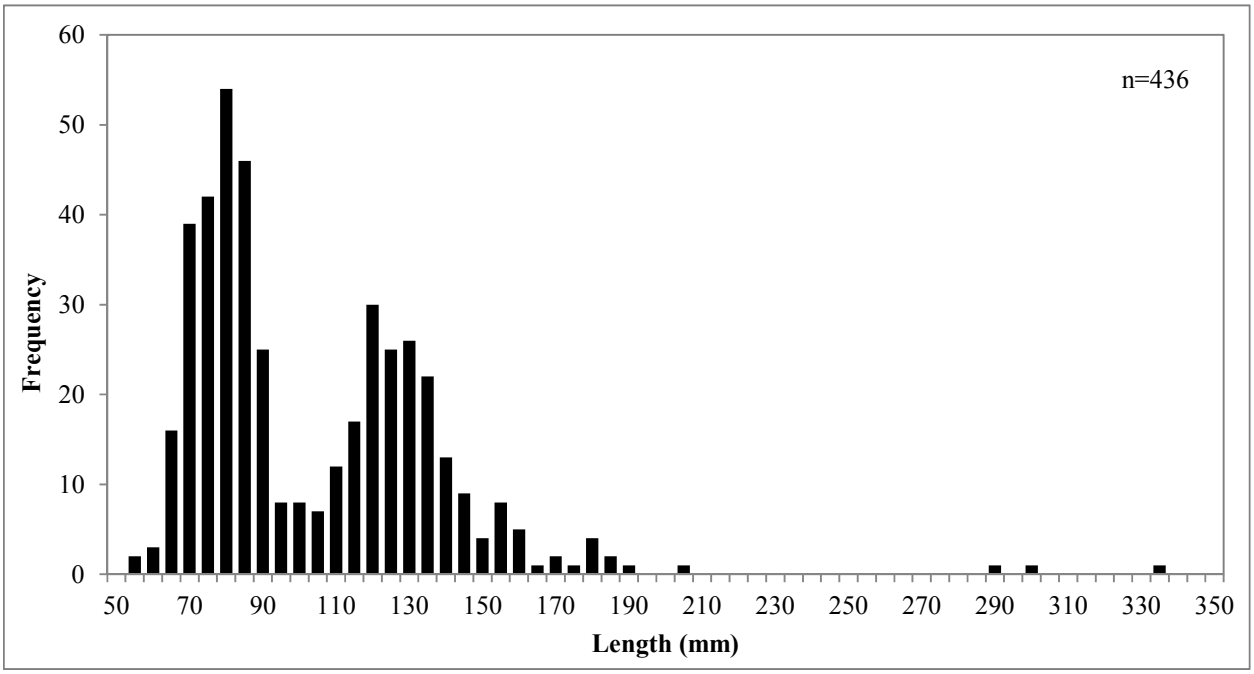

Figure 3.2-3. Length-frequency of trout captured on Oregon Creek upstream of Log Cabin Diversion Dam in 2012 during YCWA's relicensing Study 3.11, *Entrainment.*

3.2.1.2 Oregon Creek Upstream of Middle Yuba River

The site at Oregon Creek Upstream of Middle Yuba River is at El. of 1,492 ft. Sampling occurred on September 10, 2012 and September 11, 2013. Quantitative electrofishing was used over the entire site. Neither FYLF nor WPT were observed prior to electrofishing. Table 3.2-5 summarizes habitat and site information collected in 2012 and 2013. Site length and wetted width for the two sample events averaged 225 ft long and 25 ft wide. Mesohabitats at the site were comprised of step-run and pool. Streamflow was similar over both years based on the LCB gage (CDEC 2013). Boulder and bedrock were the dominant and sub-dominant substrates. Resident trout-sized spawning gravel and LWM were observed at the sampling site in 2012, while none was documented in 2013. Fish passage impediments were not observed at the site. Water temperature and DO were similar during both sample events.

Table 3.2-5. Habitat and site information for the Oregon Creek Upstream of Middle Yuba River Site (RM 0.3).[1]

Sampling date		September 10, 2012	September 11, 2013
Weather	air temperature (°F)	90	70
	atmospheric conditions	sunny	cloudy
Water quality	water temperature (°F)	63	65
	dissolved oxygen (mg/l)	8.99	8.66
	conductivity (µS/cm)	126.6	149.8
Site characteristics	elevation (ft msl)	1,492	1,492
	river mile	0.26	0.26
	site length (ft)	220	240
	average width (ft)	20	30
	average site depth (ft)	2.1	1.6
	average pool depth (ft)	2.7	3.1
	maximum pool depth (ft)	4.3	4.2
	flow (cfs)[2]	2	3
Habitat characteristics	dominant substrate	boulder	boulder
	sub-dominant substrate	bedrock	bedrock
	dominant cover type	wood	boulder
	channel confinement	shallow and deep	shallow and deep
	fish passage impediments present	no	no
	no. large woody debris pieces	1	0
	suitable spawning gravel (total area in sq ft)	4	0
	low-gradient riffle (% of site length)	0	0
	high-gradient riffle (% of site length)	0	0
	run (% of site length)	0	0
	Step-run (% of site length)	60	56
	pool (% of site length)	40	44

[1] Coordinates: upstream easting-665262, northing- 4362725; downstream easting- 665213, northing- 4362705.
[2] Flow was determined from the LCB gage (CDEC 2013).

Species composition and relative abundance at the site remained similar between 2012 and 2013 (Figure 3.2-4). Rainbow trout made up the majority of the catch numerically, followed by Sacramento sucker, and smallmouth bass (*Micropterus dolomieu*; one fish in 2012 and two in 2013).

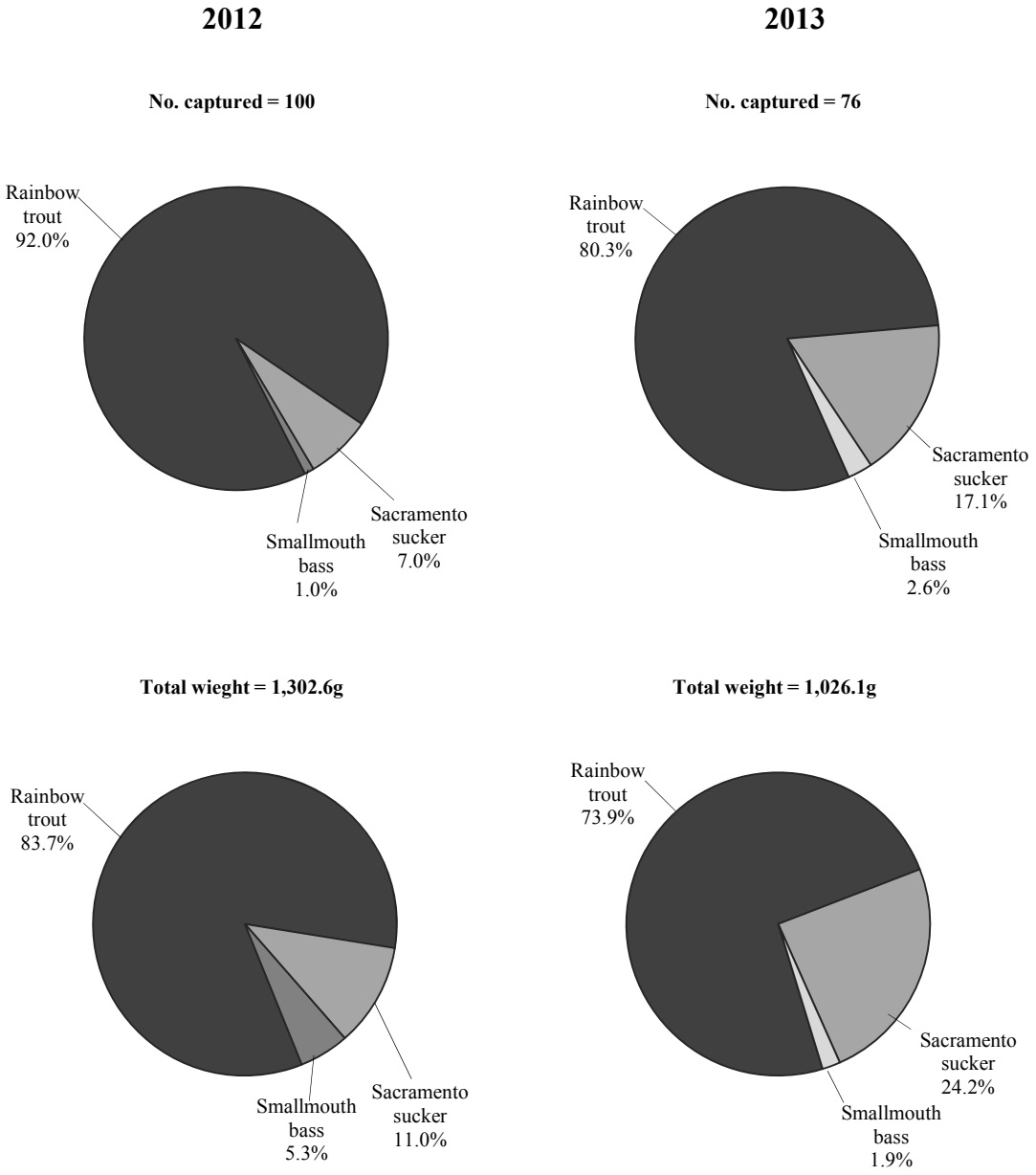

Figure 3.2-4. Proportion, by number and weight, of fish species sampled at the Oregon Creek Upstream of Middle Yuba River Site in 2012 and 2013.

Table 3.2-6 summarizes fish population data at this site, Oregon Creek Upstream of Middle Yuba River. The estimated rainbow trout density in 2012 was greater than in 2013 (i.e., 2,266 fish/mi and 1,430 fish/mi, respectively). Conversely, Sacramento sucker density increased in 2013. Biomass for rainbow trout and Sacramento sucker followed similar trends as density due to similar mean weights between years. Condition factor for rainbow trout ranged from 0.66 to 1.33 in 2012 and 0.84 to 1.17 in 2013. Sacramento sucker had condition factors ranging from 0.92 to 1.08 in 2012 and 0.81 to 1.26 in 2013 (Table 3.2-6). With exception of a single

Sacramento sucker, fish were vigorous and free of parasites. An unidentified species of anchor worm was found on one Sacramento sucker as illustrated in Figure 3.2-5.

Multiple age classes were observed for rainbow trout each sample year in similar proportions. A prevalence of age-0 rainbow trout indicated population recruitment in both years, followed by lower numbers of age-1 fish, and just a few larger age-2 fish. A shift in Sacramento sucker age-class distribution from entirely age-1 fish in 2012 to multiple age classes in 2013 was documented. The single smallmouth bass in 2012 was categorized as age-1 while the two captured in 2013 were age-0 and age-1. The length-frequency distribution for rainbow trout and Sacramento sucker is presented in Figure 3.2-6.

Figure 3.2-5. Unidentified species of anchor worm found attached to a Sacramento sucker at the Oregon Creek Upstream of Middle Yuba River Site.

Table 3.2-6. Summary of fish population information for Oregon Creek Upstream of Middle Yuba Site (RM 0.3).

Species		Rainbow trout		Sacramento sucker		Smallmouth bass	
Year		2012	2013	2012	2013	2012	2013
Abundance	no. collected by pass (total)	68-17-7 (92)	33-13-10-5 (61)	5-1-1 (7)	8-2-2-1 (13)	0-1-0 (1)	1-0-0-1 (2)
	% of fish collected	92.0%	80.3%	7.0%	17.1%	1.0%	2.6
	estimated section abundance	94	65	7	13	1	2
	95% confidence interval	92-98	61-72	7-8	13-15	1-1	2-15
	Relative Stock Density	3	7	n/a	8	100	n/a
	fish/100m	141	89	18	15	1	3
	fish/mi	2,266	1,430	169	286	24	44
Fork length (mm)	mean (range)	93 (56-171)	96 (49-168)	115 (79-132)	109 (78-158)	169	85 (75-95)
Biomass	weight of fish collected (g)	1,089.7	757.7	143.7	248.6	69.2	19.8
	mean weight (g) (range)	11.8 (2.0-56.5)	12.4 (1.2-47.8)	20.5 (10.8-30.2)	19.1 (6.5-35.3)	69.2 (69.2)	9.9 (6.9-12.9)
	estimated section biomass (g)	1,109.2	807.4	143.7	248.6	69.2	19.8
	g/100m	1,661.3	1,103.4	215.2	339.8	103.6	27.1
	lbs/ac	23.9	10.8	3.1	3.3	1.5	0.3
	kg/ha	26.8	12.1	3.5	3.7	1.7	0.3
Condition factor	relative condition range	0.66-1.33	0.84-1.17	0.92-1.08	0.81-1.26	n/a	n/a
Age class frequency in fish/mile (% of total)	0	1,355 (59.8%)	820 (57.4%)	0 (0.0%)	75 (30.8%)	0 (0.0%)	22 (50.0%)
	1	714 (31.5%)	446 (31.1%)	169 (100.0%)	150 (61.5%)	24 (100.0%)	22 (50.0%)
	2 and older	197 (8.7%)	164 (11.5%)	0 (0.0%)	19 (7.7%)	0 (0%)	0 (0.0%)

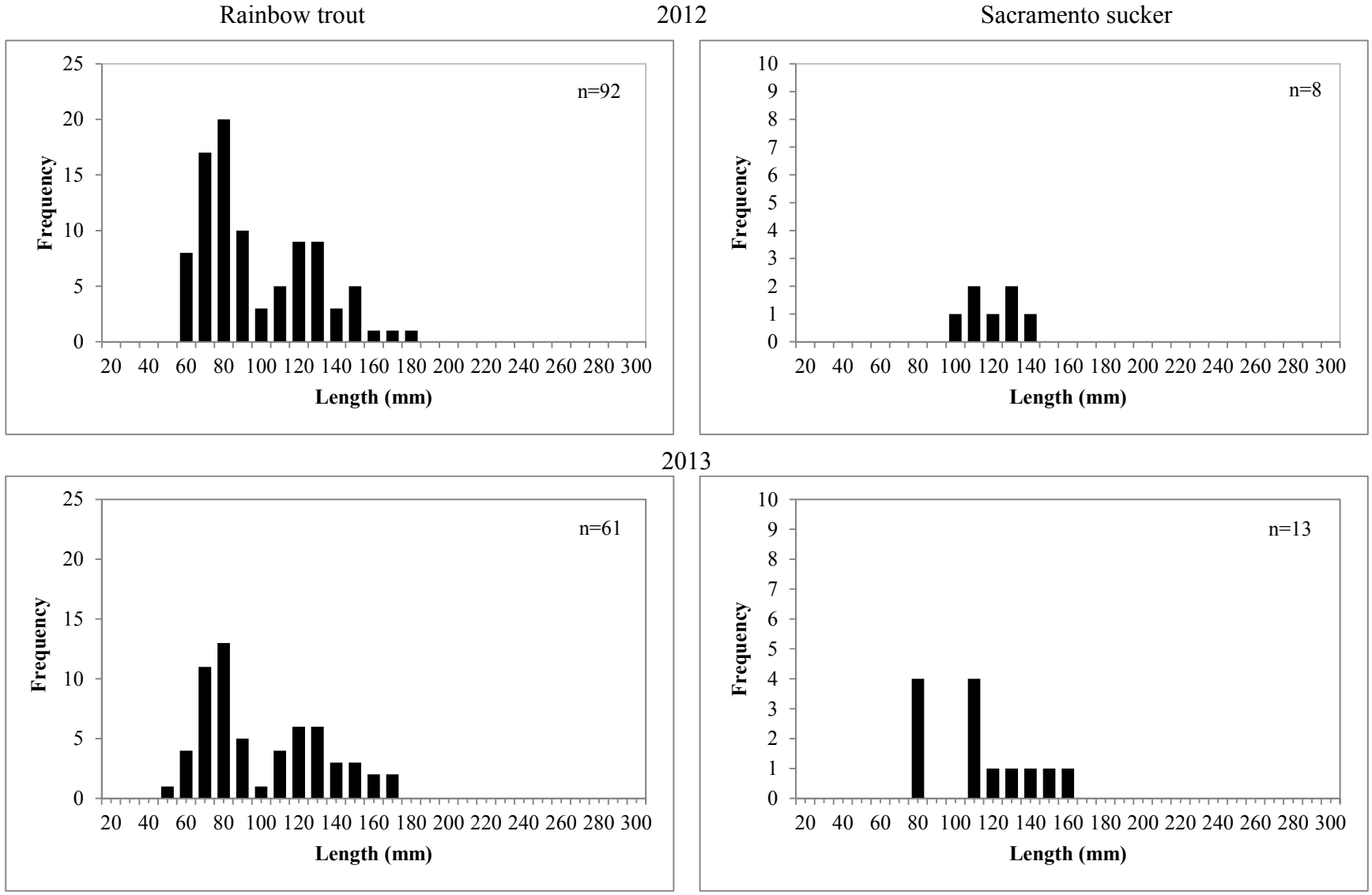

Figure 3.2-6. Length-frequency distribution of rainbow trout and Sacramento sucker collected by electrofishing in Oregon Creek upstream of the Middle Yuba River in 2012 and 2013.

3.2.2 Middle Yuba River

The Middle Yuba River is a 174.9 sq mi watershed with three facilities, YCWA's Our House Diversion Dam (RM 12.6) and Nevada Irrigation District's (NID's) Milton Diversion Dam (RM 44.8) and Jackson Meadows Dam (RM 47.0). Five sites were located on the Middle Yuba River, including one site above and four sites below Our House Diversion Dam. Three notable tributaries occur below Our House Diversion Dam: Oregon Creek at RM 4.7, Moonshine Creek at RM 3.5, and Yellowjacket Creek at RM 1.4. Sites were placed at RM 3.3 and RM 1.0 to address tributary flow input. Tables 3.2-7 and 3.2-8 provide an overview of fish species collected by site and calculated population metrics.

Table 3.2-7. Overview of fish composition collected or observed during electrofishing and snorkeling in the Middle Yuba River Sub-basin in 2012 and 2013.

Common Name	Scientific Name	Middle Yuba River Upstream of Our House Diversion Dam (RM 13.3)	Middle Yuba River Downstream of Our House Diversion Dam (RM 12.5)	Middle Yuba River Upstream of Oregon Creek (RM 5.0)	Middle Yuba River Downstream of Moonshine Creek (RM 3.3)	Middle Yuba River Downstream of Yellowjacket Creek (RM 1.0)
Rainbow trout	*Oncorhynchus mykiss*	•	•	•	•	•
Brown trout	*Salmo trutta*	•[1]	--	--	--	--
Sacramento pikeminnow	*Ptychocheilus grandis*	•	--	--	--	•
Sacramento sucker	*Catostomus occidentalis*	•	•	•	•	•
Smallmouth bass	*Micropterus dolomieu*	--	•	•	•	•

[1] Incidental collection during entrainment sampling.
• = species was captured or observed.

Table 3.2-8. Overview of fish population metrics in the Middle Yuba River Sub-basin.[1]

Stream Site	Year	Rainbow Trout			Sacramento Pikeminnow			Sacramento Sucker			Smallmouth Bass		
		Abund. (EF)	Biomass (EF)	Abund. (SN)	Abund. (EF)	Biomass (EF)	Abund. (SN)	Abund. (EF)	Biomass (EF)	Abund. (SN)	Abund. (EF)	Biomass (EF)	Abund. (SN)
		fish/mi	lbs/ac	fish/mi	fish/mi	lbs/ac	fish/mi	fish/mi	lbs/ac	fish/mi	fish/mi	lbs/ac	fish/mi
Middle Yuba River Upstream of Our House Dam (RM 13.3)	2012	409	9.8	--	131	0.6	--	917	10.1	--	--	--	--
	2013	--	--	--	16	0.1	--	160	0.6	--	--	--	--
Middle Yuba River Downstream of Our House Dam (RM 12.5)	2012	--	--	453	--	--	--	--	--	--	--	--	88
	2013	--	--	450	--	--	11	--	--	11	--	--	708
Middle Yuba River Upstream of Oregon Creek (RM 5.0)	2012	155	4.0	--	--	--	--	141	3.2	--	1,915	9.7	--
	2013	90	1.9	--	--	--	--	45	1.1	--	1,282	7.2	--
Middle Yuba River Downstream of Moonshine Creek (RM 3.3)	2012	--	--	613	--	--	--	--	--	91	--	--	126
	2013	--	--	350	--	--	--	--	--	65	--	--	212
Middle Yuba River Downstream of Yellowjacket Creek (RM 1.0)	2012	633	4.3	400	--	--	40	--	--	--	1,922	9.6	520
	2013	--	--	470	--	--	--	30	0.1	--	2,297	7	1,345

[1] EF = electrofished, SN = snorkeled

3.2.2.1 Middle Yuba River Upstream of Our House Diversion Dam

The Middle Yuba River Upstream of Our House Diversion Dam site was located at El. 2,046 ft, beyond the upstream extent of the FERC Project boundary. Sampling occurred on October 2, 2012 and September 4, 2013. Sampling was conducted by quantitative electrofishing for the entire site. Neither FYLF nor WPT were present within the site prior to electrofishing. Table 3.2-9 summarizes habitat and site information collected in 2012 and 2013. Site length averaged 327 ft with an average wetted width of 45 ft over the two sample events. Mesohabitat was comprised of low-gradient riffle and glide. Streamflow was slightly higher in 2013 based on the Middle Yuba River Below Our House Diversion Dam (ORH) gage (CDEC 2013). Cobble and boulder were the dominant and sub-dominant substrates. Spawning gravel suitable for resident trout, fish passage impediments, and LWM were not observed at this site. Water quality metrics were similar between years with only minor differences attributable to the fact that the 2013 sampling date occurred on a warmer day (i.e., elevated water temperature yields decreased capacity for dissolved gases).

Table 3.2-9. Habitat and site information for the Middle Yuba River Upstream of Our House Diversion Dam Site (RM 13.3).[1]

Sampling date		October 2, 2012	September 4, 2013
Weather	air temperature (°F)	64	95
	atmospheric conditions	sunny	sunny
Water quality	water temperature (°F)	60	67
	dissolved oxygen (mg/l)	9.18	7.86
	conductivity (µS/cm)	121	142
Site characteristics	elevation (ft msl)	2,046	2,046
	river mile	13.34	13.34
	site length (ft)	323	330
	average width (ft)	46	44
	average site depth	1.1	1.1
	average pool depth (ft)	na	na
	maximum pool depth (ft)	na	na
	flow (cfs)[2]	27	31
Habitat characteristics	dominant substrate	cobble	cobble
	sub-dominant substrate	boulder	boulder
	dominant cover type	none	none
	channel confinement	shallow	shallow
	fish passage impediments present	no	no
	no. large woody debris pieces	0	0
	suitable spawning gravel (total area in sq ft)	0	0
	low-gradient riffle (% of site length)	19	18
	high-gradient riffle (% of site length)	0	0
	run (% of site length)	0	0
	glide (% of site length)	81	82
	pool (% of site length)	0	0

[1] Coordinates: upstream easting-673325, northing- 4364411; downstream easting- 673223, northing- 4364440.
[2] Flow was determined from the ORH gage (CDEC 2013).

Sacramento sucker was the dominant species collected over both years of sampling at 63 percent and just over 90 percent of the total catch in 2012 and 2013, respectively. Rainbow trout

represented nearly 30 percent of the sample in 2012 but were not observed in 2013. A few Sacramento pikeminnow were observed in 2012 (n=8) and 2013 (n=1) making up just under 10 percent of the electrofishing catch in both years (Figure 3.2-7).

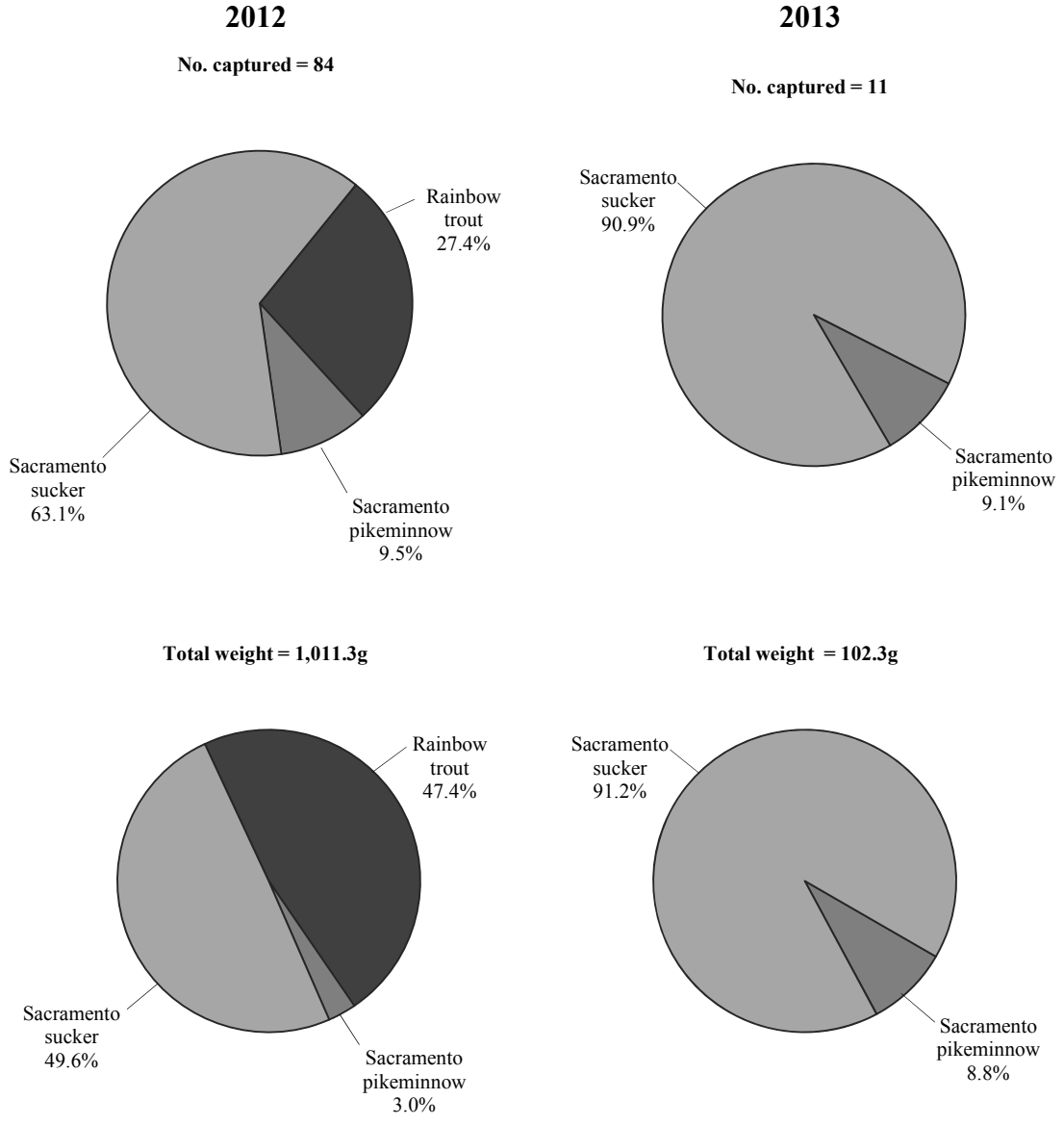

Figure 3.2-7. Proportion, by number and weight, of fish species sampled at the Middle Yuba River Upstream of Our House Dam Site in 2012 and 2013.

Table 3.2-10 summarizes the fish population data for the site. Rainbow trout, Sacramento pikeminnow, and Sacramento sucker were captured at this site in both years with the exception of rainbow trout, which were not captured in 2013. While not listed in the table, two brown trout

were collected as incidental catch during entrainment sampling in another study and are discussed later in this document.

Standardized density estimates of Sacramento suckers decreased in 2013 despite the fact that the species was the numerically dominant collected fish. As would be expected, rainbow trout density decreased to zero fish/mi in 2013 from 409 fish/mi and 9.8 lbs /ac in 2012. Sacramento pikeminnow density also decreased as would be expected due to the capture of only one specimen in 2013. The mean weight of Sacramento suckers was unchanged between 2012 and 2013 (~9.0 g.), though the difference in numbers yielded a density of 10.0 lbs/ac in 2012 and only 0.6 lbs/ac in 2013. Condition factor for rainbow trout ranged from 0.76 to 1.23 in 2012. Sacramento pikeminnow condition factors were only calculated in 2012 and ranged from 0.65 to 1.10. Sacramento sucker had condition factors ranging from 0.47 to 1.47 in 2012 and 0.73 to 1.25 in 2013. With exception of two Sacramento sucker, fish were vigorous and free of parasites. An unidentified species of anchor worm was found on two Sacramento suckers as illustrated in Figure 3.2-8.

Multiple age classes of Sacramento suckers were collected in both years, with a majority of fish collected falling into the age-0 size category (i.e., over 70% in both years). Age-1 fish were the next most common, followed by only a few specimens of age-2 or older fish. In 2012, rainbow trout captured were distributed among age-0 fish (~ 80%) and age-2 and older fish (20%), based on a total collection of 23 fish. Due to low collection numbers, pikeminnow age class distribution was harder to estimate, but generally favored age-0 fish in 2012 and a single age-1 fish in 2013. Thus, successful age-0 recruitment is evident for Sacramento suckers in both years, and for rainbow trout only in 2012. The length frequency distributions for fish commonly captured during electrofishing at this site are displayed in Figures 3.2-9 and 3.2-10.

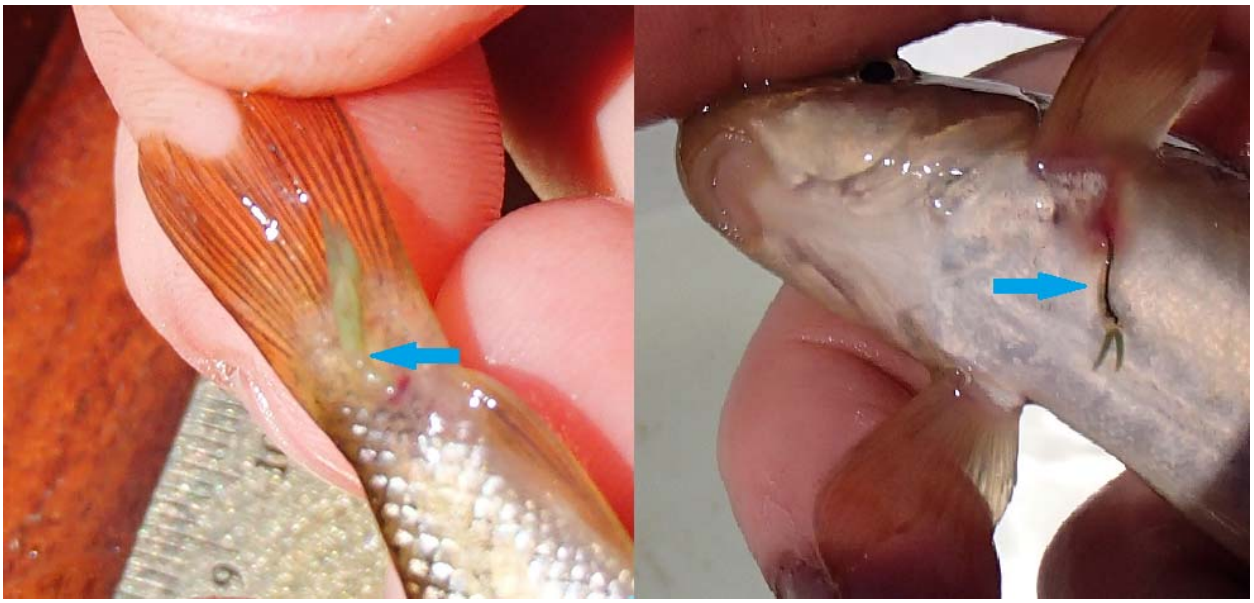

Figure 3.2-8. Unidentified species of anchor worms found on Sacramento suckers in the Middle Yuba River above Our House Dam.

Table 3.2-10. Summary of fish population information for the Middle Yuba River Upstream of Our House Diversion Dam Site (RM 13.3).

Species		Rainbow trout		Sacramento pikeminnow		Sacramento sucker	
Year		2012	2013	2012	2013	2012	2013
Abundance	no. collected by pass (total)	12-8-3 (23)	0-0-0	5-2-1 (8)	1-0-0 (1)	33-14-6 (53)	7-3-0 (10)
	% of fish collected	27.4%	0.0%	9.5%	9.1%	63.1%	90.9%
	estimated section abundance	25	0	8	1	56	10
	95% confidence interval	23-31	--	8-10	1	53-62	10
	Relative Stock Density	17	n/a	n/a	n/a	2	n/a
	fish/100m	25	0	8	1	57	10
	fish/mi	409	0	131	16	917	160
Fork length (mm)	mean (range)	98.3 (57-258)	--	70.8 (62-82)	106 (106)	84.9 (56-162)	88 (62-126)
Biomass	weight of fish collected (g)	479.3	--	30.6	9	501.4	93.3
	mean weight (g) (range)	20.8 (2.1-153.9)	--	3.8 (2.2-8.2)	9 (9)	9.5 (2.1-46.2)	9.3 (3.3-23)
	estimated section biomass (g)	520.0	0	30.6	9	532.0	93.3
	g/100m	528.9	0	31.1	9	541.1	92.7
	lbs/ac	9.8	0	0.6	0.1	10.1	0.6
	kg/ha	11.0	0	0.6	0.1	11.3	0.7
Condition factor	relative condition range	0.76-1.23	--	0.65-1.10	n/a	0.47-1.47	0.73-1.25
Age class frequency in fish/mile (% of total)	0	327 (80%)	--	131 (100%)	0 (0.0%)	753 (82.1%)	112 (70.0%)
	1	0 (0%)	--	0 (0.0%)	16 (100.0%)	147 (16.1%)	48 (30.0%)
	2 and older	82 (20%)	--	0 (0.0%)	0 (0.0%)	16 (1.8%)	0 (0.0%)

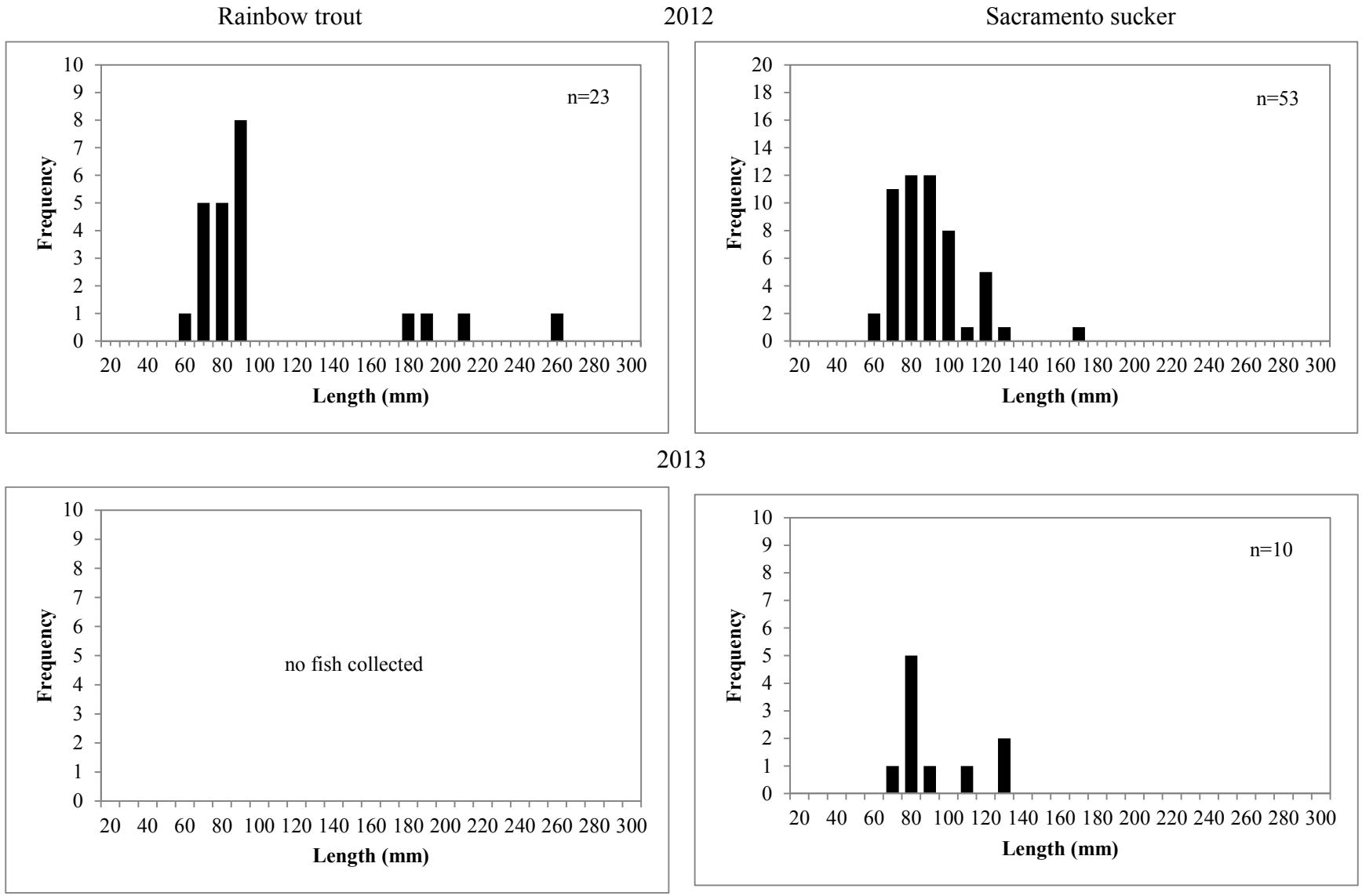

Figure 3.2-9. Length-frequency distribution of rainbow trout and Sacramento sucker collected by electrofishing at the Middle Yuba.

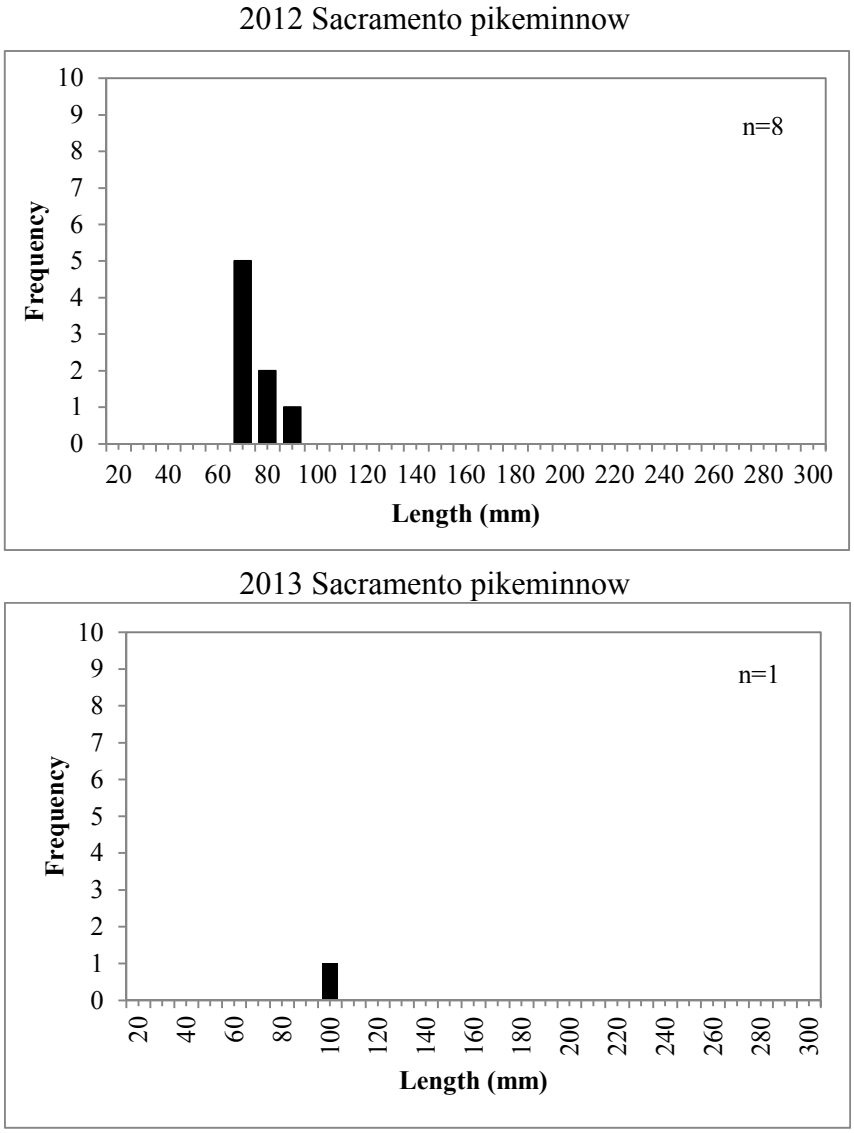

Figure 3.2-10. Length-frequency distribution of smallmouth bass collected by electrofishing at the Middle Yuba River Upstream of Our House Dam Site in 2012.

During YCWA's relicensing Study 3.11, *Entrainment*, YCWA conducted backpack electrofishing along with hook and line sampling for rainbow and brown trout in the Our House Diversion Dam impoundment approximately 1.3 mi upstream of the impoundment. The eight-day sampling effort took place from September 24 to October 5, 2012. The effort resulted in the capture of 187 rainbow trout representing all life stages (Figure 3.2-11). In addition, two brown trout were collected during sampling.

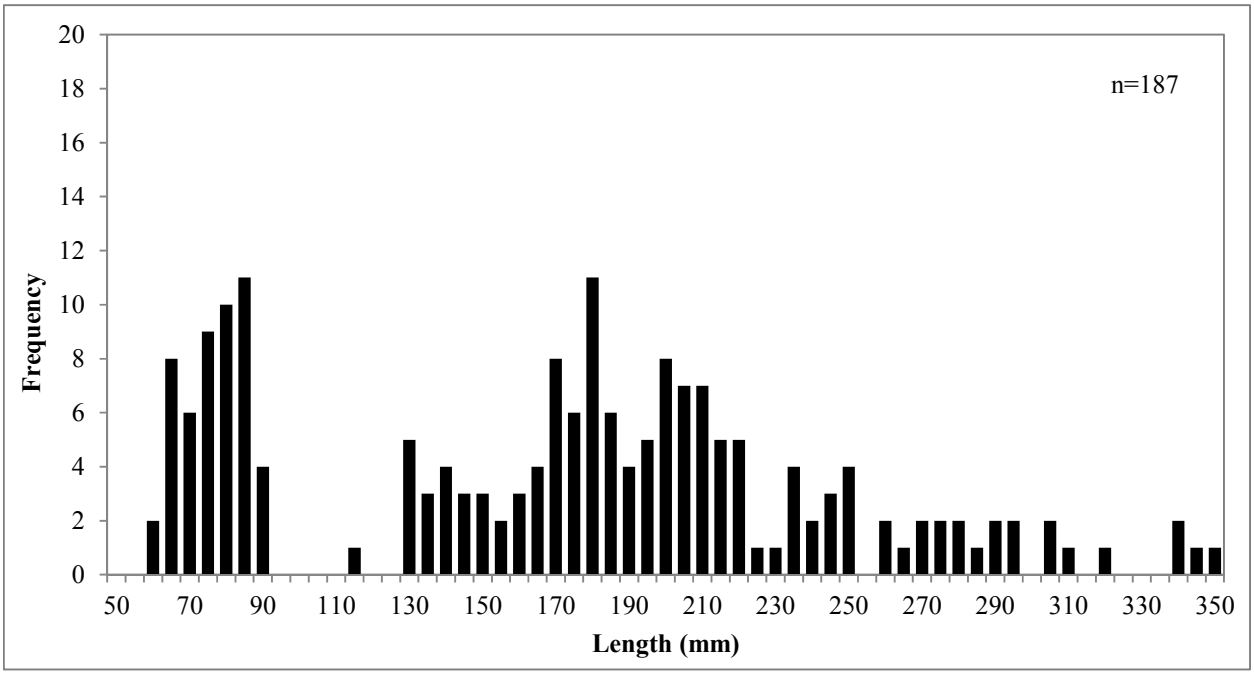

Figure 3.2-11. Length frequency of rainbow trout captured on Middle Yuba River upstream of Our House Diversion Dam during YCWA's relicensing Study 3.11, *Entrainment*, in 2012.[1]

[1] Note: two brown trout were collected and are not shown (FL: 235mm and 273mm).

3.2.2.2 Middle Yuba River Downstream of Our House Diversion Dam

The Middle Yuba River Downstream of Our House Diversion Dam site is located at El. 1,948 ft. Sampling occurred on September 15, 2012 and September 12, 2013. Due to deep-water conditions sampling was conducted by quantitative snorkeling. Neither FYLF nor WPT were observed at the site prior to sampling. Table 3.2-11 summarizes habitat and site information collected. Site length and wetted width for the two sample periods averaged 474 ft long and 48 ft wide. Mesohabitat types identified at the site were run, pocket-water, and pool. Streamflow based on the ORH gage remained similar between 2012 and 2013 (CDEC 2013). Boulder and cobble were the dominant and sub-dominant substrates. LWM was absent at the sampling site. No potential fish passage impediments were observed at this site.[4] Resident trout-sized spawning gravel was observed both years. Water temperature was similar between the two sample periods, while DO was lower in 2013.

4 The Middle Yuba River Downstream of Our House Diversion Dam site was bordered by a short cascade which was recorded on the field datasheet as a potential barrier, but was not actually within the sampling site.

Table 3.2-11. Habitat and site information for the Middle Yuba River Downstream of Our House Diversion Dam Site (RM 12.5).[1]

Sampling date		September 15, 2012	September 12, 2013
Weather	air temperature (°F)	77	81
	atmospheric conditions	sunny	sunny
Water quality	water temperature (°F)	69	68
	dissolved oxygen (mg/l)	8.82	7.97
	conductivity (µS/cm)	131	147
Site characteristics	elevation (ft msl)	1,948	1,948
	river mile	12.47	12.47
	site length (ft)	482	465
	average width (ft)	47	48.5
	average site depth	3	3
	average pool depth (ft)	3.4	3.9
	maximum pool depth (ft)	5	10
	flow (cfs)[2]	28	26
Habitat characteristics	dominant substrate	boulder	boulder
	sub-dominant substrate	cobble	cobble
	dominant cover type	boulder	boulder
	channel confinement	shallow, moderate, deep	shallow, moderate, deep
	fish passage impediments present	no	no
	no. large woody debris pieces	0	0
	suitable spawning gravel (total area in sq ft)	20	29
	low-gradient riffle (% of site length)	0	0
	high-gradient riffle (% of site length)	0	0
	run (% of site length)	31	32
	pocket water (% of site length)	10	14
	pool (% of site length)	58	55

[1] Coordinates: upstream easting-672096, northing- 4364098; downstream easting- 672207, northing- 4364176.
[2] Flow was determined from the ORH gage (CDEC 2013).

Species composition and relative abundance changed at the site over the 2-year study (Figure 3.2-12). Rainbow trout was the most common species collected in 2012 (83.7%) but comprised a smaller proportion of the population in 2013 (38.4%). Smallmouth bass made up the majority of species captured in 2013 (59.6%). Two previously unobserved species, Sacramento pikeminnow and Sacramento sucker, were observed in 2013.

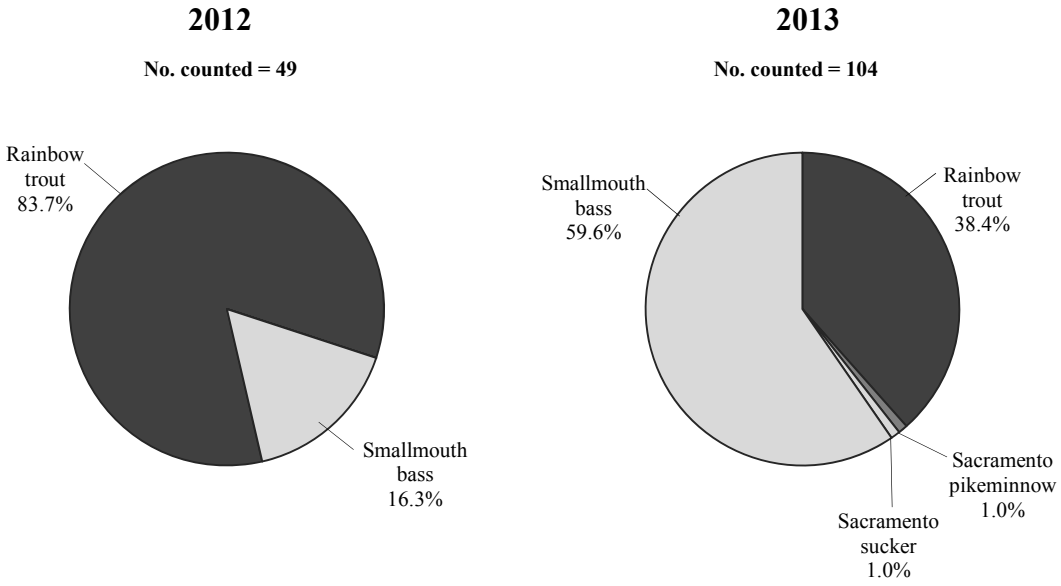

Figure 3.2-12. Proportion, by number, of fish species observed during snorkeling at the Middle Yuba River Downstream of Our House Dam Site in 2012 and 2013.

Although rainbow trout made up a smaller proportion of the assemblage in 2013, population density remained similar during the 2-year study (Table 3.2-12). Smallmouth bass density increased over eight-fold to 708 fish/mi in 2013 from 88 fish/mi in 2012.

Supplemental electrofishing was conducted in accessible habitat upstream of the snorkel site in both 2012 and 2013. A total of ten fish including rainbow trout (n=2), smallmouth bass (n=7), and Sacramento sucker (n=1) was captured over the two years of sampling. The two rainbow trout measured 138 mm and 185 mm in length and weighed 48.2 g and 76.1 g. Smallmouth bass ranged in length from 134 mm–165 mm and weight ranged from 32.9 g–65.8 g. The single Sacramento sucker measured 220 mm and weighed 139.2 g. Minimum, maximum, and average length and weight data is presented in Table 3.2-12.

The two rainbow trout both had condition factors of 1.07 as compared to the baseline sample of rainbow trout captured in the Middle Yuba River. Condition factors for smallmouth bass (Table 3.2-13) ranged from 0.89 to 0.94 in 2012 and 0.98–1.10 in 2013. Sacramento sucker were only captured in 2013 and had a condition factor of 0.95. Insufficient data was collected to calculate condition factor for Sacramento pikeminnow. Snorkelers noted several larger rainbow trout which appeared to have lesions associated with the unidentified species of anchor worm observed upstream of Our House Dam. Observers were unable to take photographs of these fish.

Few age-0 rainbow trout were observed in 2012, and age-0 rainbow trout were absent from the population the following year. Older fish (age-2+) were observed in 2012, while age-1 rainbow trout were represented most in 2013. Multiple age classes were present each year for smallmouth bass but age-1 was most common in both study years. The length-frequency distribution for rainbow trout and smallmouth bass is presented in Figure 3.2-13.

Table 3.2-12. Summary of minimum, maximum, and average lengths and weights for fish captured during supplemental electrofishing at the Middle Yuba Downstream of Our House Dam in 2012 and 2013.

Year	Species	Length (mm)			Weight (g)			n
		Minimum	Maximum	Average	Minimum	Maximum	Average	
2012	Rainbow trout	158	185	172	48.2	76.1	62.2	2
	Smallmouth bass	134	157	146	32.9	50.1	41.5	2
2013	Rainbow trout	180	205	192.5	95.3	103.5	99.4	2
	Smallmouth bass	157	165	161	57.3	65.8	60.8	5
	Sacramento sucker	220	220	220	139.2	139.2	139.2	1

Table 3.2-13. Summary of quantitative snorkeling population data for the Middle Yuba River Downstream of Our House Diversion Dam Site (RM 12.5).

Species		Rainbow trout		Smallmouth bass		Sacramento pikeminnow		Sacramento sucker	
Year		2012	2013	2012	2013	2012	2013	2012	2013
Abundance	no. counted by pass	41-40-43	38-39-42	6-6-12	55-65-67	0-0-0	2-1-0	0-0-0	2-1-0
	% of total fish counted	83.7%	38.4%	16.3%	59.6%	0%	1.0%	0%	1.0%
	estimated section abundance	41	40	8	62	0	1	0	1
	95% confidence interval	40-42	38-42	5-11	56-69	--	0-2	--	0-2
	Relative Stock Density	76	45	21	20	n/a	100	n/a	100
	fish/100m	28	28	5	44	0	1	0	1
	fish/mi	453	450	88	708	0	11	0	11
Fork length (51 mm size groups)	min	51-102	103-152	51-102	51-102	--	153-203	--	153-203
	max	357+	255-305	153-203	204-254	--	153-203	--	204-254
	mean	153-203	153-203	103-152	103-152	--	153-203	--	204-254
Condition factor	relative condition range	1.07-1.07	--	0.89-0.94	0.98-1.10	--	--	--	0.95-0.95
Age class frequency in fish/mile (% of total)	0	4 (0.8%)	0 (0.0%)	7 (8.3%)	151 (21.4%)	--	0 (0.0%)	--	0 (0.0%)
	1	106 (23.4%)	246 (54.6%)	62 (70.8%)	413 (58.3%)	--	0 (0.0%)	--	0 (0.0%)
	2 and older	344 (75.8%)	204 (45.4%)	18 (20.8%)	144 (20.3%)	--	11 (100.0%)	--	11 (100.0%)

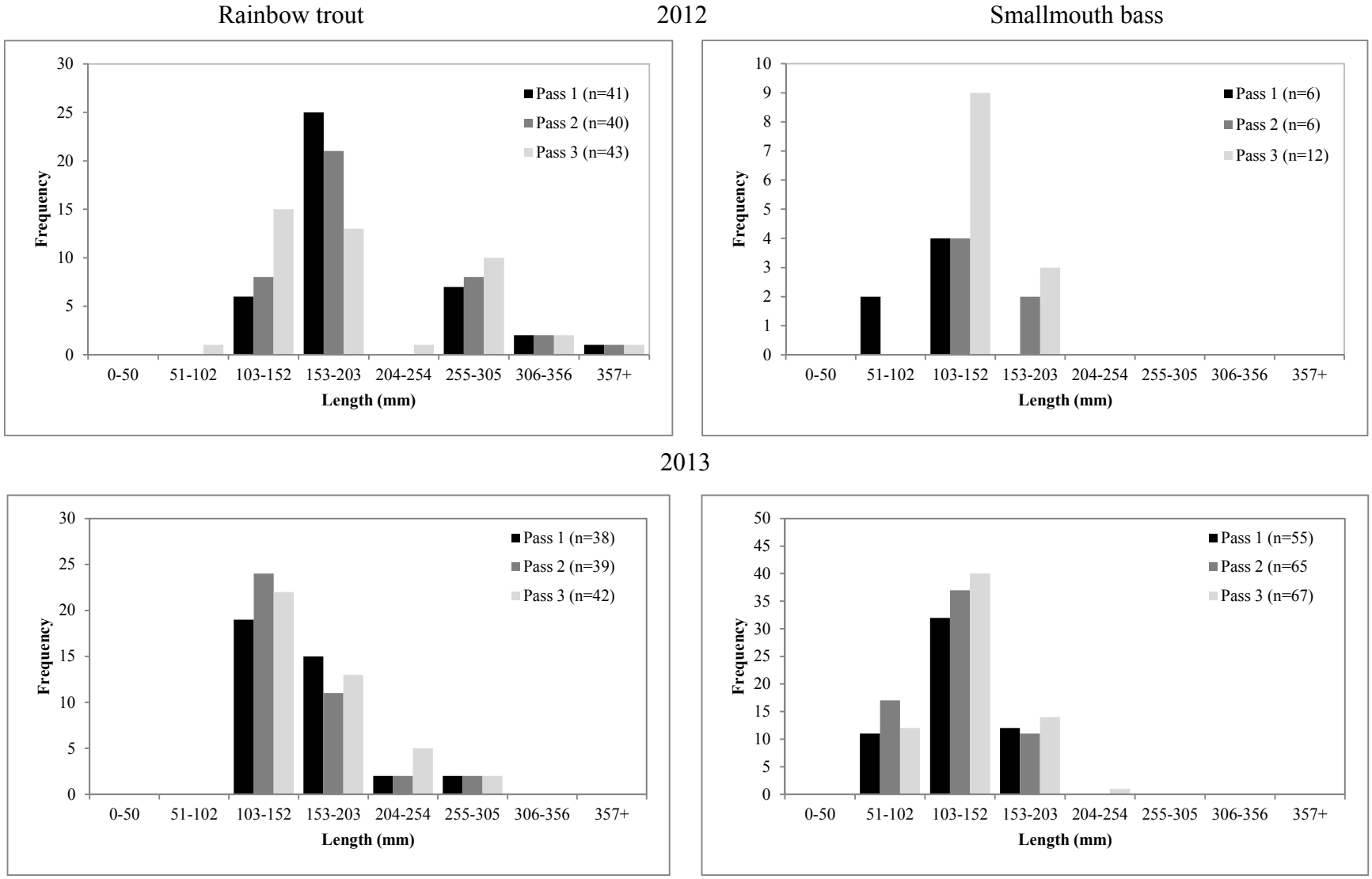

Figure 3.2-13. Length-frequency distribution for rainbow trout and smallmouth bass observed by snorkeling at the Middle Yuba River Downstream of Our House Diversion Dam Site in 2012 and 2013.

3.2.2.3 Middle Yuba River Upstream of Oregon Creek

The Middle Yuba River Upstream of Oregon Creek Site is located at an elevation of. 1,470 ft. Sampling occurred on September 12, 2012 and September 5, 2013. Table 3.2-14 summarizes the habitat and site information collected. Quantitative electrofishing was conducted over the entire site. Neither FYLF nor WPT were present in the site prior to electrofishing. Site length averaged 363 ft with an average wetted width of 45 ft during the two sample periods. Mesohabitat types at the site included pocket-water and pool. Streamflow remained similar during each sample event based on the ORH gage (CDEC 2013). Boulder and cobble were the dominant and sub-dominant substrates. Resident trout-sized spawning gravel was observed at the site in 2012, but was not documented in 2013. No impediments to fish passage or LWM were documented either study year. Water temperature during sampling was higher in 2013, while dissolved oxygen was lower. Among other water quality parameters that were measured on site in 2012; conductivity was 129.1 µS/cm, DO was 9.19 mg/L, and water temperature was 66°F.

Table 3.2-14. Habitat and site information for the Middle Yuba River Upstream of Oregon Creek Site (RM 5.0).[1]

Sampling date		September 12, 2012	September 5, 2013
Weather	air temperature (°C)	84	77
	atmospheric conditions	sunny	sunny
Water quality	water temperature (°C)	66	69
	dissolved oxygen (mg/l)	9.19	7.56
	conductivity (µS/cm)	129.1	134.3
Site characteristics	elevation (ft msl)	1,470	1,470
	river mile	5.04	5.04
	site length (ft)	375	350
	average width (ft)	44.0	46.3
	average site depth	2.4	2.2
	average pool depth (ft)	2.8	--
	maximum pool depth (ft)	4.2	--
	flow (cfs)[2]	29	31
Habitat characteristics	dominant substrate	boulder	boulder
	sub-dominant substrate	cobble	cobble
	dominant cover type	boulder	boulder
	channel confinement	moderate	moderate
	fish passage impediments present	no	no
	no. large woody debris pieces	0	0
	suitable spawning gravel (total area in sq ft)	12	0
	low-gradient riffle (% of site length)	0	0
	high-gradient riffle (% of site length)	0	0
	glide (% of site length)	0	0
	pocket water (% of site length)	26	41
	pool (% of site length)	74	59

[1] Coordinates: upstream easting-665535, northing- 4362225; downstream easting- 665448, northing- 4362196.
[2] Flow was determined from the ORH gage (CDEC 2013).

Rainbow trout, Sacramento sucker, and smallmouth bass were collected at this site in both years with smallmouth bass comprising the majority of the catch at 85.0 percent and 87.7 percent of

the total captured fish in 2012 and 2013, respectively. Rainbow trout and Sacramento sucker were also present but only made up 7.9 percent and 7.1 percent of the total number of fish captured in 2012, and 8.2 percent and 4.1 percent of the total captured in 2013, respectively (Figure 3.2-14).

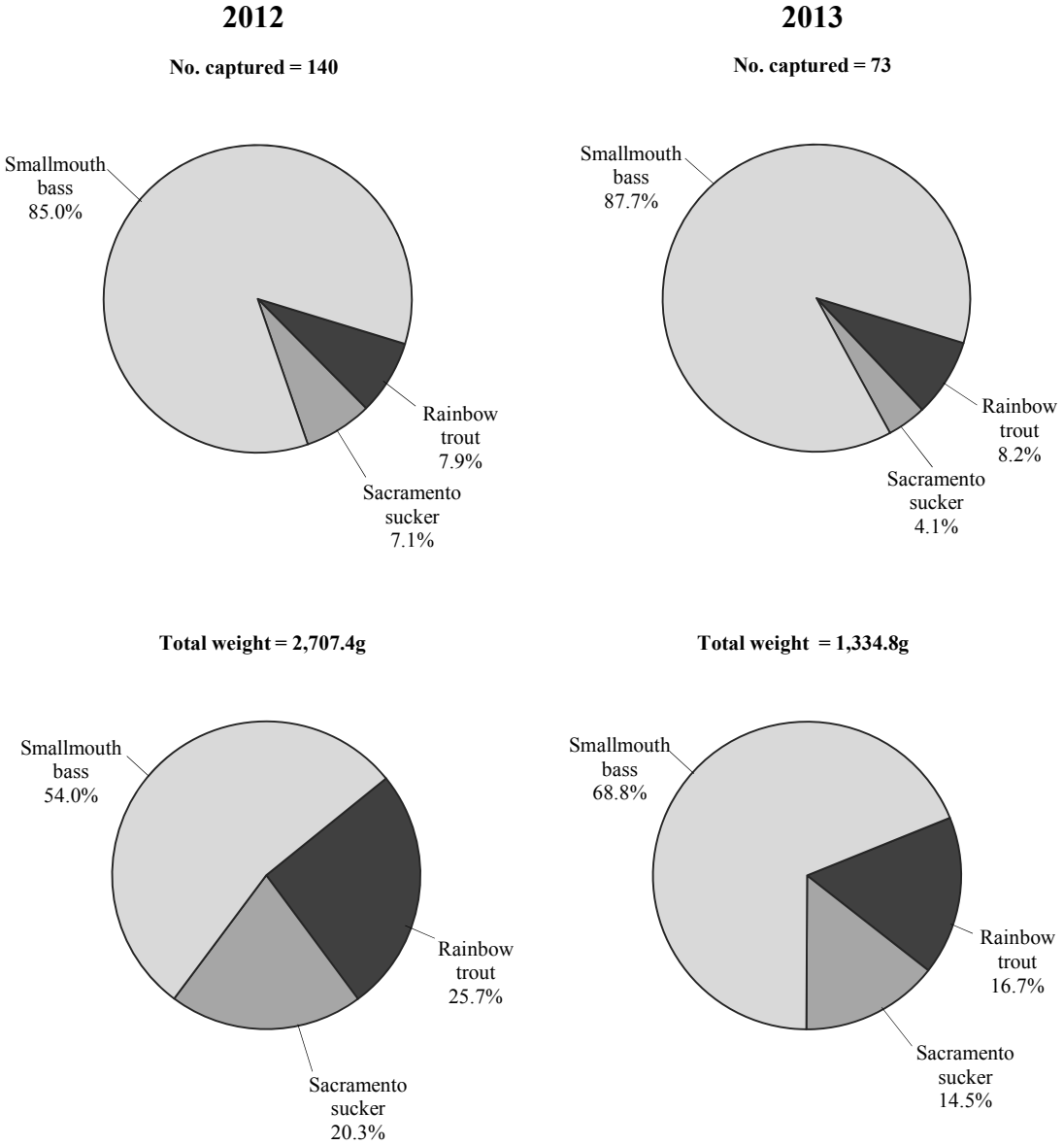

Figure 3.2-14. Proportion, by number and weight, of fish species sampled at the Middle Yuba River Upstream of Oregon Creek Site in 2012 and 2013.

Table 3.2-15 summarizes the fish population data for the site. Rainbow trout, Sacramento sucker, and smallmouth bass were collected at this site. Smallmouth bass made up the majority of the catch numerically in both 2012 and 2013. The smallmouth bass extrapolated density was estimated at 1,915 fish/mi in 2012 and slightly lower, at 1,282 fish/mi in 2013. Rainbow trout

density was estimated at 155 fish/mi in 2012 and 90 fish/mi in 2013. In fact, smallmouth bass were over ten times as abundant as either rainbow or suckers, with an estimated reach abundance of 136 and 85 in 2012 and 2013, respectively. In all species density estimates decreased by a factor of about half from 2012 to 2013 (Table 3.2-15). Concurrent with the decrease in the number of captured fishes, estimates of biomass for the area decreased in 2013 for all species. From 2012 to 2013, rainbow trout biomass decreased from 4.0 to 1.9 lbs/ac, Sacramento sucker density decreased by a similar factor from 3.2 to 1.1 lbs/ac, and smallmouth bass density decreased from 9.7 to 7.2 lbs/ac. For all species however, the mean weight of fish (g) remained consistent between years, despite the aforementioned changes in density. Condition factors for rainbow trout ranged from 0.79 to 1.41 in 2012 and 0.81 to 1.03 in 2013. Sacramento sucker condition factors ranged from 0.76 to 1.08 in 2012 and 0.81 to 1.02 in 2013. Smallmouth bass had condition factors ranging from 0.67 to 1.34 in 2012 and 0.69 to 1.54 in 2013. In general, fish were vigorous and free of parasites.

Due to relatively robust sample numbers, there are adequate data to determine the age-frequency distribution of fish collected at this site. Multiple age classes were present for all species captured. The abundance of age-0 smallmouth bass in both years (82.4% and 86.0%) clearly indicates age-0 recruitment and regular reproduction. The rainbow trout specimens captured were mostly age-2 or older fish in both 2012 (90.0%) and 2013 (83.3%). Sacramento suckers were also mostly represented by age-2 or older fish in both years (50% in 2012 and 66.7% in 2013) with fewer representatives from the other age classes. Length-frequency distributions for captured fish at Middle Yuba above Oregon Creek are displayed in Figures 3.2-15 and 3.2-16 by species.

Table 3.2-15. Summary of fish population information for the Middle Yuba River Upstream of Oregon Creek Site (RM 5.0).

Species		Rainbow trout		Sacramento sucker		Smallmouth bass	
Year		2012	2013	2012	2013	2012	2013
Abundance	no. collected by pass (total)	6-2-2-1 (11)	2-2-1-1 (6)	5-4-1-0 (10)	0-3-0-0 (3)	54-30-26-9 (119)	23-19-14-8 (64)
	% of fish collected	7.9%	8.2%	7.1%	4.1%	85.0%	87.7%
	estimated section abundance	11	6	10	3	136	85
	95% confidence interval	11-13	6-9	10-11	3-6	119-153	64-114
	Relative Stock Density	83	91	67	30	11	3
	fish/100m	10	6	9	3	119	80
	fish/mi	155	90	141	45	1,915	1,282
Fork length (mm)	mean (range)	177 (144-213)	169 (135-218)	135 (49-294)	173 (147-196)	85 (42-181)	91 (55-195)
Biomass	weight of fish collected (g)	695.5	334.4	550.8	193.5	1461.6	918.4
	mean weight (g) (range)	63.2 (32.3-110.5)	55.7 (27.9-111.5)	55.1 (1.5-304.4)	64.5 (41.6-82.6)	12.3 (1.0-72.5)	14.4 (3.1-91.8)
	estimated section biomass (g)	695.5	34.4	551.0	193.5	1,672.8	1,219.8
	g/100m	608.3	313.4	481.9	181.0	1,463.1	1,143.0
	lbs/ac	4.0	1.9	3.2	1.1	9.7	7.2
	kg/ha	4.5	2.2	3.6	1.3	10.9	8.1
Condition factor	relative condition range	0.79-1.14	0.81-1.03	0.76-1.08	0.81-1.02	0.67-1.34	0.69-1.54
Age class frequency in fish/mile (% of total)	0	0 (0.0%)	0 (0.0%)	42 (30.0%)	0 (0.0%)	1,577 (82.4%)	1,102 (86.0%)
	1	14 (9.1%)	15 (16.7%)	28 (20.0%)	15 (33.3%)	322 (16.8%)	140 (10.9%)
	2 and older	141 (90.9%)	75 (83.3%)	70 (50.0%)	30 (66.7%)	16 (0.8%)	40 (3.1%)

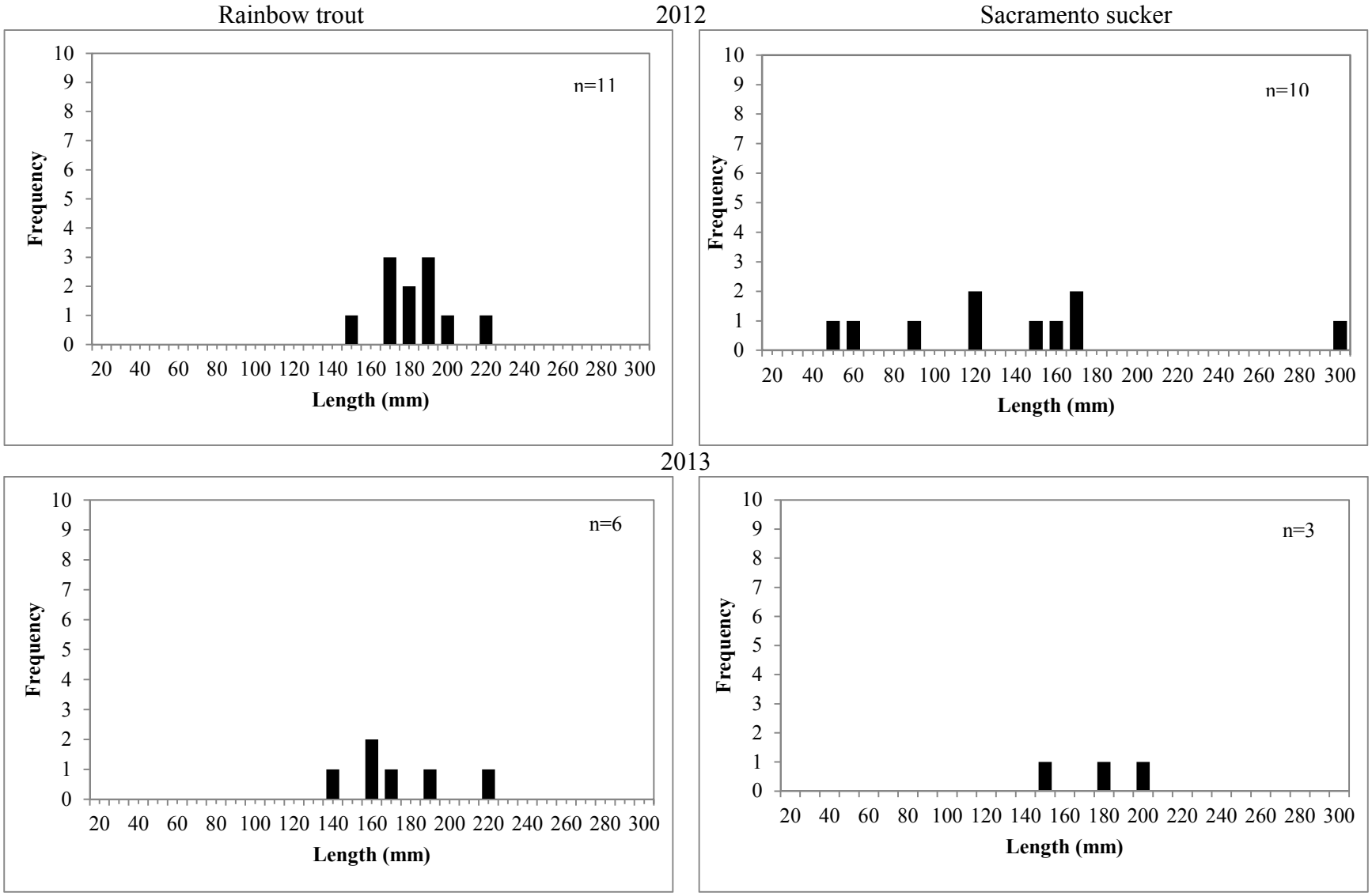

Figure 3.2-15. Length-frequency distribution of rainbow trout and Sacramento sucker collected by electrofishing at the Middle Yuba River Upstream of Oregon Creek Site in 2012 and 2013.

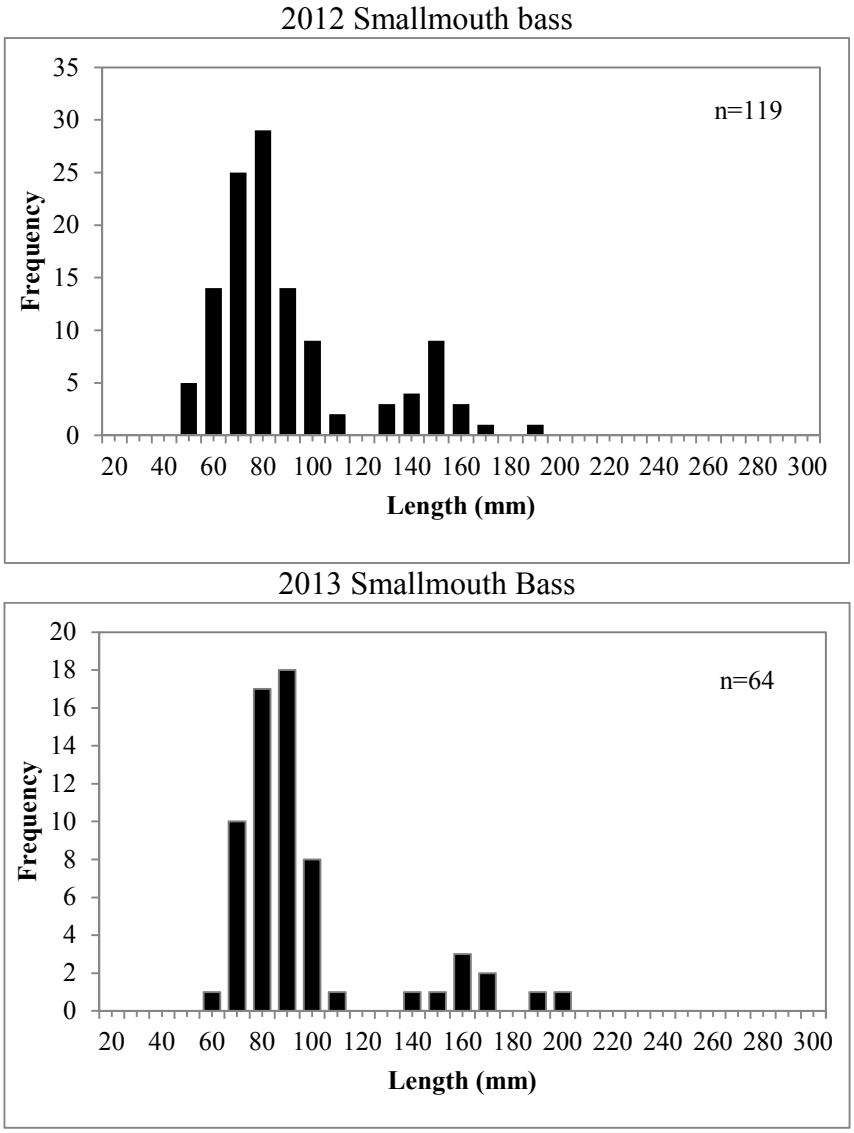

Figure 3.2-16. Length-frequency distribution of smallmouth bass collected by electrofishing at the Middle Yuba River Upstream of Oregon Creek Site in 2012 and 2013.

3.2.2.4 Middle Yuba River Downstream of Moonshine Creek

The Middle Yuba River Downstream of Moonshine Creek site is located at El. 1,398 ft. Sampling occurred on September 17, 2012 and September 9, 2013. Due to deep-water conditions, sampling was conducted by quantitative snorkeling. Neither FYLF nor WPT were observed in the site prior to sampling. Table 3.2-16 summarizes habitat and site information collected. Site length and wetted width for the two sample years averaged 607 ft long and 48 ft wide. The mesohabitat was comprised of runs and pools. Streamflow based on the combined flow of the LCB and ORH gages remained the same for both sample years (CDEC 2013). Bedrock and boulder were the dominant and sub-dominant substrates. LWM and fish passage impediments were not documented. Approximately 200 sq ft of suitable resident trout spawning

gravel was identified in 2012, but was not documented in 2013. Water temperature and DO were similar between sample events.

Table 3.2-16. Habitat and site information for the Middle Yuba River Downstream of Moonshine Creek Site (RM 3.3).[1]

Sampling date		September 17, 2012	September 9, 2013
Weather	air temperature (°F)	90	93
	atmospheric conditions	sunny	sunny
Water quality	water temperature (°F)	67	67
	dissolved oxygen (mg/l)	8.18	8.53
	conductivity (µS/cm)	133	146
Site characteristics	elevation (ft msl)	1,398	1,398
	river mile	3.29	3.29
	site length (ft)	617	597
	average width (ft)	45	51.3
	average site depth	4.0	3.3
	average pool depth (ft)	4.5	6.9
	maximum pool depth (ft)	10.8	12.3
	flow (cfs)[2]	30	30
Habitat characteristics	dominant substrate	bedrock	bedrock
	sub-dominant substrate	boulder	boulder
	dominant cover type	boulder	boulder
	channel confinement	shallow and deep	shallow and deep
	fish passage impediments present	no	no
	no. large woody debris pieces	0	0
	suitable spawning gravel (total area in sq ft)	200	0
	low-gradient riffle (% of site length)	0	0
	high-gradient riffle (% of site length)	0	0
	run (% of site length)	42	46
	glide (% of site length)	0	0
	pool (% of site length)	58	54

[1] Coordinates: upstream easting-663859, northing- 4361336; downstream easting- 663743, northing- 4361200.
[2] Flow was determined from the combined flow of the LCB and ORH gages (CDEC 2013).

Species composition and relative abundance remained similar over the two-year study (Figure 3.2-17). Rainbow trout was the most abundant species observed each year, although the abundance of smallmouth bass increased more than two-fold in 2013. Sacramento sucker represented nearly the same proportion of the population each year.

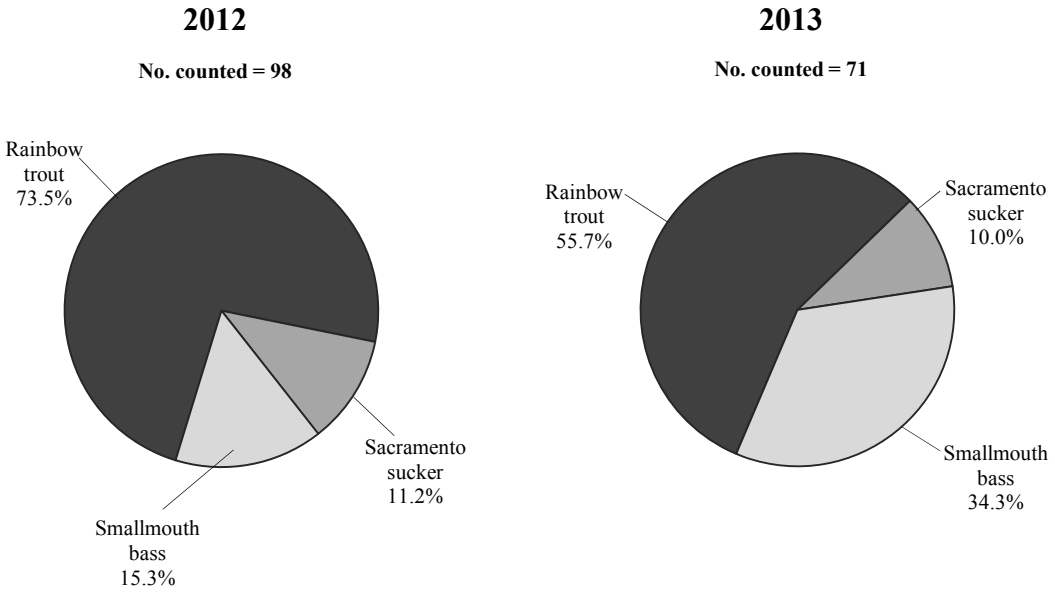

Figure 3.2-17. Proportion, by number, of fish species observed during snorkeling at the Middle Yuba River Downstream of Moonshine Creek Site in 2012 and 2013.

Rainbow trout population density was about twice as high in 2012 as in 2013. Sacramento sucker density also decreased from 2012 to 2013 by 71.4 percent. Smallmouth bass population density increased significantly in 2013 (68.3%, Table 3.2-18).

Supplemental electrofishing was conducted in accessible habitat upstream of the snorkel site in both 2012 and 2013. A summary of the weights and lengths is presented in Table 3.2-17. Three species were captured including, rainbow trout, Sacramento sucker, and smallmouth bass. Sacramento sucker were the numerically dominant species over the two years (n=26) followed by rainbow trout (n=10) and smallmouth bass (n=2). Rainbow trout ranged from 125mm–205mm in length, with weights ranging from 18.2 g–103.5 g. Sacramento sucker ranged in length from 96 mm–257 mm and weight from 16.2g–237.1g. The two smallmouth bass measured 90 mm and 92 mm and weighed 13.1 g and 13.2 g, respectively.

Condition factors for rainbow trout ranged from 0.79–1.13 in 2012 and 1.04–1.41 in 2013. Sacramento sucker ranges included 0.86–1.11 in 2012 and 0.82-1.26 in 2013. Smallmouth bass were only calculated in 2013 and ranged from 1.07-1.28 (Table 3.2-18).

Multiple age classes were observed in rainbow trout and smallmouth bass populations each sample year; however fewer age-0 fish were present at the site in 2013. Age-0 rainbow trout were represented in the 2012 sample, but were nearly absent the following year (1.7%). Few age-2+ smallmouth bass or Sacramento sucker were observed in 2012, but age-2+ fish represented about half the population in 2013. The length-frequency distribution for rainbow trout, Sacramento sucker, and smallmouth bass is presented in Figure 3.2-18 and Figure 3.2-19. Larger fish were better represented in the 2013 sample for each species.

Table 3.2-17. Summary of minimum, maximum, and average lengths and weights for fish captured during supplemental electrofishing at the Middle Yuba Downstream of Moonshine Creek Site in 2012 and 2013.

Year	Species	Length (mm)			Weight (g)			n
		Minimum	Maximum	Average	Minimum	Maximum	Average	
2012	Rainbow trout	125	185	159	18.2	69.5	48.4	8
	Sacramento Sucker	114	155	134	16.2	42.8	30.0	7
2013	Rainbow trout	180	205	192.5	95.3	103.5	99.4	2
	Sacramento Sucker	96	257	175	13.3	237.1	101.6	19
	Smallmouth bass	90	92	91	13.1	13.3	13.2	2

Table 3.2-18. Summary of quantitative snorkeling population data for the Middle Yuba River Downstream of Moonshine Creek Site (RM 3.3).

Species		Rainbow trout		Sacramento sucker		Smallmouth bass	
Year		2012	2013	2012	2013	2012	2013
Abundance	no. counted by pass	78-74-63	36-47-36	8-9-15	8-6-8	8-15-21	16-26-30
	% of total fish counted	73.5%	55.7%	11.2%	10.0%	15.3%	34.3%
	estimated section abundance	72	40	11	7	15	24
	95% confidence interval	64-79	33-46[1]	8-14[1]	6-8	8-21	17-31
	Relative Stock Density	31	86	6	55	5	47
	fish/100m	38	22	6	4	8	13
	fish/mi	613	350	91	65	126	212
Fork length (51 mm size groups)	min	0-50	0-50	0-50	103-152	0-50	51-102
	max	255-305	204-254	255-305	153-203	153-203	204-254
	mean	103-152	153-203	103-152	153-203	51-102	153-203
Condition Factor	condition factor range	0.79-1.13	1.04-1.42	0.86-1.11	0.82-1.26	--	1.07-1.28
Age class frequency in fish/mile (% of total)	0	86 (14.0%)	6 (1.7%)	9 (9.4%)	0 (0.0%)	80 (63.6%)	38 (18.1%)
	1	337 (54.9%)	41 (11.9%)	77 (84.4%)	30 (45.5%)	40 (31.8%)	74 (34.7%)
	2 and older	191 (31.2%)	303 (86.4%)	6 (6.3%)	35 (54.5%)	6 (4.5%)	100 (47.2%)

[1] The lower range of the 95 percent confidence interval was less than the lowest pass and as a result, the lowest pass was used.

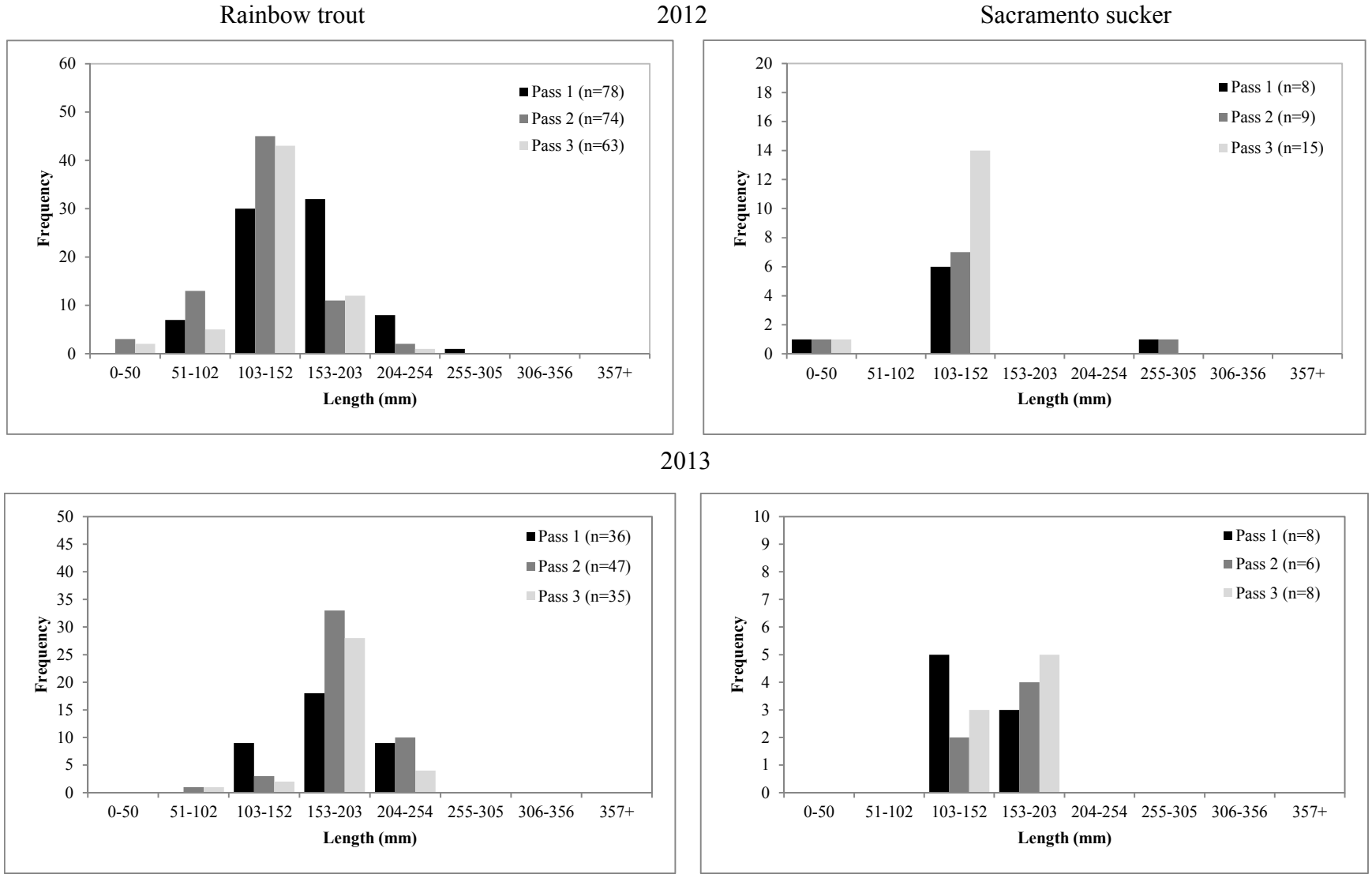

Figure 3.2-18. Length-frequency distribution of rainbow trout and Sacramento sucker observed by snorkeling in the Middle Yuba River Downstream of Moonshine Creek Site in 2012 and 2013.

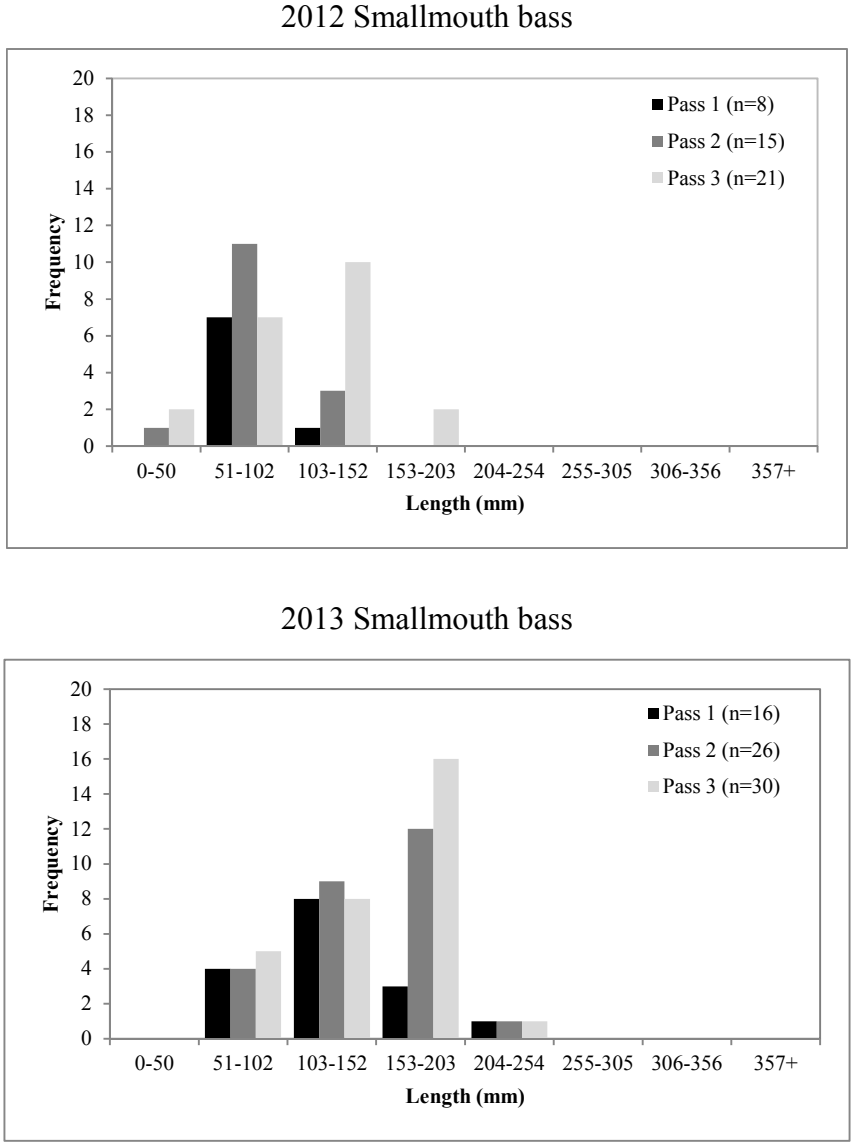

Figure 3.2-19. Length-frequency distribution of smallmouth bass observed by snorkeling in the Middle Yuba River Downstream of Moonshine Creek Site in 2012 and 2013.

3.2.2.5 Middle Yuba River Downstream of Yellowjacket Creek

The Middle Yuba River Downstream of Yellowjacket Creek Site is at an El. of 1,261 ft. Sampling took place on September 11, 2012 and September 6, 2013. Due to varying depths, sampling methodology was split; quantitative snorkeling was used in a pool section and quantitative electrofishing took place at a high-gradient riffle and a glide. Neither FYLF nor WPT were present prior to electrofishing. Table 3.2-19 summarizes the habitat and site information. Site length and wetted width for the two sample periods averaged 351 ft and 62 ft, respectively. Streamflow based on the combined flow of the LCB and ORH gages was slightly higher in 2013 (CDEC 2013). Cobble and gravel were the dominant and sub-dominant

substrates. Neither LWM or fish passage impediments were documented at the site. Suitable spawning gravel for resident trout was not observed in 2012 thought 200 sq ft was documented in 2013. Water temperature was similar between the two sample years, while DO was lower in 2013.

Table 3.2-19. Habitat and site information for the Middle Yuba River Downstream of Yellowjacket Creek Site (RM 1.0).

Sampling date		September 11, 2012	September 6, 2013
Weather	air temperature (°F)	86	92
	atmospheric conditions	sunny	sunny
Water quality	water temperature (°F)	66	67
	dissolved oxygen (mg/l)	9.17	8.1
	conductivity (µS/cm)	130.5	151
Site characteristics	elevation (ft msl)	1,261	1,261
	river mile	1.04	1.04
	site length (ft)	349	353.5
	average width (ft)	62	61
	average site depth	2.5	1.5
	average pool depth (ft)	2.5	4
	maximum pool depth (ft)	6	5.5
	flow (cfs)[2]	30	33
Habitat characteristics	dominant substrate	cobble	cobble
	sub-dominant substrate	gravel	gravel
	dominant cover type	boulder	boulder
	channel confinement	shallow	shallow
	fish passage impediments present	no	no
	no. large woody debris pieces	0	0
	suitable spawning gravel (total area in sq ft)	0	200
	low-gradient riffle (% of site length)	0	0
	high-gradient riffle (% of site length)	19	20
	run (% of site length)	0	0
	glide (% of site length)	43	40
	pool (% of site length)	38	40

[1] Coordinates: upstream easting-661382, northing- 4360393; downstream easting- 661438, northing- 4360269.
[2] Flow was determined from the combined flow of the LCB and ORH gages (CDEC 2013).

Species composition and relative abundance changed at the site over the 2-year study (Figure 3.2-20). Smallmouth bass was the most common species collected during electrofishing and observed while snorkeling in both years. Rainbow trout represented a large portion of the species assemblage in 2012 (23.8% of electrofish capture, 46.1% of species observed snorkeling), but only one was observed in the snorkeled section in 2013.

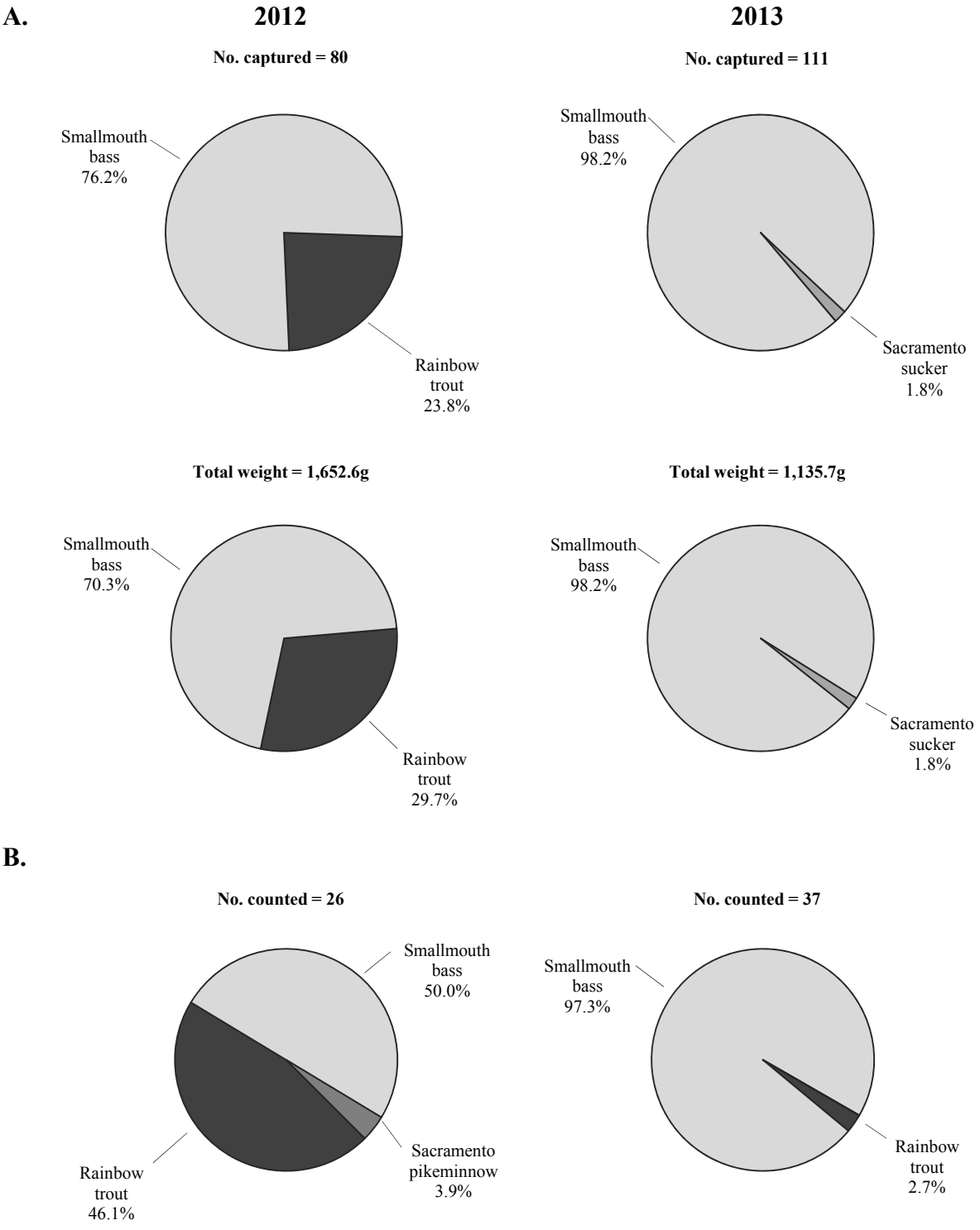

Figure 3.2-20. A) Proportion, by number and weight, of fish species sampled by A) electrofishing; and B) proportion, by number, of fish species observed during snorkeling at the Middle Yuba River Downstream of Yellowjacket Creek Site in 2012 and 2013.

The density of smallmouth bass increased in 2013 while rainbow trout density decreased (Table 3.2-20). Although smallmouth bass capture increased nearly two-fold in 2013, the estimated smallmouth bass biomass remained relatively unchanged due to much lower mean individual weight for the species. Smallmouth bass captured in 2012 were nearly twice as large as 2013 specimens (mean weight of 19.0 g and 10.2 g, respectively). Condition factor for rainbow trout ranged from 0.93–1.55 in 2012. Sacramento sucker was captured in 2013 and had a condition factor ranging from 1.02–1.25. Smallmouth bass condition factors ranged from 0.79–1.68 in 2012 and 0.85–1.22 in 2013. In general, fish were vigorous and free of parasites.

Table 3.2-20. Summary of quantitative fish population data for the Middle Yuba River Downstream of Yellowjacket Creek Site (RM 1.0).

Species		Rainbow trout		Sacramento pikeminnow		Sacramento sucker		Smallmouth bass	
Year		2012	2013	2012	2013	2012	2013	2012	2013
ELECTROFISHING SECTION									
Abundance	no. collected by pass (total)	3-7-4-4-1 (19)	0-0-0-0	0-0-0-0	0-0-0-0	0-0-0-0-0	1-0-1-0 (2)	20-14-10-12-5 (61)	41-26-27-15 (109)
	% of fish collected	23.8%	0.0%	0.0%	0.0%	0.0%	1.8%	76.2%	98.2%
	estimated section abundance	26	0	0	0	0	2	79	154
	95% confidence interval	19-45	--	--	--	--	2-9	61-104	109-202
	Relative Stock Density[1]	30	n/a	n/a	n/a	n/a	n/a	5	3
	fish/100m	39	0	0	0	0	3	119	237
	fish/mi	633	0	0	0	0	49	1,922	3,809
Fork length (mm)	mean (range)	105 (68-225)	--	--	--	--	91 (76-105)	103 (62-185)	85 (57-179)
Biomass	weight of fish collected (g)	490.5	--	--	--	--	20.6	1,161.8	1,115.1
	mean weight (g) (range)	25.8(5.3-121.0)	--	--	--	--	10.3(6.3-14.3)	19.0 (3.7-83.6)	10.2 (2.8-75.8)
	estimated section biomass (g)	670.80	0	0	0	0	20.6	1,501.0	1,575.5
	g/100m	1,013.9	0	0	0	0	31.6	2,268.8	2,420
	lbs/ac	4.3	0	0	0	0	0.2	9.6	11.6
	kg/ha	4.8	0	0	0	0	0.2	10.7	13.0
Condition factor	relative condition range	0.93-1.55	--	--	--	--	1.02-1.25	0.79-1.68	0.85-1.22
Age class freq. in fish/mile (% of total)	0	333 (52.6%)	--	--	--	--	15 (50.0%)	1,796 (93.4%)	3,704 (97.2%)
	1	166 (26.3%)	--	--	--	--	15 (50.0%)	63 (3.3%)	35 (0.9%)
	2 and older	133 (21.1%)	--	--	--	--	0 (0.0%)	63 (3.3%)	70 (1.9%)
SNORKELING SECTION									
Abundance	no. counted by pass	12-15-10-10	1-1-1	1-1-1-1	0-0-0	0-0-0	0-0-0	7-11-19-13	36-36-35
	% of total fish counted	46%	3%	4%	0%	0%	0%	50%	97%
	estimated section abundance	12	1	1	0	0	0	13	36
	95% confidence interval	10-14[2]	1	1	--	--	--	8-18	35-36
	Relative Stock Density[1]	30	n/a	n/a	n/a	n/a	n/a	5	3
	fish/100m	29	2	2	0	0	0	32	84
	fish/mi	470	38	40	0	0	0	520	1,345
Fork length (51 mm size groups)	min	0-50	103-152	103-152	--	--	--	0-50	0-50
	max	204-254	103-152	103-152	--	--	--	153-203	153-203
	mean	103-152	103-152	103-152	--	--	--	103-152	103-152
Age class freq. in fish/mile (% of total)	0	90 (19.1%)	0 (0.0%)	0 (0.0%)	--	--	--	303 (58.2%)	918 (68.2%)
	1	170 (36.2%)	38 (100.0%)	40 (100.0%)	--	--	--	186 (35.8%)	339 (25.2%)
	2 and older	210 (44.7%)	0 (0.0%)	0 (0.0%)	--	--	--	83 (16.0%)	88 (6.6%)

[1] Relative stock density was calculated for the entire site (snorkeling and electrofishing combined).

[2] The lower range of the 95% confidence interval was less than the lowest pass and as a result, the lowest pass was used.

Multiple age classes were present for all species captured or observed at this site. Most smallmouth bass captured during electrofishing were categorized as age-0 (92.9%), though age-1 and age-2+ fish were found each year. A smaller proportion of age-0 smallmouth bass were observed while snorkeling the pool upstream (65.5%). Successful recruitment of multiple age-classes is evident in rainbow trout in 2012. Similarly, older age-classes preferred the upstream pool habitat to the electrofished riffle and glide. The length-frequency distribution for fish commonly captured at the Middle Yuba Downstream of Yellow Jacket site during electrofishing is displayed in Figure 3.2-21.

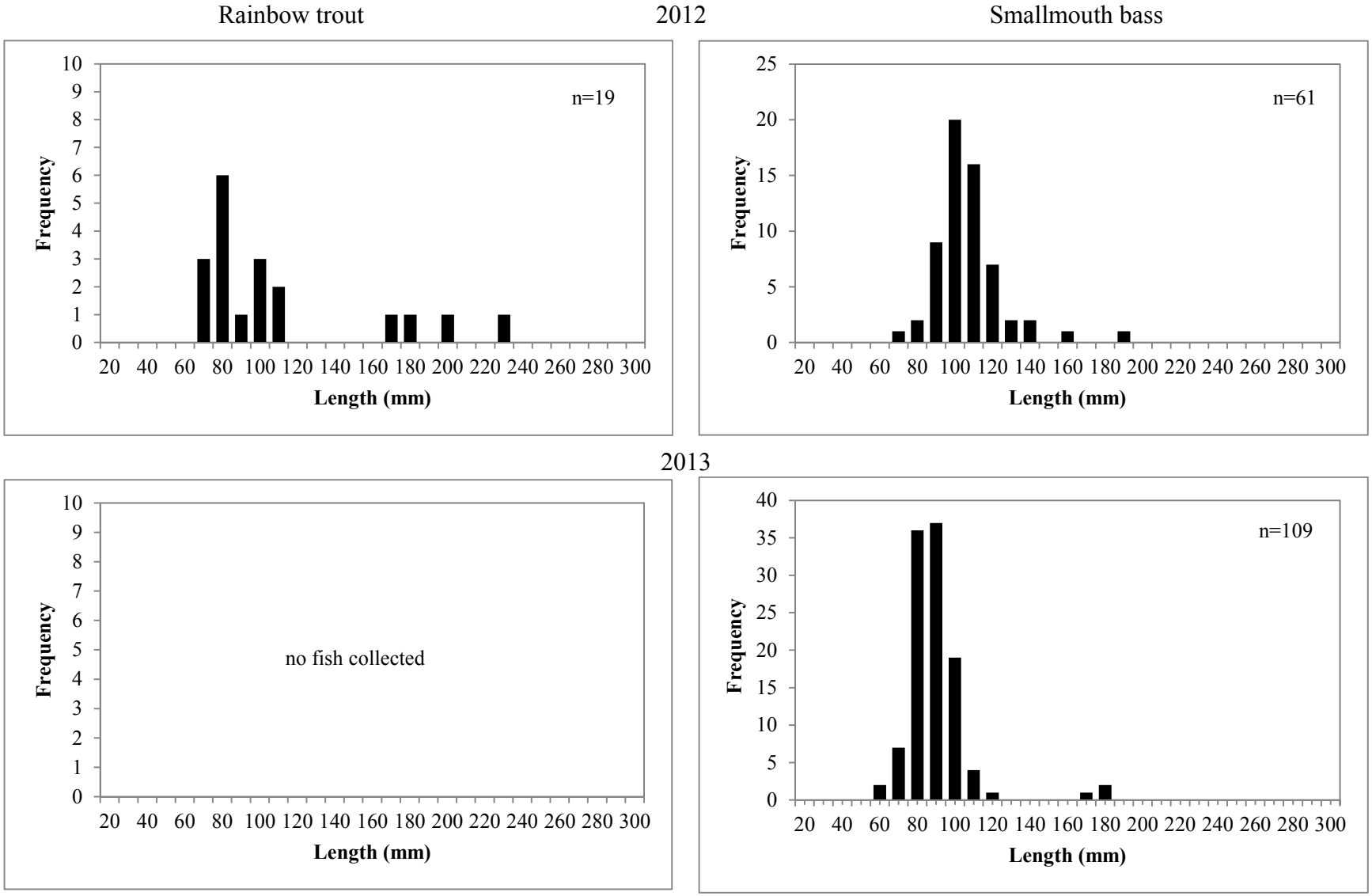

Figure 3.2-21. Length-frequency distribution of rainbow trout, and smallmouth bass collected by electrofishing at the Middle Yuba River Downstream of Yellowjacket Creek Site in 2012 and 2013.

3.2.3 North Yuba River

The North Yuba River is a 490.7 sq mi watershed with one facility, New Bullards Bar Dam (RM 2.4). Only 71.1 sq mi lie below the Project, as a significant portion of the North Yuba River lies upstream of the New Bullards Bar Reservoir. There is no other Project facility upstream of the reservoir. The North Yuba River flows 2.3 miles, from the base of New Bullards Bar Dam to the confluence with the Yuba River. One site was located on the North Yuba River at RM 0.2. An additional site was intended in closer proximity to the dam; however, the short reach is characterized by large 'car-sized' boulders and only interstitial streamflow. The only feasible site reasonably identified for access and suitable sampling habitat was selected for this study.

3.2.3.1 North Yuba River Upstream of Middle Yuba River

The North Yuba River Upstream of Middle Yuba River site is located at El. 1,132 ft. Sampling occurred on September 18, 2012 and September 7, 2013. Due to the depth, sampling was conducted by quantitative snorkeling. Neither FYLF nor WPT were observed at the site prior to electrofishing. Table 3.2-21 summarize habitat and site information collected in both years. Site length and wetted width for the two sample events averaged 391 ft long and 40 ft wide. Mesohabitat at the site consisted of pocket-water and pools. Streamflow was 5 cfs (New Bullards Bar Powerhouse minimum flow) during both sample periods. Cobble and boulder were the dominant and sub-dominant substrates. Both LWM and suitable spawning gravel for resident trout were absent at the sampling site. No potential fish passage impediments were identified at this site.[5] Water temperature was cooler and DO concentration higher in 2013 than in 2012.

Table 3.2-21. Habitat and site information for the North Yuba River Upstream of Middle Yuba River Site (RM 0.2).[1]

Sampling date		September 13, 2012	September 7, 2013
Weather	air temperature (°C)	82	86
	atmospheric conditions	sunny	sunny
Water quality	water temperature (°C)	19	17.4
	dissolved oxygen (mg/l)	7.94	8.63
	conductivity (µS/cm)	59.8	77.8
Site characteristics	elevation (ft msl)	1,132	1,132
	river mile	0.19	0.19
	site length (ft)	373	409
	average width (ft)	36	44
	average site depth	3.5	2.9
	average pool depth (ft)	3.3	3.8
	maximum pool depth (ft)	8	8
	flow (cfs)[2]	5	5

[5] The downstream border of the North Yuba River Upstream of Middle Yuba River site was formed by a waterfall which was recorded on the field datasheet as a potential barrier, but was not actually within the sampling site.

Table 3.2-21. (continued)

Sampling date		September 13, 2012	September 7, 2013
Habitat characteristics	dominant substrate	cobble	cobble
	sub-dominant substrate	boulder	boulder
	dominant cover type	boulder	boulder
	channel confinement	shallow	shallow
	fish passage impediments present	yes	yes
	no. large woody debris pieces	0	0
	suitable spawning gravel (total area in sq ft)	0	0
	low-gradient riffle (% of site length)	0	0
	high-gradient riffle (% of site length)	0	0
	run (% of site length)	0	0
	pocket water (% of site length)	25	27
	pool (% of site length)	75	73

[1] Coordinates: upstream easting-660200, northing- 4359507; downstream easting- 660291, northing- 4359441.
[2] Flow was determined from the New Bullards Bar Powerhouse minimum flow.

Species composition and relative abundance changed over the two-year study (Figure 3.2-22). Overall, fewer fish were observed in 2013. Sacramento sucker was the numerically dominant species observed in 2012 (84.6%), while rainbow trout made up 74.6 percent of the population in 2013. Sacramento pikeminnow was observed in 2012, but were absent the following year.

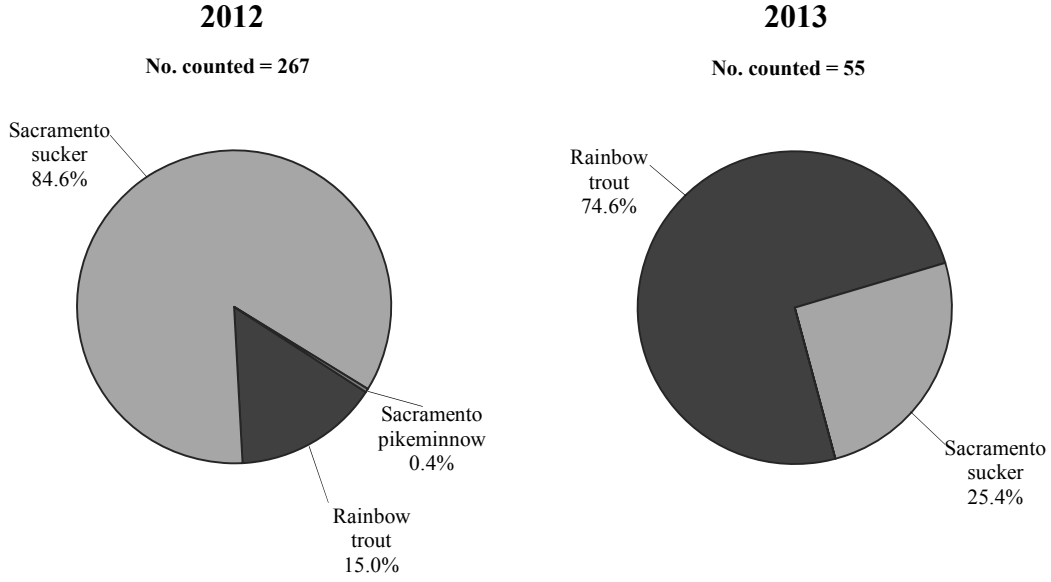

Figure 3.2-22. Proportion, by number, of fish species observed by snorkelers at the North Yuba River Upstream of Middle Yuba River Site in 2012 and 2013.

Although far fewer total fish were observed at the site in 2013, rainbow trout density was similar (Table 3.2-23). Smallmouth bass density was estimated to be 2,303 fish/mi in 2012, but only 181 fish/mi the following year. One speckled dace was captured while qualitatively electrofishing the stream margins in 2013.

Supplemental electrofishing was conducted in accessible habitat upstream of the snorkel site in both 2012 and 2013. A summary of the weights and lengths is presented in Table 3.2-22. Three species were captured including rainbow trout, Sacramento sucker, and speckled dace. Sacramento sucker were the numerically dominant species over the two years (n=38) followed by rainbow trout (n=23) and speckled dace (n=1). Rainbow trout ranged from 51 mm–151 mm in length, with weights ranging from 1.2 g–39.0 g. Sacramento sucker ranged from 37 mm–213 mm in length and weighed from 0.7 g–110.8g. The speckled dace measured 44 mm and weighed 5.2 g.

Condition factors for rainbow trout and Sacramento sucker are included in Table 3.2-18. Rainbow trout condition factors ranged from 0.76–1.14 in 2012 and from 0.41–1.95 in 2013. Condition factors for Sacramento sucker ranged from 0.63–1.33 in 2012 and from 0.54–1.73 in 2013. In general, fish were vigorous and free of parasites.

The rainbow trout age-class structure was similar between 2012 and 2013. Age-0 fish were most commonly observed in 2012 and 2013 (95.8% and 86.3%, respectively). Sacramento sucker were entirely age-0 in 2012, and nearly all (95.2%) were age-0 the following year. The length-frequency distribution for rainbow trout and Sacramento sucker is presented in Figure 3.2-23.

Table 3.2-22. Summary of minimum, maximum, and average lengths and weights for fish captured during supplemental electrofishing at the North Yuba River Upstream of Middle Yuba River Site in 2012 and 2013.

Year	Species	Length (mm)			Weight (g)			n
		Minimum	Maximum	Average	Minimum	Maximum	Average	
2012	Rainbow Trout	55	81	62	1.9	6.5	1.0	8
	Sacramento Sucker	37	213	64	0.7	110.8	8.1	26
2013	Rainbow Trout	51	151	90	1.2	39.0	11.6	15
	Sacramento Sucker	50	180	111	3.3	57.2	20.2	12
	Speckled Dace	44	44	44	5.2	5.2	5.2	1

Table 3.2-23. Summary of quantitative snorkeling population data for the North Yuba River Upstream of Middle Yuba River Site (RM 0.2).

Species		Rainbow trout		Sacramento sucker		Sacramento pikeminnow	
Year		2012	2013	2012	2013	2012	2013
Abundance	no. counted by pass	37-40-43	46-39-39	208-224-246	7-15-20	1-0-0	0-0-0
	% of total fish counted	15.0%	74.6%	84.6%	25.4%	0.4%	0%
	estimated section abundance	40	41	226	14	1	0
	95% confidence interval	37-43	39-45[1]	208-245[1]	7-21	1	--
	Relative Stock Density	2	3	n/a	n/a	100	n/a
	fish/100m	35	33	199	11	1	0
	fish/mi	567	534	3,203	181	14	0
Fork length (51 mm size groups)	min	0-50	0-50	0-50	0-50	153-203	--
	max	153-203	153-203	51-102	103-152	153-203	--
	mean	0-50	51-102	0-50	51-102	153-203	--
Condition factor	condition factor range	0.76-1.14	0.41-1.95	0.63-1.33	0.54-1.73	--	--
Age class frequency in fish/mile (% of total)	0	543 (95.8%)	460 (86.3%)	3,203 (100.0%)	172 (95.2%)	0 (0.0%)	--
	1	14 (2.5%)	56 (10.5%)	0 (0.0%)	9 (4.8%)	0 (0.0%)	--
	2 and older	9 (1.7%)	17 (3.2%)	0 (0.0%)	0 (0.0%)	14 (100.0%)	--

[1] The lower range of the 95 percent confidence interval was less than the lowest pass and as a result, the lowest pass was used.

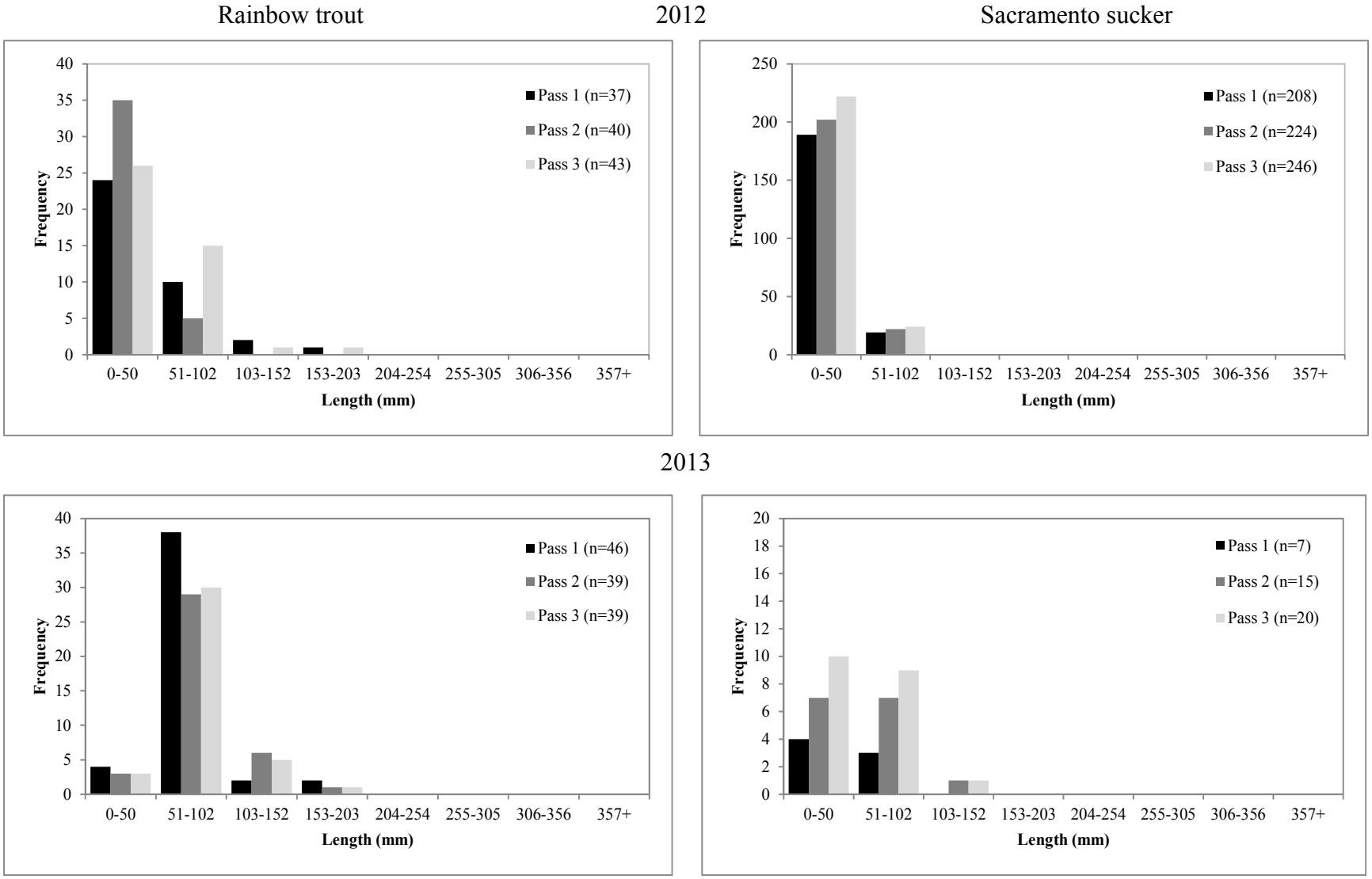

Figure 3.2-23. Length-frequency distribution of rainbow trout and Sacramento sucker observed by snorkeling at the North Yuba River Upstream of Middle Yuba River Site in 2012 and 2013.

3.2.4 Yuba River

The Yuba River is a 94.7 sq mi watershed, not including tributary watersheds upstream, with multiple facilities. The Project Area for the stream fish population work was upstream of Englebright Reservoir (RM 32.2). Above Englebright Reservoir, YCWA operates one facility on the Yuba River, the New Colgate Powerhouse (RM 34.2). Three major tributaries flow into the Yuba River, the North Yuba River (confluence RM 40.0), Middle Yuba River (confluence RM 40.0), and South Yuba River (flows into Englebright Reservoir). Monitoring locations were placed below the confluence of the Middle and North Yuba River confluence (RM 39.6), upstream of the New Colgate Powerhouse (RM 35.0), and downstream of the powerhouse (RM 33.7). Table 3.2-24 and 3.2-25 provide an overview of fish species collected by site and calculated population metrics.

Table 3.2-24. Overview of fish composition in the Yuba River Sub-basin.

Species		Yuba River Downstream of Middle Yuba River	Yuba River Upstream of New Colgate Powerhouse	Yuba River Downstream of New Colgate Powerhouse
Common Name	Scientific Name	(RM 39.6)	(RM 35.0)	(RM 33.7)
Rainbow trout	*Oncorhynchus mykiss*	•	•	•
Brown trout	*Salmo trutta*	--	--	•
Kokanee	*Oncorhynchus nerka*	--	--	•[2]
Sacramento pikeminnow	*Ptychocheilus grandis*	•	--	--
Smallmouth bass	*Micropterus dolomieu*	•	•	•[1]
Sacramento sucker	*Catostomus occidentalis*	•[1]	--	•

[1] Captured during supplemental qualitative electrofishing only.
[2] Incidental observation during Study 3.12, *New Colgate Powerhouse Ramping*.
• = species was observed..

Table 3.2-25. Overview of fish population metrics in the Yuba River Sub-basin.[1]

Stream Site	Year Sampled	Rainbow trout	Brown Trout	Sacramento Pikeminnow	Sacramento Sucker	Smallmouth Bass
		Abundance (SN) fish/mi	Abundance (SN) fish/mi	Abundance (SN) fish/mi	Abundance (SN) fish/mi	Abundance (SN) fish/mi
Yuba River Downstream of Middle Yuba River (RM 39.6)	2012	543	--	13	--[2]	337
	2013	243	--	--	--[2]	889
Yuba River Upstream of New Colgate Powerhouse (RM 35.0	2012	108	--	--	--	1,409
	2013	16	--	--	--	1,257
Yuba River Downstream of New Colgate Powerhouse (RM 33.7)	2012	323	8	--	--[2]	--[2]
	2013	560	--	--	6	--[2]

[1] SN = snorkel
[2] Species was captured during supplemental qualitative electrofishing only; no fish population metrics were calculated.

3.2.4.1 Yuba River Downstream of Middle Yuba River

The Yuba River Downstream of Middle Yuba River Site is at El. 1,088 ft. Sampling occurred on September 13, 2012 and September 8, 2013. Depth at the site precluded quantitative

electrofishing; instead, sampling was conducted by quantitative snorkeling. Neither FYLF nor WPT were observed at the site prior to electrofishing. Table 3.2-26 summarize habitat and site information collected. Over the two sample periods, the site averaged 412 ft long and 53 ft wide. Mesohabitat types sampled included glides and pools. Streamflow remained similar among sample events based on the combined flow of the Oregon Creek (LCB gage), Middle Yuba (ORH gage), and North Yuba (New Bullards Bar Powerhouse minimum flow; CDEC 2013). Cobble and boulder were the dominant and sub-dominant substrates. Suitable resident trout sized spawning gravel, LWM, and fish passage impediments were absent both sample years at the site. Water temperature was similar each year, while DO was slightly lower in 2013.

Table 3.2-26. Habitat and site information for the Yuba River Downstream of Middle Yuba River Site (RM 39.6).[1]

Sampling date		September 13, 2012	September 8, 2013
Weather	air temperature (°F)	77	84
	atmospheric conditions	sunny	sunny
Water quality	water temperature (°F)	66	66
	dissolved oxygen (mg/l)	8.82	8.24
	conductivity (µS/cm)	134.5	140.6
Site characteristics	elevation (ft msl)	1,088	1,088
	river mile	39.75	39.75
	site length (ft)	411	412
	average width (ft)	60	45
	average site depth	4.5	3.5
	average pool depth (ft)	8	8
	maximum pool depth (ft)	16	14
	flow (cfs)[2]	36	35
Habitat characteristics	dominant substrate	cobble	cobble
	sub-dominant substrate	boulder	boulder
	dominant cover type	boulder	boulder
	channel confinement	shallow	shallow
	fish passage impediments present	no	no
	no. large woody debris pieces	0	0
	suitable spawning gravel (total area in sq ft)	0	0
	low-gradient riffle (% of site length)	0	0
	high-gradient riffle (% of site length)	0	0
	run (% of site length)	0	0
	glide (% of site length)	16	15
	pool (% of site length)	84	85

[1] Coordinates: upstream easting-660519, northing- 4358966; downstream easting- 660508, northing- 4358834.

[2] Flow was determined from the combined flow of the LCB and ORH gages, and the New Bullards Bar Powerhouse minimum flow (CDEC 2013)

Species composition and relative abundance changed over the two-year study (Figure 3.2-24). Rainbow trout was the most common species observed in 2012 (60.9%), while smallmouth bass were primarily observed the following year (77.4%). Sacramento sucker, observed in low numbers in 2012, were absent from the observed population in 2013. Two Sacramento sucker were captured while qualitatively electrofishing the stream margins in 2012, though the species was not captured while electrofishing the following year.

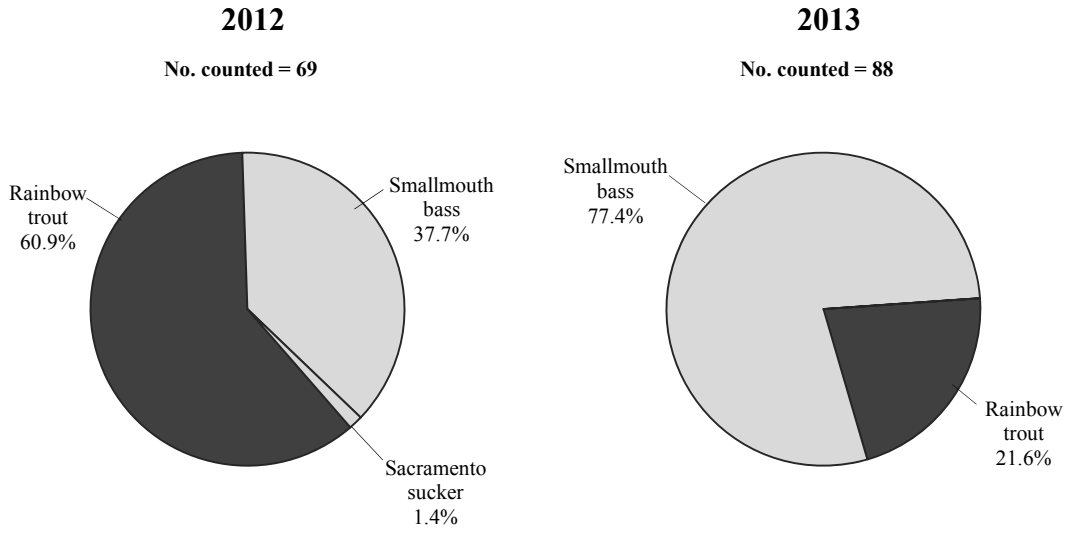

Figure 3.2-24. Proportion, by number, of fish species observed by snorkelers at the Yuba River Downstream of Middle Yuba River Site in 2012 and 2013.

Rainbow trout density decreased significantly from 2012 to 2013 (543 fish/mi and 243 fish/mi, respectively). At the same time, smallmouth bass density increased from 337 fish/mi to 889 fish/mi (Table 3.2-28).

Supplemental electrofishing was conducted in accessible habitat upstream of the snorkel site in both 2012 and 2013. A summary of the weights and lengths is presented in Table 3.2-27. Two species were captured including smallmouth bass and Sacramento sucker. Smallmouth bass were the numerically dominant species over the two years (n=10) followed by Sacramento sucker (n=1). Smallmouth bass ranged from 76 mm–215 mm in length, with weights ranging from 6.7 g–135.1 g. The single Sacramento sucker measured 94 mm and weighed 10.1 g.

Smallmouth bass condition factors ranged from 0.84–1.12 in 2012 and from 0.84–1.09 in 2013 (Table 3.2-28). In general, fish were vigorous and free of parasites.

Multiple age classes were observed in the rainbow trout population during the study though age-0 fish represented the smallest proportion of the population in both years. In each study year, age-2+ fish were the most commonly observed age class. The smallmouth bass age class structure shifted from largely age-0 fish in 2012 to mostly age-1 and age-2+ the following year. The length-frequency distribution for rainbow trout and smallmouth bass is displayed in Figure 3.2-25.

Table 3.2-27. Summary of minimum, maximum, and average lengths and weights for fish captured during supplemental electrofishing at the Yuba River Downstream of Middle Yuba River Site in 2012 and 2013.

Year	Species	Length (mm)			Weight (g)			n
		Minimum	Maximum	Average	Minimum	Maximum	Average	
2012	Smallmouth bass	76	143	96	6.7	35.2	13.6	7
2013	Smallmouth bass	124	215	166	28.5	135.1	71.8	3
	Sacramento sucker	94	94	94	10.1	10.1	10.1	1

Table 3.2-28. Summary of quantitative snorkeling population data for the Yuba River Downstream of Middle Yuba River Site (RM 39.6).

Species		Rainbow trout		Sacramento pikeminnow		Smallmouth bass	
Year		2012	2013	2012	2013	2012	2013
Abundance	no. counted by pass	29-58-44-38	20-19-18	0-1-0-1	0-0-0	13-29-21-42	70-73-65
	% of total fish counted	60.9%	21.6%	1.4%	0%	37.7%	77.4%
	estimated section abundance	42	19	1	0	26	69
	95% confidence interval	30-54	18-20	0-1	--	14-39	65-73
	Relative Stock Density	53	75	n/a	n/a	4	43
	fish/100m	34	15	1	0	21	55
	fish/mi	543	243	13	0	337	889
Fork length (51 mm size groups)	min	0-50	51-102	103-152	--	0-50	0-50
	max	306-356	255-305	103-152	--	153-203	204-254
	mean	153-203	253-203	103-152	--	51-102	103-152
Condition factor		--	--	--	--	0.84-1.12	0.84-1.09
Age class frequency in fish/mile (% of total)	0	58 (10.7%)	4 (1.8%)	0 (0.0%)	--	212 (62.9%)	184 (20.7%)
	1	199 (36.7%)	55 (22.8%)	13 (100.0%)	--	119 (35.2%)	320 (36.0%)
	2 and older	286 (52.7%)	184 (75.4%)	0 (0.0%)	--	6 (1.9%)	384 (43.3%

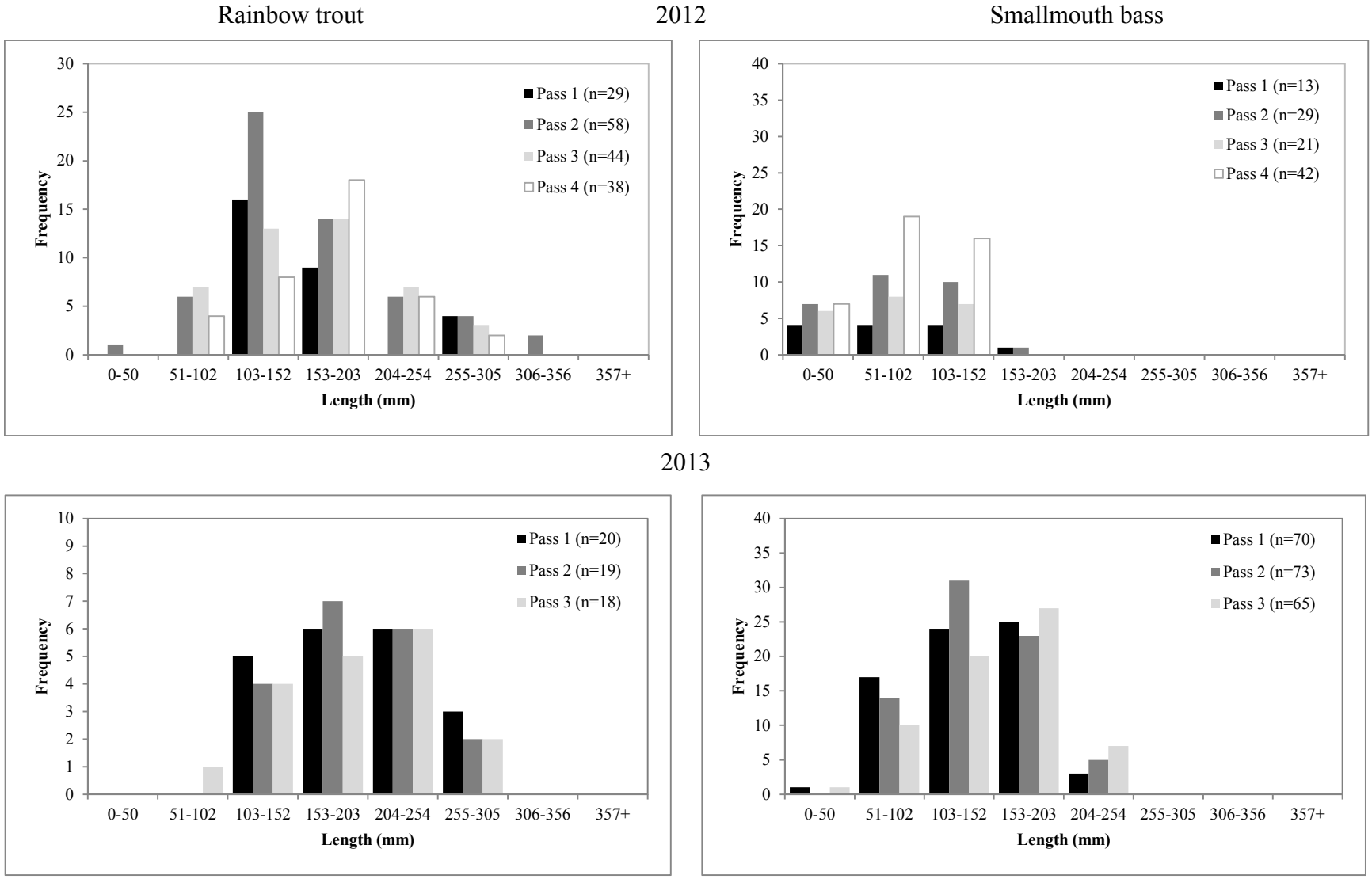

Figure 3.2-25. Length-frequency distribution of rainbow trout and Sacramento sucker observed by snorkeling at the Yuba River Downstream of Middle Yuba River Site in 2012 and 2013.

3.2.4.2 Yuba River Upstream of New Colgate Powerhouse

The Yuba River Upstream of New Colgate Powerhouse Site is at El. 579 ft. Sampling occurred on September 16, 2012 and September 13, 2013. Depth precluded quantitative electrofishing; instead quantitative snorkeling was employed. Neither FYLF nor WPT were observed at the site prior to snorkeling. Table 3.2-29 summarizes habitat and site information collected during the study. Site length and wetted width for the two sample events averaged 341 ft long and 58 ft wide. The mesohabitat sampled consisted of pocket-water and pools. Streamflow remained similar among sample events based on the combined flow of the Oregon Creek (LCB gage), Middle Yuba (ORH gage), and North Yuba (New Bullards Bar Powerhouse minimum flow; CDEC 2013). Bedrock and cobble were the dominant and sub-dominate substrates. Suitable resident trout spawning gravel was identified at the site in 2012 and 2013 (10 sq ft and 50 sq ft, respectively). Fish passage impediments and LWM were absent each year. Water temperature was similar each sampling period, while DO was slightly lower in 2013.

Table 3.2-29. Habitat and site information for the Yuba River Upstream of New Colgate Powerhouse Site (RM 35.0).[1]

Sampling date		September 16, 2012	September 13, 2013
Weather	air temperature (°F)	90	80
	atmospheric conditions	sunny	sunny
Water quality	water temperature (°F)	70	71
	dissolved oxygen (mg/l)	9	8.5
	conductivity (µS/cm)	132	100
Site characteristics	elevation (ft msl)	576	576
	river mile	34.96	34.96
	site length (ft)	359	322
	average width (ft)	54	62
	average site depth	3.8	4.0
	average pool depth (ft)	4	4
	maximum pool depth (ft)	7	7.5
	flow (cfs)[2]	35	34
Habitat characteristics	dominant substrate	bedrock	bedrock
	sub-dominant substrate	cobble	cobble
	dominant cover type	boulder	boulder
	channel confinement	deep	deep
	fish passage impediments present	no	no
	no. large woody debris pieces	0	0
	suitable spawning gravel (total area in sq ft)	10	50
	low-gradient riffle (% of site length)	0	0
	high-gradient riffle (% of site length)	0	0
	run (% of site length)	0	0
	pocket water (% of site length)	43	43
	pool (% of site length)	57	57

[1] Coordinates: upstream easting-656540, northing- 435541; downstream easting- 656555, northing- 4355651.

[2] Flow was determined from the combined flow of the LCB and ORH gages, and the New Bullards Bar Powerhouse minimum flow (CDEC 2013).

Species composition and relative abundance were similar over the two-year study (Figure 3.2-26). The species assemblage was dominated by smallmouth bass each year. Rainbow trout were observed in both 2012 and 2013, but only represented 6.8 percent and 1.3 percent of the population, respectively. Qualitative electrofishing occurred near the stream margins, during which only smallmouth bass were captured each season.

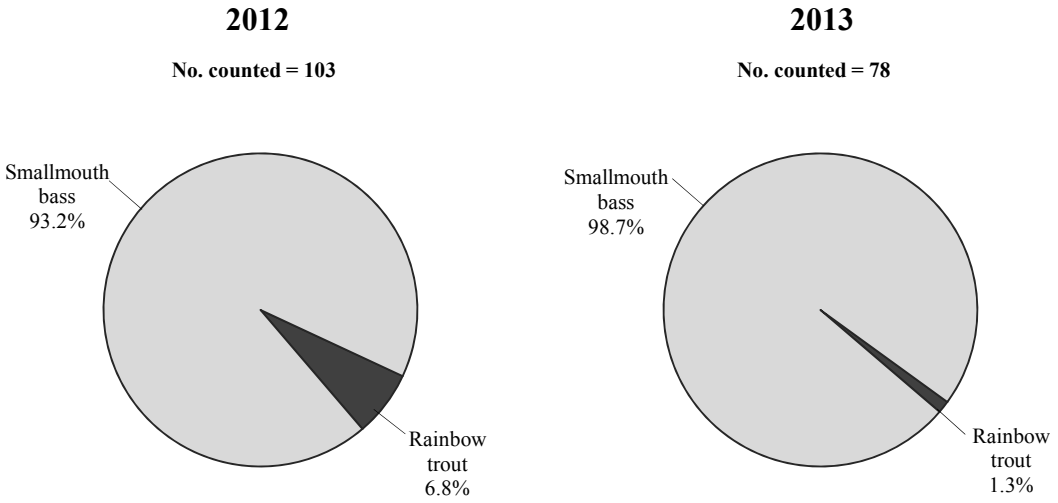

Figure 3.2-26. Proportion, by number, of fish species observed by snorkelers at the Yuba River Upstream of New Colgate Powerhouse Site in 2012 and 2013.

Rainbow trout density decreased considerably from 2012 to 2013 (108 fish/mi and 16 fish/mi, respectively). Smallmouth bass density was similar between the two study years (Table 3.2-31).

Supplemental electrofishing was conducted in accessible habitat at the margins of the reach within the snorkel site in both 2012 and 2013. A summary of the weights and lengths is presented in Table 3.2-30. Smallmouth bass was the single species captured (n=9). Lengths ranged from 40 mm–103 mm, with weights ranging from 0.8 g–22.5 g.

Smallmouth bass condition factors ranged from 0.92–1.22 in 2012 and from 0.79–1.60 in 2013 (Table 3.2-31). In general, fish were vigorous and free of parasites.

Age-0 rainbow trout were absent from the population in both years of sampling. Each sample period, age-2+ rainbow trout were the most common age-class, though sample size was smaller in 2013 (n=1). Successful recruitment of multiple age classes is evident in smallmouth bass in 2012 and 2013. Age-0 fish were the primary age class in 2012, and the proportion of age-0 and age-1 fish were similar in 2013. Although similar proportions of age-0 fish were observed each year, this age class appears to have a larger average length-frequency in 2013 (Figure 3.2-27).

Table 3.2-30. Summary of minimum, maximum, and average lengths and weights for fish captured during supplemental electrofishing at the Yuba River Upstream of New Colgate Powerhouse Site in 2012 and 2013.

Year	Species	Length (mm)			Weight (g)			n
		Minimum	Maximum	Average	Minimum	Maximum	Average	
2012	Smallmouth bass	40	96	61	0.8	15	4.62	5
2013	Smallmouth bass	55	103	84	1.4	22.5	11.2	4

Table 3.2-31. Summary of quantitative snorkeling population data for the Yuba River Upstream of New Colgate Powerhouse Site (RM 35.0).

Species		Rainbow trout		Smallmouth bass	
Year		2012	2013	2012	2013
Abundance	no. counted by pass	4-9-9	1-1-1	95-97-95	76-78-76
	% of total fish counted	6.8%	1.3%	93.2%	98.7%
	estimated section abundance	7	1	96	77
	95% confidence interval	4-10	1	95-97	76-78
	Relative Stock Density	86	100	9	4
	fish/100m	7	1	88	78
	fish/mi	108	16	1,409	1,257
Fork length (51 mm size groups)	min	103-152	153-203	0-50	0-50
	max	306-356	153-203	204-254	153-203
	mean	153-203	153-203	51-102	103-152
Condition factor	condition factor range	--	--	0.92-1.22	0.79-1.60
Age class frequency in fish/mile (% of total)	0	0	0	957 (67.9%)	563 (44.8%)
	1	15 (13.6%)	0	324 (23.0%)	645 (51.3%)
	2 and older	93 (86.4%)	16 (100.0%)	128 (9.1%)	49 (3.9%)

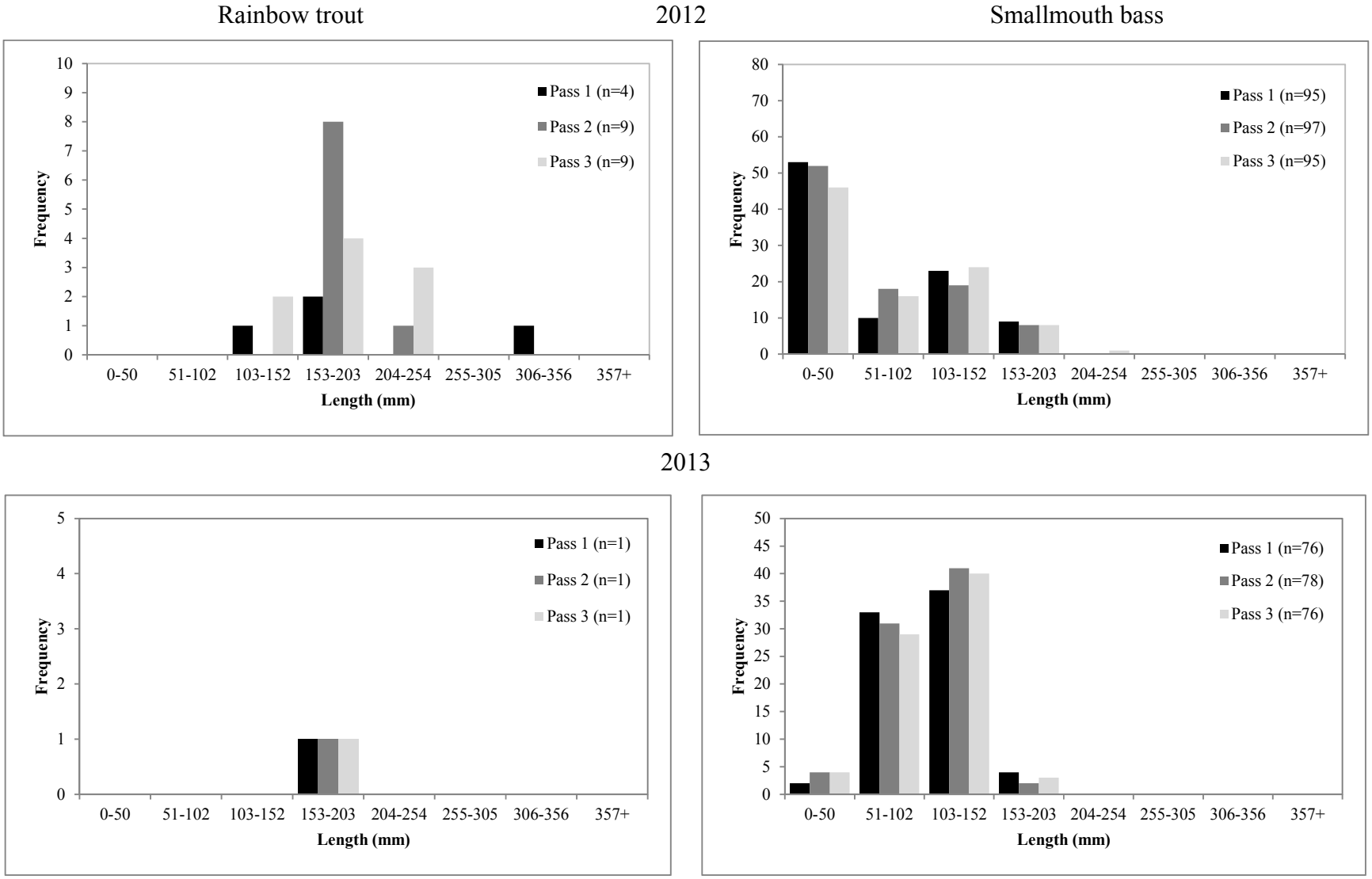

Figure 3.2-27. Length-frequency distribution rainbow trout and smallmouth bass observed by snorkeling in the Yuba River Upstream of New Colgate Powerhouse Site in 2012 and 2013.

3.2.4.3 Yuba River Downstream of New Colgate Powerhouse

The Yuba River Downstream of New Colgate Powerhouse Site is at El. 550 ft. Sampling occurred on November 10, 2012 and September 14, 2013. Depth precluded quantitative electrofishing at the site; instead quantitative snorkeling was employed. Neither FYLF nor WPT were observed at the site prior to snorkeling. Site length and wetted width for the two sample events averaged 659 ft long and 58 ft wide. The site was comprised of five mesohabitat types: 1) low gradient riffle; 2) high gradient riffle; 3) run; 4) step; and 5) pool. Streamflow was 16 cfs higher in 2012 based on the combined flow of the Oregon Creek (LCB gage), Middle Yuba (ORH gage), and North Yuba (BUL gage; CDEC 2013). Boulder and cobble were the dominant and sub-dominant substrates. Suitable spawning gravel for resident trout was identified in 2012 and 2013 (83 sq ft and 225 sq ft, respectively). Fish passage impediments and LWM were absent at the site each year. Water temperature was cooler in 2012, and DO was correspondingly much higher (Table 3.2-32).

Table 3.2-32. Habitat and site information for the Yuba River Downstream of New Colgate Powerhouse Site (RM 33.7).[1]

Sampling date		November 10, 2012	September 14, 2013
Weather	air temperature (°F)	55	90
	atmospheric conditions	partly cloudy	sunny
Water quality	water temperature (°F)	50	70
	dissolved oxygen (mg/l)	10.9	8.8
	conductivity (µS/cm)	133	126
Site characteristics	elevation (ft msl)	550	550
	river mile	33.5	33.5
	site length (ft)	702	616
	average width (ft)	66.5	49.2
	average site depth	2.5	2.5
	average pool depth (ft)	2.5	4.2
	maximum pool depth (ft)	6	6
	flow (cfs)[2]	50	34
Habitat characteristics	dominant substrate	boulder	boulder
	sub-dominant substrate	cobble	cobble
	dominant cover type	none	boulder
	channel confinement	shallow and moderate	shallow and moderate
	fish passage impediments present	no	no
	no. large woody debris pieces	0	0
	suitable spawning gravel (total area in sq ft)	83	225
	low-gradient riffle (% of site length)	6	0
	high-gradient riffle (% of site length)	13	9
	run (% of site length)	24	29
	step-run (% of site length)	21	25
	pool (% of site length)	37	36

[1] Coordinates: upstream easting-655424, northing- 4354662; downstream easting- 655387, northing- 4354488.

[2] Flow was determined from the combined flow of the LCB and ORH gages, and the New Bullards Bar Powerhouse minimum flow (CDEC 2013).

Rainbow trout were the most abundant species observed in the study during both study years (Figure 3.2-28). A brown trout was observed in 2012 (n=1), but the species was absent the following year. In 2013, one Sacramento sucker was observed on site. Smallmouth bass were captured while qualitatively electrofishing the stream margins in 2012, but not in 2013.

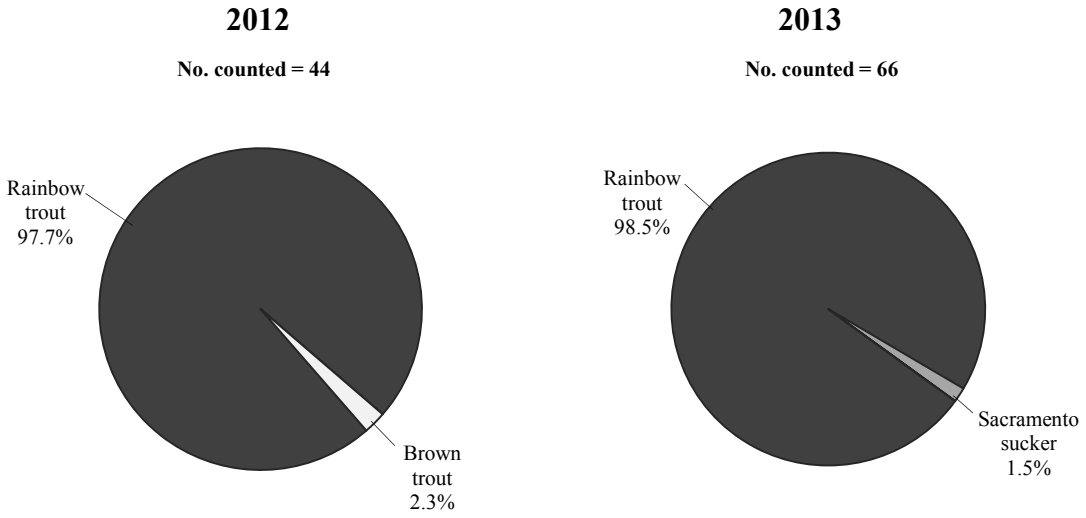

Figure 3.2-28. Proportion, by number, of fish species observed by snorkelers at the Yuba River Downstream of New Colgate Powerhouse Site in 2012 and 2013.

Rainbow trout density increased from 323 fish/mi in 2012 to 560 fish/mi in 2013 (Table 3.2-34). Nearly all rainbow trout observed in 2012 were classified as age-2+. Age 2+ rainbow trout were the most common age class in 2013, but age-0 and age-1 fish represented a larger portion of the population.

Supplemental electrofishing was conducted in accessible habitat at the margins of the reach within the snorkel site in both 2012 and 2013, although fish were only captured in 2012. A summary of the weights and lengths is presented in Table 3.2-33. Rainbow trout was the numerically dominant species captured (n=5). Two fish; a single Sacramento sucker measuring 95 mm and weighing 11.4 g; and a single smallmouth bass measuring 75 mm and weighing 6.1 g were the only other fish captured. Lengths ranged from 40 mm–103 mm, with weights ranging from 0.8 g–22.5 g.

Condition factor for the single smallmouth bass was 1.06 relative to other smallmouth bass captured in the Yuba River (Table 3.2-34). Available data for rainbow trout and Sacramento sucker were insufficient to calculate condition factors for these individuals. In general, fish were vigorous and free of parasites.

Figure 3.2-29 indicates a shift in rainbow trout length-frequency between study years. Age-2 and older fish were still well represented in the population in 2013, but fewer large fish were observed.

Table 3.2-33. Summary of minimum, maximum, and average lengths and weights for fish captured during supplemental electrofishing at the Yuba River Downstream of New Colgate Powerhouse Site in 2012 and 2013.

Year	Species	Length (mm)			Weight (g)			n
		Minimum	Maximum	Average	Minimum	Maximum	Average	
2012	Rainbow trout	132	371	244	27.8	621.5	231.68	5
	Sacramento sucker	95	95	95	11.4	11.4	11.4	1
	Smallmouth bass	75	75	75	6.1	6.1	6.1	1

Table 3.2-34. Summary of quantitative snorkeling population data for the Yuba River Downstream of New Colgate Powerhouse Site (RM 33.7).[1]

Species		Rainbow trout		Brown trout		Sacramento sucker	
Year		2012	2013	2012	2013	2012	2013
Abundance	no. counted by pass	44-43-42	60-65-71	0-1-0	0-0-0	0-0-0	1-1-0
	% of total fish counted	97.7%	98.5%	2.3%	0%	0%	1.5%
	estimated section abundance	43	65	1	0	0	1
	95% confidence interval	42-44	60-71	1	--	--	0-1
	Relative Stock Density	99	60	100	n/a	n/a	n/a
	fish/100m	20	34	1	0	0	0
	fish/mi	323	560	8	--	--	6
Fork length (51 mm size groups)	min	103-152	51-102	255-305	--	--	103-152
	max	306-356	357+	255-305	--	--	103-153
	mean	153-203	153-203	255-305	--	--	103-154
Age class frequency in fish/mile (% of total)	0	0 (0.0%)	83 (14.8%)	0 (0.0%)	--	--	0 (0.0%)
	1	3 (1.0%)	140 (25.0%)	0 (0.0%)	--	--	6 (100.0%)
	2 and older	320 (99.0%)	337 (60.2%)	8 (100.0%)	--	--	0 (0.0%)

[1] In 2012, four passes were completed at this site, but the first pass was an outlier and was omitted to better refine statistical confidence. No species were excluded as a result of omitting the first pass.

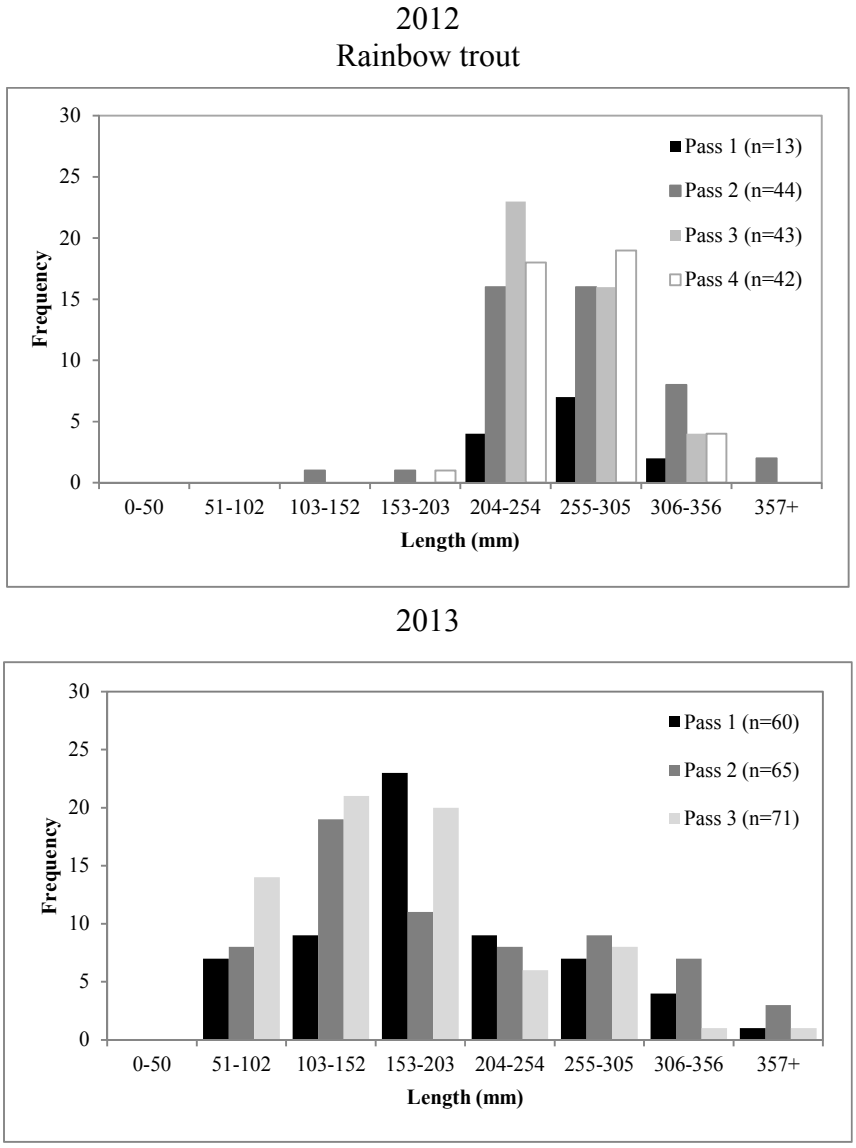

Figure 3.2-29. Length-frequency distribution of rainbow trout observed by snorkeling in the Yuba River Downstream of New Colgate Powerhouse Site in 2012 and 2013.

An incidental observation from YCWA's relicensing Study 3.12, *New Colgate Powerhouse Ramping*, found several adult kokanee (*Oncorhynchus nerka*) carcasses below New Colgate Powerhouse proximal to the stream fish population site at RM 33.7.

4.0 Discussion

The study documented characteristics of stream fish populations potentially affected by the Project that provide a basic metric for comparing the relative health of fish communities within the area, and over time. With the goal of providing a comparative analysis of fish population status in the watershed, the following objectives were adopted in the study: 1) salmonid fry emergence timing; 2) characterization of stream fish communities; 3) species composition and relative spatial distribution; 4) total or relative abundance of fish by species; 5) analysis of fish population size-structure and age-class structure; and 6) physical condition factor of stream fishes. The purpose of this discussion is to summarize the results of the study, which was conducted in 2012 and 2013 to gather information and data on the abundance, distribution, and condition of the fish species that inhabit Project-affected reaches of the Yuba River and its tributaries above Englebright Dam.

The combination of the objectives listed above address the broader study goal of performing a community analysis for stream fish in the Yuba River Watershed above Englebright Dam based on three levels of biological organization: 1) *individual,* which pertains to the fitness and behavior of each fish; 2) *population,* which ascertains whether the fish population is reproductive, self sustaining, and healthy; and 3) *community*, which addresses resilience of the population to disturbance, population structure and niche overlap of co-evolved (or co-habiting) species, persistence of the species assemblage over time, and incidence of the same population structure in other parts of the watershed. Each objective is addressed in the sections that follow; which each include a summary of collected data and trends, a discussion regarding the factors that contribute to any trends, and an analysis of the trends (to the extent that available data and statistical rigor allow) on an individual, population, and community level.

4.1 Species Composition and Relative Spatial Distribution

Throughout the geographical area covered by this study, no fish species were documented that are listed as endangered or threatened under the California Endangered Species Act or the federal Endangered Species Act, sensitive by the Forest Service, or a Species of Special Concern by Cal Fish and Wildlife.

The numerically dominant species included rainbow trout, Sacramento sucker, Sacramento pikeminnow, and smallmouth bass. Two other species were documented (i.e., brown trout and speckled dace), but these occurrences were rare.

The Middle Yuba River portion of the study area overlaps with part of the area surveyed in FERC Project 2310 (NID and PG&E 2010) completed in 2008-2009. The fish species assemblage documented in 2012-2013 is similar to that documented (NID and PG&E 2010) on the Middle Yuba in 2008-2009.

Little historical information was available for the fishes in Oregon Creek, the North Yuba River, and the mainstem Yuba River upstream of Englebright Reservoir. YCWA found two sources of data: one from snorkeling performed by Gast in 2004 (Gast et al. 2005) and the other from

electrofishing and snorkeling by NID and PG&E (NID and PG&E 2010). Table 4.1-1 provides a summary of YCWA's recent sampling and the historic information.

Table 4.1-1. Overview of current species presence from the 2012 and 2013 study effort and documented species presences from historical reports.

Site	RM	Rainbow Trout	Brown Trout	Sacramento Pikeminnow	Sacramento Sucker	Smallmouth Bass	Kokanee	Speckled Dace
Oregon Creek Upstream of Log Cabin Diversion Dam	4.5	●	--	●	●	--	--	--
Oregon Creek Upstream of Middle Yuba River	0.3	●	--	--	●	●	--	--
Middle Yuba River Upstream of Our House Dam	13.3	●	--	●	●	--	--	--
Middle Yuba River Downstream of Our House Dam	12.5	●	--	●	●	●	--	--
Middle Yuba River Upstream of Oregon Creek	5.0	●	--	--	●	●	--	--
Middle Yuba River Downstream of Moonshine Creek	3.3	●	--	--	●	●	--	--
Middle Yuba River Downstream of Yellowjacket Creek	1.0	●	--	●	●	●	--	--
North Yuba River Upstream of Middle Yuba River	0.2	●	--	●	●	--	--	●
Yuba River Downstream of Middle Yuba River	39.9	●	--	●	●	●	--	--
Yuba River Upstream of New Colgate Powerhouse	35.0	●	--	--	--	●	--	--
Yuba River Downstream of New Colgate Powerhouse	33.7	●	●	--	●	●	O	--

Source: Gast et al. 2005; NID and PG&E 2010
Key: •=present in 2012/ 2013 current study; shaded grey=known to be present. **O**=incidental observation from Study 3.12, *New Colgate Powerhouse Ramping.*

Based on these information sources, a transition fishery[6] occurs in the vicinity of Our House Diversion Dam. Species composition of the fish population in the Middle Yuba River above Our House surveyed in 2004 was corroborated by NID in 2008 and 2009 (NID and PG&E 2010) and by findings of the current study. Cal Fish and Wildlife does not stock fish in this area of the Middle Yuba River.

The following description of results from 2004 snorkel surveys in the Middle Yuba River from its confluence with the North Yuba River to Our House Diversion Dam is based on Gast et al. (2005). In 2004, trout frequency was lower in the warmer, lower section of the river (Table 4.1-2).

[6] A transition fishery is one that includes both cold-water and warm-water fishes and is typically found in the Sierra in lower elevations where the fish community transitions from a cold-water fishery dominated by trout in the higher elevations to a warm water fishery in the lower elevations.

Table 4.1-2. Historical distribution of fish species relative to river mile and stream temperature observed during 2004 Middle Yuba River snorkel surveys.

RM (beginning at the confluence of the Middle Yuba and the North Yuba rivers)	Tributary Inflow	Middle Yuba Water Temperature (°F)	Rainbow Trout	Brown Trout	Pikeminnow Hardhead[1]	Pikeminnow	Hardhead	Suckers	Smallmouth Bass	Rainbow (Fry Lane)	Non-game (Fry Lane)
0.0	--	--	--	--	--	--	--	--	--	--	--
0.1	--	74	●	--	--	●	--	--	●	---	--
1.8	Yellow jacket Creek	--	--	--	--	--	--	--	--	--	--
2.6	--	69	●	--	--	●	--	●	●	--	--
4.8	Oregon Creek	71	--	--	--	--	--	--	●	--	--
12.6	--	75	●	--	●	●	●	●	●	--	●

Source: Gast *et al*. 2005
[1] Pikeminnow and hardhead less than 4" in length not discernible.

While brown trout was found over 20 miles upstream on the Middle Yuba River during 2008–2009 sampling (NID and PG&E 2010), it was not common near the confluence (Gast et al. 2005). Congruently, brown trout was not documented in the Middle Yuba River in 2012, but was only found at the lowest Yuba River site below New Colgate Powerhouse. Although not in the immediate vicinity of a dam, it is likely that cold water from the powerhouse has a resetting effect on the transition fishery in this area, similar to an effect sometimes seen directly below large dams.

Fish density sampling (i.e., multi-pass snorkeling) on the Middle Yuba River in 2008 and 2009 yielded similar results to the current effort. The closest sampling location occurred at RM 13.6 where rainbow trout, Sacramento pikeminnow and Sacramento sucker over two years old were collected. In 2012, sampling occurred at RM 13.3 where the same species were collected. All collected species in 2012 were higher in density, with the exception of Sacramento sucker, which was more dense in only one year of historical sampling. In 2013, a similar sampling effort resulted in abundance estimates lower than both the 2012 numbers for all species; and estimates from work cited in 2008-2009.

YCWA was unable to find any historic information regarding the fish community in Oregon Creek near Log Cabin Diversion Dam. Cal Fish and Wildlife does not stock fish in Oregon Creek.

It is well documented that fish populations in regulated streams in the Sierra Nevada Range are sensitive to changes in seasonal streamflows which has broad reaching impact on population distribution, species assemblage, and habitat use (Marchetti and Moyle, 2001; Moyle and Randall, 1998; Moyle and Baltz, 1985). Hydraulic variability between seasons and over years due to operation of dams and other diversion structures can predictably (not necessarily detrimentally) affect both habitat availability and corresponding fish assemblages (Marchetti and Moyle, 2001). The timing of flow events particularly can affect the structure of fish populations in regulated rivers like the Yuba, where fish species are adapted to changing hydraulic regimes (Lytle and Poff, 2004) and in many cases rely indirectly on such structures to provide flow/ habitat availability and temperature refugia in otherwise low-flow or drought periods. Since

microhabitat requirements are so specific to individual fish species (with a unique interplay of temperature, depth, velocity, cover, substrate, and food availability being required by each species), slight changes in flow regime can change the distribution of these microhabitats causing a reach or area to become either more or less suitable for a given species as conditions fluctuate over time.

The fish community in the Yuba River and its tributaries appear to be structured deterministically whereby: the species present in the drainage are segregated by microhabitat and diet due to morphological differences and known feeding behaviors; and across years, the species assemblage in the Yuba basin appears relatively persistent which is indicative of long co-existence of species and community resilience. In the broader context of the Sierra Nevada, the Yuba River fish community is not unlike that of other small California streams as described by Moyle and Vondracek (1985) in which a small number of fish species have a fluctuating coexistence within different reaches as the environment changes, alternately favoring one species over another (Warren et al. 2009). The persistence of the same species assemblage in the Yuba Basin over the years for which data are available clearly supports this finding - relative abundance appears to fluctuate without causing the extirpation of any species over a broader time-frame.

For the most part, the species composition was unchanged over the course of the two-year study though relative abundance did vary. However, there were several localized instances where species present in one year were absent in another, for example: the Middle Yuba above Our House where rainbow trout was common in 2012 but absent entirely in 2013; and the Middle Yuba below Yellow Jacket where rainbow also disappeared in 2013, concurrent with an increase in smallmouth bass numbers. The most variable member of the species assemblage was the Sacramento pikeminnow that disappeared from the Middle Yuba below Yellow Jacket, the North Yuba above Middle Yuba, and the Yuba River below Middle Yuba in 2013, all locations where the fish was documented in 2012. Concurrently, Sacramento pikeminnow appeared in the Middle Yuba below Our House in 2013 where it had not previously been documented (2012). While Sacramento pikeminnow spatial distribution was variable, the species' abundance at each site was very low to begin with (less than 10 fish), which would eliminate the pikeminnow from being considered a part of the core fish community in the watershed by standards described in Moyle and Vondracek (1985).

A comparison of species richness above and below the various dams and diversions within the Yuba River system indicates (as expected) that these structures play some role in the segregation of populations, particularly smallmouth bass. Above the New Colgate Powerhouse, smallmouth bass and rainbow trout (albeit low numbers) were documented, while below the dam, only rainbow was present in any numbers (one brown trout in 2012 and two suckers in 2013 were observed). Likewise at Our House Diversion Dam, smallmouth bass was present below the structure but absent above it in both years. Generally, it appears that from 2012-2013, the smallmouth population was confined to the Middle Yuba River below Our House, Oregon Creek below Log Cabin, the North Yuba below New Bullards Bar, and the Yuba River above New Colgate Powerhouse. As these facilities are not equipped with fish passage structures, it is to be expected that they would serve as barriers to further spatial distribution. Certainly, habitat

characteristics such as relatively cold water (i.e., below New Colgate Powerhouse) may also be implicated in the absence of warm water-favoring bass at some sample sites.

4.2 Relative Abundance

Abundance in this study was measured in terms of the proportion of different fish species that make up the total fish count (either from electrofishing or snorkeling) for each species commonly encountered in the study area. A comparison of the relative abundance of species encountered at each reach between years indicated that the dominance of species was variable at some sites, though not at others.

Sierra Nevada rivers are typified by high seasonal variation in both flow and temperature. Additional variability in relative abundance can be influenced by biological factors including survival and reproductive success of each species. Individual fish (and the broader population) have adapted to redistribute as conditions (including temperature, flow, food availability, etc.) change. This adaptability is a characteristic of transition zone fisheries. Based on this foundation of knowledge, it is to be expected that relative abundance (and even species assemblage) is dynamic within a river system like the Yuba and its tributaries. Indeed, over the course of Study 3.8, such changes in the relative abundance of species were documented in several areas. Over the two year period, smallmouth bass became more abundant at sites on the Middle Yuba (below Our House, below Moonshine Creek, below Yellow Jacket Creek) and Yuba River (below Middle Yuba River). By comparison, rainbow trout relative abundance to Sacramento sucker increased in the North Yuba above the Middle Yuba under virtually the same environmental conditions at the nearby Yuba River site. This seemingly paradoxical shift in abundance can be explained by a drop in the density of Age-0 Sacramento sucker paired with almost no change in the density of rainbow trout at this site. A similar shift in relative abundance was observed in Oregon Creek above Log Cabin Dam, only this shift was created by an increase in the number of rainbow trout relative to stable numbers of Sacramento sucker, from year to year. At all other sites, the relative abundance of species was consistent both between years and with previous studies in the basin.

While it is impossible to know the fate or source of ‘missing’ or ‘extra’ fish from one year to the next based on the methods of the current study effort, it can be reasonably expected that they have moved to a habitat more favorable for their fitness and survival or are suffering some other (probably temporary) competitive disadvantage or predator-prey imbalance. This supposition is corroborated by Moyle and Baltz (1985) who suggest that in a fish community made of up of species with slightly different optimum environments, minor change in flow (and other microhabitat characteristics) can result in major changes in the relative abundance of species. Certainly the species encountered during this study can be categorized by preference for certain types of habitats. Rainbow trout and other salmonids generally seek swift, cool water while bass and other warm water game fish prefer slow moving, warmer waters. It is to be expected then, that as conditions change, rainbow trout will seek higher gradient water with temperature refugia while bass will move toward higher temperatures and more gentle flows. This seeking behavior can be exhibited both within an individual reach, and across a broader spatial scale. Variability in

relative abundance of species between years was also documented in sites covered by the 2008-2009 population study at Middle Yuba River sites (NID and PG&E 2010).

4.3 Population Size and Age-class Structure

Fish population size was extrapolated based on the total number of fish collected during both snorkeling and quantitative electrofishing efforts in 2012 and 2013. Population size was variable across sites and within sites-between years. Generally, rainbow trout, Sacramento sucker, and Sacramento pikeminnow populations were larger in 2012 than 2013, while the opposite trend was observed for smallmouth bass.

The age-class distribution of all fish species observed in 2012 and 2013 varied considerably between sites and to a lesser extent between years; however, some general trends emerged. For the most part, smallmouth bass populations at each study site had age-frequency distributions that would be expected for a self-sustaining population. Such populations are expected to include age-0 individuals at the greatest abundance with age-1 and older cohorts making up sequentially smaller portions of the population as predation, competition, and other causes of natural mortality deplete the standing stock. Within the range of the smallmouth bass population surveyed in 2012 and 2013 (see *Relative Spatial Distribution*, above), each age class was well represented, with more age-0 fish than other cohorts.

In 2013, the population size of smallmouth bass at most sites did decrease (see above section, *Relative Abundance*) but the age-structure indicates that the population is still diverse and likely will not suffer permanently from the decreased overall abundance of fishes in this particular year.

Sacramento sucker were not universally represented across all sample sites in 2012 or 2013 and their abundance was generally low relative to other species. Where they did occur, sample sizes were generally not large enough to reliably profile age-class diversity.

Rainbow trout age-structure throughout the watershed was much less ordered than the smallmouth bass age-structure described above. The most diversified rainbow populations were on Oregon Creek both above Log Cabin and above the Middle Yuba, and on the North Yuba above Middle Yuba where age-0 fish were numerically dominant, with smaller proportions of age-1 and age-2+ fishes. There was also age-class diversity observed in rainbow trout on the Middle Yuba above Our House Diversion Dam in both 2008 and 2009 (NID and PG&E 2010). These sample sites also have diverse mesohabitat structure including riffles, runs, step-runs, and pools. Mitro and Zale (2011) documented that stream-dwelling rainbow trout age-0 preferred complex habitat structure, shallow water, and steeper gradients rather than simple bank structure and deeper pools (Mitro and Zale 2011), while Moyle and Vondracek (1985) report that a stream reach with the greatest habitat diversity (a mixture of riffles, runs, and pools) would be expected to contain the highest biomass, number of fishes, and diversity of age-classes. Of course, habitat availability is not the only potential driver of age-class diversity but should be considered as an important factor. Also noteworthy, is that the habitat reaches surveyed during this study are localized, spatially disparate, and small relative to the available habitat. Thus, it is possible that a

particular age-class of fish would not be represented in a sampling area if the habitat within the study reach did not favor them.

Other rainbow trout populations surveyed in 2012 and 2013 were abundant; though generally there was a decreasing trend of overall population size (except the Oregon Creek sites mentioned above where populations grew in 2013). At sites where the rainbow trout population was not age-class diverse, habitats were not considerably different from areas where populations were age-class diverse. This may be attributable to slightly cooler temperatures in Oregon Creek than lower in the system, a feature favorable to salmonids. The lack of age-class diversity (in any species) may be the result of a range of factors including (but not limited to): a lack of consistent age-0 recruitment; predation by larger fishes; absence of a reproducing population at that site; or flow and temperature-related redistribution events associated with variable water-years. High discharge events (such as floods) at the time of fry emergence have been linked to salmonids year-class representation (Warren et al. 2009) as salmonid fry are particularly vulnerable to involuntary redistribution for a period following their emergence. High water events during this period can cause the loss or severe depletion of a given year class (Warren et al 2009). However, both years sampled were dry water years. The year 2012 experienced several storm events resulting in spill from YCWA's dams, but these were outside of the documented fry emergence and rearing periods. The 2013 water year did not include any notably large storm events. Further, there is a size-dependent risk of mortality due to winter starvation in cold-water streams which exerts strong selective pressure on the smallest fish, young of the year trout for example, that do not reach a critical size during summer foraging risk depletion of lipid reserves, and elevated risk of mortality than larger conspecifics (Biro, et al. 2004). Evaluating overwinter survival potential of age-0 fish was outside the scope of this study.

4.4 Condition Factor

For the most part, fish encountered during the study were healthy, free of parasites, and had no apparent signs of disease. On the individual level, at sites throughout the watershed, the three most prevalent fish species (rainbow trout, Sacramento sucker, and smallmouth bass) tended to have relative condition factor ranges that indicated a length-weight ratio of that would be expected for each species relative to a baseline reference population. At each site, and for each species, relative condition factors were distributed both above and below 1.0, which indicates that food may not be a limiting factor since some fish were able to achieve plumpness. A similar range of condition factors were measured during the 2008-2009 study at Middle Yuba above Our House (NID and PG&E 2010). Within a population, it is important to address relative condition factor on an age-related basis to determine whether there are discrepancies among age-classes of fish within a species. For example, in some species, age-0 fish are ecologically distinct from larger conspecifics because they do not share a food source or compete for the same habitat. To determine whether the overall community is resilient to disturbances in the food supply (starvation), it is expected that no age-class is in better shape than another (Murphy et al. 1991). This determination for Yuba River populations (which requires a large sample size) was outside the scope of this study, but the small dataset available does not suggest any major discrepancies.

4.5 Fry Emergence Modeling

Field surveys of rainbow trout presence and mean daily water temperature were conducted to calculate the timing of spawning, hatching, and emergence. Rainbow trout incubation and emergence has been widely studied in the region and elsewhere. Rainbow trout are stimulated to spawn in the spring by rising water temperatures. Behnke (1992) suggests that along the Pacific coast, a temperature of about 37.4–42.8°F may initiate spawning activity, but actual spawning does not occur until the temperatures reach 42.8–48.2°F. While this spawning activity would typically occur from late December through April, in some very cold headwater streams local temperatures may delay spawning until July or August for some stocks. Piper et al. (1982) concluded that rainbow trout spawning should occur between 50–55°F, and Bell (1986) set the range for spawning at 36–66°F. Table 4.5-1 presents a review of rainbow trout incubation and emergence temperatures over a wide-range of temperatures, compiled from numerous sources.

Table 4.5-1. Summary of incubation and emergence data for rainbow trout periodicity.

◦F	Incubation and Emergence
59.0	Rainbow eggs can survive, but mortality is high compared to lower temps[1]
57.2	Sharp decrease in survival as temps increase[2]
55.4	Maximum weekly maximum temperature should not exceed for incubation and emergence[3]
53.6	Maximum daily average temperature should be below this range at time of hatching[4] / Symptoms of thermal stress begin to develop[2]
51.8	
50.0	Steelhead and rainbow trout eggs had the highest survival within this range[1] / Optimum temperature for salmonid egg survival to hatching[5] / Mean daily temperature should not exceed this range throughout embryo development[4]
48.2	
46.4	
44.6	
42.8	
41.0	
39.2	
37.4	
35.6	Eggs can survive at this range but mortality is high compared to higher temperatures[1]

[1] Myrick and Cech (2001)
[2] Lower Yuba River Accord (2010)
[3] USEPA (2003)
[4] WDOE (2002)
[5] USEPA (2001)

The emergence timing of rainbow trout fry is of interest to YCWA because it helps define periodicity in the watershed with regards to rainbow trout ecology. The first emergent rainbow trout in the Middle Yuba River and Oregon Creek were observed in May and June 2012, respectively. Back-calculations, using DTUs found that the fish had spawned between April 12 to May 19, 2012 on the Middle Yuba River and May 6 to May 19, 2012 on Oregon Creek. Emergence was calculated to be between May 30 and June 20, 2012 on the Middle Yuba River and June 11 to June 20, 2012 on Oregon Creek.

4.6 Fish Community Analysis

To recapitulate, the broader goal of Study 3.8 was to perform a community analysis for stream fish in the Yuba River Watershed above Englebright Dam based on three levels of biological

organization: 1) *individual,* which pertains to the fitness and behavior of each fish; 2) *population,* which ascertains whether the fish population is reproductive, self sustaining, and healthy; and 3) *community*, which addresses resilience of the population to disturbance, population structure and niche overlap of co-evolved (or co-habiting) species, persistence of the species assemblage over time, and incidence of the same population structure in other parts of the watershed.

On an individual level, results of direct length-weight measurements and survey of each captured fish for parasites, deformities, and other indications of decreased fitness indicates that fish appear in an acceptable, and expected condition. Since condition factor ranges for each species at each site bracketed the value 1.0 (the ideal 'condition' for fish based on relative condition modeling), it can be inferred that within each site, there are fish that have achieved plumpness and those that have been less successful with a balance point at a healthy 1.0.

A population level approach reveals that fish populations in some areas appear to be reproductive and self-sustaining while fish populations in others appear to be made up of redistributed fish from other areas (where age-0 recruitment is successful). In areas where there is age-class diversity, it is expected that the population is self-reproducing at least a portion of the fish documented in that habitat. Areas where age-classes are not distributed with age-0 fish being the most abundant cohort are either not self-sustaining, or have experienced some habitat, predation or flow related event that caused a redistribution of age classes. Not all areas surveyed in 2012 and 2013 contained suitable habitat for rainbow trout spawning, thus it would not be expected that populations in these areas would have successful age-0 recruitment.

The repeated surveys of fish population distribution, species abundance, and relative condition completed over the years by YCWA, and other agencies clearly indicate that the community-level species assemblage has been relatively unchanged and resilient to any changes in flow or other disturbance over time. Stream fish population data collected in this study corroborates findings from previous studies, and indicates that the populations on a community level are stable. While the relative abundance of species may vary slightly over brief time periods, the persistence of the species assemblage throughout these various studies (discussed above) clearly suggests that the fish community in the Yuba River basin is productive and self-sustaining.

5.0 Study-Specific Consultation

The FERC-approved study required one study-specific consultation:

> YCWA will select sampling sites, and then invite interested and available Relicensing Participants into the field to comment on selected sites (Step 1).

YCWA invited Relicensing Participants into the field during site selection on November 7 and 8, 2011. Participants included representatives from the Forest Service and CDFG. Participants in the field agreed to all sampling sites and lengths.

6.0 Variances from FERC-Approved Study

The study was performed in conformance with the FERC-approved study with one exception. The FERC-approved study plan included 11 sampling locations. During the site selection process, YCWA and Relicensing Participants agreed to not sample the North Yuba River downstream of New Bullards Bar Reservoir. This site offered minimal access to open water and was primarily composed of interstitial flow in a boulder garden. The site was collaboratively replaced by an additional site on the Middle Yuba River, below Yellow Jacket Creek.

7.0 Attachments to this Technical Memorandum

This technical memorandum includes four attachments:

Attachment 3-8A	Physical Habitat and Fish Composition Data [1 Microsoft Excel file: 4 Mb; 16 pages formatted to print on 8 ½ x 11 paper; 11 pages formatted to print on 11 x 17 paper]
Attachment 3-8B	Representative Photos of Sites [1 Adobe PDF file: 4 MB; 18 pages formatted to print on 8 ½ x 11 paper]
Attachment 3-8C	Relative Condition Factor [1 Microsoft Excel file: 95 kB; 5 pages formatted to print on 8 ½ x 11 paper; 7 pages formatted to print on 11 x 17 paper]
Attachment 3-8D	Length-Weight Regressions for Collected Fish [1 Adobe PDF file: 85 kB; 10 pages formatted to print on 8 ½ x 11 paper]

8.0 References Cited

Anderson, R.O., and S.J. Gutreuter. 1983. Length, weight, and associated structural indices. *Fisheries Techniques*, edited by L. A. Nielson, D.L. Johnson and S.S. Lampton. Bethesda: American Fisheries Society.

Anderson, R.O., S.J. Gutreuter. and R.M. Neumann. 1996. Length, weight, and associated structural indices. In *Fisheries Techniques*, edited by B. R. Murphy and D. W. Willis. Bethesda: American Fisheries Society.

Bell, M.C. 1986. Fisheries handbook of engineering requirements and biological criteria. Fish Passage Development and Evaluation Program. U.S. Army Corps of Engineers. 209pp.

Behnke, R.J. 1992. Native trout of western North America. Monograph 6 Bethesda, MD. American Fisheries Society.

Biro, P.A., Morton, A.E., Post, J.R., Parkinson, E.A. 2004. Over-winter lipid depletion and mortality of age-0 rainbow trout (Oncorhynchus mykiss). Canadian Journal of Fisheries and Aquatic Sciences. 61: 1513-1519.

California Data Exchange Center (CDEC). 2013. Water Supply Information. Available online: <http://cdec.water.ca.gov/water_supply.html>. Accessed October 2013. Updated daily.

_____. 2012. Water Supply Information. Available online: <http://cdec.water.ca.gov/water_supply.html>. Accessed October 2012. Updated daily.

Dolloff, A., J. Kershner, and R. Thurow. 1996. Underwater Observation. Pages 533–554 in Murphy, B.R. and D.W. Willis, editors. *Fisheries techniques*, 2nd edition. American Fisheries Society, Bethesda, Maryland.

Gast, T, M. Allen and S. Riley. 2005. Middle and South Yuba rainbow trout (*Onchorhynchus mykiss*) distribution and abundance dive counts August 2004. Included as Appendix G of California Department of Water Resources 2006.

Hankin, D.G. and G.H. Reeves. 1988. Estimating total fish abundance and total habitat area in small streams based on visual estimation methods. Canadian Journal of Aquatic Science. 45: 834–844.

Le Cren, E.D. 1951. Length-weight relationship and seasonal cycle in goand weight and condition in the perch (*Perca fluviatilis*). Journal of Animal Ecology 20: 201–239.

Lower Yuba River Accord. 2010. Lower Yuba River Water Temperature Objectives Technical Memorandum. Available online: <http://www.yubaaccordrmt.com/Studies%20%20Reports/LYR%20Water%20Temp%20Objectives%20Tech%20Memo.pdf>. Accessed November 05, 2012

Lytle, D.A. and Poff, N.L. 2004. Adaptations to natural flow regimes. Trends in Ecology and Evolution. 19: 94-100.

Marchetti M.P., and Moyle P.B. 2001. Effects of flow regime on fish assemblages in a regulated California Stream. Ecological Applications 11(2): 530-539.

Mitro, M.G. and Zale, A.V. 2002. Seasonal survival, movement, and habitat use of age-0 rainbow trout in the Henry's Fork of the Snake River, Idaho. Transactions of the American Fisheries Society. 131(2): 271-286.

Moyle, P.B. 2002. *Inland Fishes of California*. University of California Press, Berkeley and Los Angeles, California. pp. 157, 187, 275, 395, 403.

Moyle, P.B. and Baltz, D.M. 1985. Microhabitat use by an assemblage of California stream fishes: developing criteria for instream flow determinations. Transactions of the American Fisheries Society. 114: 695-704.

Moyle, P.B. and Vondracek, B. 1985. Persistence and structure of the fish assemblage in a small California stream. Ecology. 66(1): 1-13.

Moyle, P.B., and M.P. Marchetti. 1998. Applications of indices of biological integrity to California streams and watersheds. Pages 367–380 in T.P. Simon and R. Hughes, editors. Assessing the sustainability and biological integrity of water resources using fish communities. CRC Press, Boca Raton, Florida.

Moyle, P.B., M.P. Marchetti, J. Baldrige, T.L. Taylor. 1998. Fish health and diversity: justifying flows for a California stream. Fisheries 23. (7): 6–15.

Moyle, P.B. and Randall, P.J. 1998. Evaluating the biotic integrity of watersheds in the Sierra Nevada, California. Conservation Biology. 12(6): 1318-1326.

Murphy, B.R., Willis, D.W., Springer, T.A. 1991. The relative weight index in fisheries management: status and needs. Fisheries. 16(2): 30-38.

Myrick C.A., and J.J. Cech. 2001. Temperature Effects on Chinook Salmon and Steelhead: a Review Focusing on California's Central Valley Populations. Bay-Delta Modeling Forum. Technical Publication 01-1. 57 pp.

Nevada Irrigation District and Pacific Gas and Electric (NID and PG&E). 2010. Technical Memorandum 2.3.1 – Stream Fish Populations. Prepared by NID and PG&E for the Relicensings of NID's Yuba-Bear Hydroelectric Project (FERC Project No. 2266) and PG&E's Drum-Spaulding Project (FERC Project No. 2310).

O'Neal, J.S. 2007. Snorkel Surveys. *Salmonid Field Protocols Handbook – Techniques for Assessing Status and Trends in Salmon and Trout Populations*. American Fisheries Society, Bethesda, Maryland, and State of the Salmon, Portland, Oregon.

Piper, R.G., I.B. McElwain, L.E. Orme, J.P. McCraren, L.G. Fowler, and J.R. Leonard. 1982. Fish Hatchery Management. US Department of the Interior, Fish and Wildlife Service, Washington, D.C.

Senn, H., J. Mack, and L. Rothfus. 1984. Compendium of low-cost Pacific salmon and steelhead trout production facilities and practices in the Pacific Northwest. Bonneville Power Administration Progress Report 83–353, Portland, Oregon.

Slaney, P.A., and A.D. Martin. 1987. Accuracy of underwater census of trout populations in a large stream in British Columbia. North American Journal of Fisheries Management 7:117–122.

Temple, G.M. and T.N. Pearsons. 2007. Electrofishing: Backpack and Drift Boat. In Salmonid Field Protocols Handbook – Techniques for Assessing Status and Trends in Salmon and Trout Populations. American Fisheries Society, Bethesda, Maryland, and State of the Salmon, Portland, Oregon.

Thurow, R.F. 1994. Underwater methods for study of salmonids in the Intermountain West. U.S. Forest Service, Intermountain research Station, general Technical Report INT-GTR-307, Ogden, Utah.

United States Environmental Protection Agency (USEPA). 2003. EPA Region 10 Guidance for Pacific Northwest State and Tribal Water Quality Standards. Region 10, Seattle, WA. EPA 910- B-03-002. 49pp. Available online at: <http://www.epa.gov/r10earth/temperature.htm>. Website accessed on October 23, 2012.

_____. 2001. Issue Paper 5: Summary of technical literature examining the effects of temperature on salmonids. Region 10, Seattle, WA. EPA 910-D-01-005. 113pp. Available online at: <http://yosemite.epa.gov/R10/water.nsf>. Website accessed on October 23, 2012.

United States Department of Interior, Fish and Wildlife Service (USFWS). 2005. Revised Guidance on Site Assessments and Field Surveys for the California Red-legged Frog. Online: http://www.fws.gov/sacramento/es/documents/crf_survey_guidance_aug2005.doc. (Accessed November 2007).

United States Geological Survey (USGS). 2003. Open-File Report 03-383. Bathymetric and Geophysical Surveys of Englebright Lake, Yuba-Nevada Counties, California, 2003.

Van Deventer, J.S. and W.S. Platts. 1989. Microcomputer software system for generating population statistics from electrofishing data-User's guide for MicroFish 3.0. U.S. Department of Agriculture, Forest Service. Intermountain Research Station, General Technical Report INT-254.

Warren, D.R., Ernst, A.G., Baldigo, B.P. 2009. Influence of spring floods on year-class strength of fall- and spring- spawning salmonids in Catskill mountain streams. Transactions of the American Fisheries Society. 138: 200-210.

Washington State Department of Ecology (WDOE). 2002. Evaluating Standards for Protecting Aquatic Life in Washington's Surface Water Quality Standards: Temperature Criteria. Draft Discussion Paper and Literature Summary. Publication Number 00-10-070. 189pp.