TECHNICAL MEMORANDUM 3-7

Reservoir Fish Populations

Yuba River Development Project
FERC Project No. 2246

September 2012

TECHNICAL MEMORANDUM 3-7

EXECUTIVE SUMMARY

In 2012, Yuba County Water Agency (YCWA) performed fish sampling in the tributaries to and in New Bullards Bar Reservoir. Sampling also occurred in the United States Army Corps of Engineer's Englebright Reservoir. The goal of the study was to provide information concerning the distribution, occurrence, and condition of fishes in the reservoirs that could be affected by the Yuba River Development Project (Project), Federal Energy Regulatory Commission (FERC) Project No. 2246.

Reservoir surveys included gillnet sampling and boat electrofishing, and tributary surveys consisted of fish passage and species composition assessments. Water clarity and chemistry information (temperature, dissolved oxygen, and conductivity) was collected in reservoirs and tributaries concurrent with surveys. Gillnet sampling and boat electrofishing occurred twice during the year, coinciding with low and high pool levels (January and June) within New Bullards Bar Reservoir, but only during June in Englebright Reservoir. Englebright Reservoir has only mild stage fluctuations throughout the year with no identifiable increasing or decreasing operational trends. Tributaries to New Bullards Bar Reservoir were assessed for fish passage in April and for species composition in June.

Gillnet sampling and boat electrofishing in New Bullards Bar Reservoir captured 971 fish from 11 species over the two sampling events, compared to 22 fish species that have been previously documented in the reservoir. No new species were found. Spotted bass (*Micropterus punculatus*) dominated the catch from both gears (66.3% of the catch and 65.7% of the biomass), with little difference in catch between events or among sampling sites. Bluegill (*Lepomis macrochirus*) was the next most common species (8.1% of the catch), and common carp (*Cyprinus carpio*) accounted for the majority of the remaining biomass (21.8%). Salmonid species were represented by rainbow trout (*Oncorhynchus mykiss*) and kokanee (*O. nerka*), which accounted for 5.0 percent and 4.8 percent of the catch, respectively. Spotted bass, common carp, rainbow trout and Sacramento sucker (*Catostomus occidentalis*) accounted for 93.9 percent of the total biomass captured in the reservoir. Length-frequency distributions were indicative of natural reproduction by spotted bass and rainbow trout.

For both fish sampling gear types used in New Bullards Bar Reservoir, more individuals were collected in June, but more species were collected in January. Spotted bass and kokanee had the highest catch rates during both gillnetting events, and spotted bass and bluegill had the highest catch rates during both electrofishing events. Catch of rainbow trout by electrofishing decreased dramatically from January to June.

Catch also varied among sampling sites and habitats in New Bullards Bar Reservoir. Although spotted bass were collected at all sampling sites, almost half of all rainbow trout captured by electrofishing were found at the upper end of the reservoir. Gillnet catches were highest in nets set near shore, and catch was lowest at the site closest to the dam. Only one kokanee and one

spotted bass were captured in deepwater nets that were set closest to the deepwater intakes at the dam.

Gillnet sampling and boat electrofishing in Englebright Reservoir captured 362 fish from 11 species, compared to 18 fish species that have been documented to occur in the reservoir. Redear sunfish (*Lepomis microlophus*) and green sunfish (*Lepomis cyanellus*) were collected but had not been identified in historic records.

No one species dominated the catch in Englebright Reservoir unlike New Bullards Bar Reservoir. Sacramento sucker was the most common species (31.5% of the total catch), followed by spotted bass (26.5%). Salmonid species were represented by rainbow trout (8.3% of the catch) and brown trout (*Salmo trutta*, 1.7%). Commonly collected native cyprinids included hardhead (*Mylopharodon conocephalus*, 13.5%) and Sacramento pikeminnow (*Ptychocheilus grandis*, 6.9%). Hardhead are listed as a Class 3 (Watch List) species by the California Department of Fish and Game (CDFG).

No species accounted for the majority of biomass (total weight), but biomass of Sacramento sucker was more than double that of any other species. Common carp, spotted bass, and hardhead were other species accounting for at least 10 percent of the biomass each. These four species combined for 88.3 percent of the total biomass captured in the reservoir. Length-frequency distributions were indicative of natural reproduction by spotted bass, rainbow trout, and hardhead.

Unlike New Bullards Bar Reservoir, rainbow trout were relatively common in the electrofishing catch during June in Englebright Reservoir.

Although total catch did not vary greatly among sites in Englebright Reservoir, catch of individual species sometimes did. Most notably, no spotted bass were collected by electrofishing at a site near the upper end of the reservoir (Site 5), but more rainbow trout were collected there than at any other site. This was also the only electrofishing site where brown trout were found. This was the only site with both flowing and still water, with extensive shallow areas, and with substrates of primarily sand and gravel.

The lowest gillnet catch was at the site nearest the Englebright Dam intakes. Catch in deepwater nets included only two rainbow trout and one brown trout.

Of 13 tributaries of New Bullards Bar Reservoir assessed for upstream passage, nine were considered accessible to adfluvial spawning fish. These included the North Yuba River, and Slate, Deadwood, Indian/Slapjack, Bridger, Willow, Mill, Little Oregon, and Burnt Bridge creeks. Streams considered inaccessible had waterfalls over bedrock and very steep gradients combined with low flows. Four of the nine accessible tributaries had a total of eight potential barriers to fish passage. Seven of these potential barriers were leaping barriers and one was a shallow water barrier. Only one potential leaping barrier in Mill Creek would not be fully inundated by the reservoir during spring and summer.

Fish species found in the accessible tributaries were brown trout, rainbow trout, and Sacramento sucker. Brown trout were limited to Mill Creek. Only the North Yuba River and Willow Creek contained both rainbow trout and Sacramento sucker. Six of the nine tributaries contained rainbow trout only.

The study was conducted in conformance with the FERC-approved Reservoir Fish Populations Study (Study 3.7), with one variance. The sampling site for Gillnet Site 6 in New Bullards Bar Reservoir was moved. Placing nets where originally planned posed an unacceptable risk because of the high number of recreational houseboats in the area. The alternative location represented similar habitat, but did not pose any safety concerns. This variance does not significantly alter the results of the study.

The study is complete.

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Table of Contents

Table of Contents (continued)

List of Figures

List of Figures (continued)

List of Tables

List of Tables (continued)

List of Attachments

TECHNICAL MEMORANDUM 3-7

RESERVOIR FISH POPULATIONS[1]

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 a potential to affect fish populations in reservoirs.

1.0 Goals and Objectives

The goal of the study was to provide information concerning the distribution, occurrence, and condition of fishes in Project reservoirs and the United States Army Corps of Engineer's (USACE) Englebright Reservoir.

The objectives of the study were to: 1) characterize fish species composition, relative abundance (e.g., catch per unit effort [CPUE]), and population size; 2) characterize management of reservoir water surface elevations and its relationship to availability of fish habitat under existing and potential Project operations; 3) characterize individual fish size and condition factor; and 4) assess tributary access and composition of fish within accessible tributaries in New Bullards Bar Reservoir.

2.0 Methods

YCWA conducted a series of integrated efforts consisting of: 1) reservoir gillnet sampling; 2) reservoir boat electrofishing; and 3) reservoir tributary assessments. In addition, YCWA reviewed and summarized historical sampling and fish stocking records for integration into study analyses. Individual methods for each study effort are described below. Where required, permits for sampling were obtained.

2.1 Study Area

The study area included New Bullards Bar Reservoir, the tributaries surrounding New Bullards Bar Reservoir, and Englebright Reservoir.

2.2 Data Collection

Data collection included gillnet sampling, boat electrofishing, stream sampling using snorkeling or backpack electrofishing, and a historical review of available stocking and reservoir fish population data. The methods for these activities are described below.

[1] This Technical Memorandum presents the results for Study 3.7, Reservoir Fish Populations, included in YCWA's Revised Study Plan filed with FERC on August 14, 2009, and approved by FERC in its Study Determination on September 14, 2009. There was one minor modification (gillnet placement) to Study 3.7 subsequent to FERC's September 30, 2011 Study Determination.

2.2.1 Gillnet Sampling

Gillnet sampling occurred twice during the year, coinciding with low and high pool levels within New Bullards Bar Reservoir (January 16-19 and June 18-21, 2012), and once in Englebright Reservoir (June 22-24, 2012). Adult and juvenile variable mesh gillnets were deployed at eight sites in New Bullards Bar Reservoir and four sites in Englebright Reservoir. The adult variable mesh gillnets were 125 feet (ft) long and 8 ft deep and consisted of five, 25-ft long panels. Panel mesh sizes were 0.75-, 1.5-, 2-, 2.5-, and 3-inch (in.) The panels were successively arranged by mesh size with the smallest mesh size placed nearest the shore. The juvenile gillnets were 25 ft long and 8 ft deep and included two panels 12.5 ft long that had mesh sizes of 0.5 and 0.75 in., respectively.

Gillnet sample sites were selected around New Bullards Bar Reservoir and Englebright Reservoir to obtain representative samples among the diversity of identified pelagic habitats. Sample sites were selected near the Project intakes of both reservoirs where sampling could be safely performed, near tributaries, and at locations that would cover a broad spatial extent of the reservoir.

At each identified site, four adult gillnets and four juvenile gillnets were deployed to sample shoreline, shallow, mid-water, and deepwater habitat. The near-shore ends of the gillnets for the shoreline were placed at the water's edge, and the gillnet was extended outward along the water's surface. The shallow sampling gillnets were placed offshore, to float on the reservoir surface. Gillnets for mid-water sampling were placed above the thermocline, if present, or at 50 percent of the total depth when there was no discernible thermocline. Gillnets for deepwater sampling were placed below the thermocline, if present, or at 85 percent of the total depth, but no deeper than 100 ft. Gillnets were oriented perpendicular to the shore with the finest mesh panel closest to the shore. Each deployed gillnet was marked by buoys for ease of relocation and easy visibility by recreational boaters. Water temperature (±0.2 degrees Celsius, [°C]) and Dissolved Oxygen (DO, ±0.2 milligrams per liter [mg/L]) profiles were collected using a Hydrolab at 10 ft intervals at four (25% intervals of length along the thalweg of the reservoir) locations within the reservoir to determine the presence and potential location of the thermocline and appropriate mid-water and deepwater net depth.

Gillnets were fished once during the day (day set) and once at night (night set), providing one day sample and one night sample for each site per sampling event. The time of day that sampling occurred varied with seasonal daylight conditions to assure consistent diel effort and ambient conditions. Time of deployment and location of each gillnet set were recorded and sites were photographed to characterize net placement relative to the shoreline.

Fish collected in gillnets were quickly processed and then released away from the gillnets to avoid recapture. Fish were identified as being of hatchery or wild origin, when possible, using basic visual identification features, such as clipped adipose fins. Information collected during processing included species, length (total length [TL] of all fish species without forked caudal fins and fork length [FL] for all species with forked caudal fins, in mm), and weight in grams (g). Condition was noted if fish were showing any visible health issues, such as disease or parasites.

Other information collected with sampling effort included impoundment name, Universal Transverse Mercator (UTM) coordinates of the sample site, names of crew members, weather condition, air temperature, Secchi depth, water temperature, DO, and conductivity (micromhos per centimeter [µmhos/cm]). Minimum, maximum, and mean water depths were recorded, along with the depth placement of each gillnet.

2.2.2 Boat Electrofishing

Boat electrofishing was used to sample fish populations in near-shore habitats at New Bullards Bar and Englebright reservoirs. Sampling occurred twice during the year, coinciding with high and low pool levels within New Bullards Bar Reservoir and once during summer in Englebright Reservoir. Boat electrofishing was conducted prior to gillnetting efforts to alleviate issues that may arise from overlap of sampling areas. Samples were collected at night, beginning 1 hour after civil twilight, and used standard methods described by Reynolds (1996). Two electrode booms were employed; the booms and boat were outfitted with non-conductive material for safety. Electrofishing effort or "time on," was recorded for each sampling site. Effort and pace were consistent for all sites. Boat electrofishing crews included three individuals, one operating the boat and two netting fish.

Electrofishing sites were selected to represent the array of habitats available within the near-shore areas of the reservoirs and were in areas of relatively mild gradient or level lake bottom. Sampling units for electrofishing stations were approximately 1,000 meters (m) in length and established around the reservoir to obtain representative samples among the diversity of identified near-shore habitats that are feasible to sample by boat electrofishing. Ten boat electrofishing sites were surveyed for New Bullards Bar Reservoir and five for Englebright Reservoir. Sites were replaced if safety became a concern (i.e., excessive nearby recreation). Once selected, the sampling sites were depicted on ortho-photographs, with specific sample start and end points using a Global Positioning System (GPS) to collect UTM coordinates.

All captured fish were placed into an aerated holding tank for processing. Information collected during processing included species, length (TL or FL as appropriate, in mm), weight (g), and, if applicable, notes on general condition of the fish. Condition was noted if fish were showing any visible issues, such as disease or parasites. After processing, fish were returned to the reservoir into the general area where they were collected. General information recorded included impoundment name, UTM coordinates of the sample site, crew member names, weather conditions, air temperature, and basic water quality data, including water temperature, DO, and electrical conductivity for each sampling site during each event.

2.2.3 Reservoir Tributary Assessment

The reservoir tributary assessment was conducted in two parts: 1) fish passage assessment and 2) species composition assessment. Only tributaries to New Bullards Bar Reservoir were surveyed.[2] Thirteen tributaries were visited to assess if they are accessible to fish and have

[2] A tributary assessment was not conducted for United States Army Corps of Engineers' (USACE's) Englebright Reservoir because multiple parties affect reservoir elevations in that reservoir.

nominal flow. A determination of whether the tributary met established criteria was made at each stream with supporting notes and pictures. Tributaries that were found to be accessible and have nominal flow were further surveyed with the two-part assessment described below.

2.2.3.1 Fish Passage Assessment

This assessment focused on potential barriers to fish movement out of New Bullards Bar Reservoir into tributaries in spring, when adfluvial spawning fish may move out of the reservoir and connective flow is present from spring runoff. Surveys were conducted when the reservoir was drawn down and extended from the reservoir pool level at the time of the survey to the normal maximum water surface elevation (NMWSE). Passage barriers were defined as a vertical height in the stream bed of 3 ft or greater, or shallow water where the thalweg depth was less than 0.3 ft for a distance exceeding 3 ft. All data were entered onto a Reservoir Tributaries Assessment Field Data Form. Current pool elevations from the day of field studies were obtained from the Project operator.

Surveys began in the reservoir pool (i.e., where flowing water met slack-water in the reservoir) and moved upstream to the reservoir NMWSE. At the starting point, a brief description was noted, UTM coordinates were collected, and photographs were taken. Several measurements were collected at each potential barrier. At potential leaping barriers, the plunge pool depth, landing pool depth, landing pool length, barrier height, and wetted width were recorded. At potential shallow water barriers, the width, maximum depth, depth range and length of the thalweg, and wetted width of the channel were recorded. Other general information collected for potential barriers included dominant and sub-dominant substrate, photographs, and observational notes. The NMWSE was identified by the presence of riparian vegetation, substrate change, or a water mark on the bank.

2.2.3.2 Species Composition Assessment

A single qualitative backpack electrofishing assessment was conducted in each tributary considered accessible to fish. Sampling focused on habitat in the tributary from the reservoir water surface to the NMWSE.

Fish collected during backpack electrofishing were placed in buckets with water and processed. Information collected during fish processing included species, length (TL or FL, as appropriate, in mm), weight (g), and if applicable, notes on fish condition. Electrofishing effort was measured as "time on" to determine relative abundance and was reported as catch per unit effort (CPUE). The assessment did not include quantitative estimates of fish abundance.

Qualitative direct observation snorkeling was used in unwadeable stream sections, exceeding water depth of 1.5 m, where electrofishing becomes ineffective and potentially unsafe. The number of snorkelers was based on visibility and stream width. Snorkelers occupied a pre-defined lane and moved in tandem upstream. Visual counts were coordinated between snorkelers to minimize any duplicate counts. Observed individual fish were identified to species and size was visually estimated by two-inch intervals (e.g., > 0–2 in., > 2–4 in., etc.). English measurement units were converted to metric units prior to analyses. Surveys were conducted

during the day when sufficient light was present. The number of fish observed was reported as the number of fish per linear meter to standardize effort. However, the number of observed fish reported per meter is not a true quantitative measure and does not represent a statistically supported density measurement.

General site information collected during species composition assessments included stream name, sampled stream length, mean wetted width, crew members, time of day, environmental (weather) conditions, riparian/channel characteristics (i.e., percent canopy, substrate, mean depth, and maximum depth), aquatic habitat characteristics (i.e., habitat type[s], and cover), air temperature, water chemistry (water temperature, DO, and conductivity), and UTM coordinates. Photographs were taken to document conditions of the site. Collected parameters were the same, regardless of the use of backpack electrofishing or snorkeling.

2.2.4 Species Presence and Stocking Records

An investigation into available stocking records and historical documentation of species presence was conducted. Numerous resources were solicited for data, including private business operators on New Bullards Bar Reservoir, agency representatives and other sources. The compiled information is presented, relative to findings from the current sampling effort, in Section 4.2.2 to identify changes in expected species presence.

2.3 Data Analysis

2.3.1 Reservoir Assessment

Water temperature and DO profile information for each reservoir and sampling event, as well as collected water temperature, DO, conductivity, and Secchi depth information was summarized. Summaries of the relative proportions, lengths, and weights of each fish species were developed for each reservoir by sampling event and sampling site for both methods, and for diel period and net depth for gillnet sampling. CPUE, calculated as the number of fish collected per hour that a gillnet soaked and the number of fish collected per hour that the electrofishing unit was "on," was calculated.

Length and weight data from both sampling methods was pooled for each reservoir to compute a relative condition factor (Kn):

$$Kn = W/W'$$

where W equals individual fish weight and W' equals length-specific weight from the weight-length relationship. Regression analysis was used to estimate the weight-length relationship in the form:

$$W' = a(FL)^b$$

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

Relative condition factor provides a general indication of individual fish condition and health, where a value of Kn greater than or equal to 1.0 indicates fish of average or better condition. Since condition is relative to each collected population of fish, individual condition scores are reported in Attachment 3-7A. Overall scores are provided in the results.

2.3.2 New Bullards Bar Reservoir Tributary Assessment

Data collected during passage and fish composition assessments were summarized by site. Fish sampling data were summarized by species and size interval. Relative condition factor was calculated for gamefish of interest, including rainbow (*Onchorhynchus mykiss*) and brown trout (*Salmo trutta*) in tributaries that were electrofished. Potential barriers documented during the surveys were highlighted and described.

2.4 Data QA/QC

All field notes were organized and checked for missing pages and photocopied at the end of each field week. Originals and copies were kept in separate locations until the originals were delivered for storage in a fireproof safe. All digital photos were downloaded weekly to a server protected by a redundant data system.

Field data were entered into a spreadsheet and checked independently by two technicians for transcription error. The original field technician was consulted to confirm data entries that needed clarification.

3.0 Results

3.1 Reservoir Assessment

Maps of both reservoirs showing the gillnet and boat electrofishing sites are presented in Figure 3.1-1. In Figure 3.1-1, NBEF=New Bullards Bar electrofishing, EBEF= Englebright electrofishing, and GN=gill net. All results are separated by reservoir. Gillnet sampling took place at 8 sites and at New Bullard Bar Reservoir, electrofishing took place at 10 sites. On Englebright Reservoir, there were 4 gillnet sampling sites and 4 electrofishing sites.

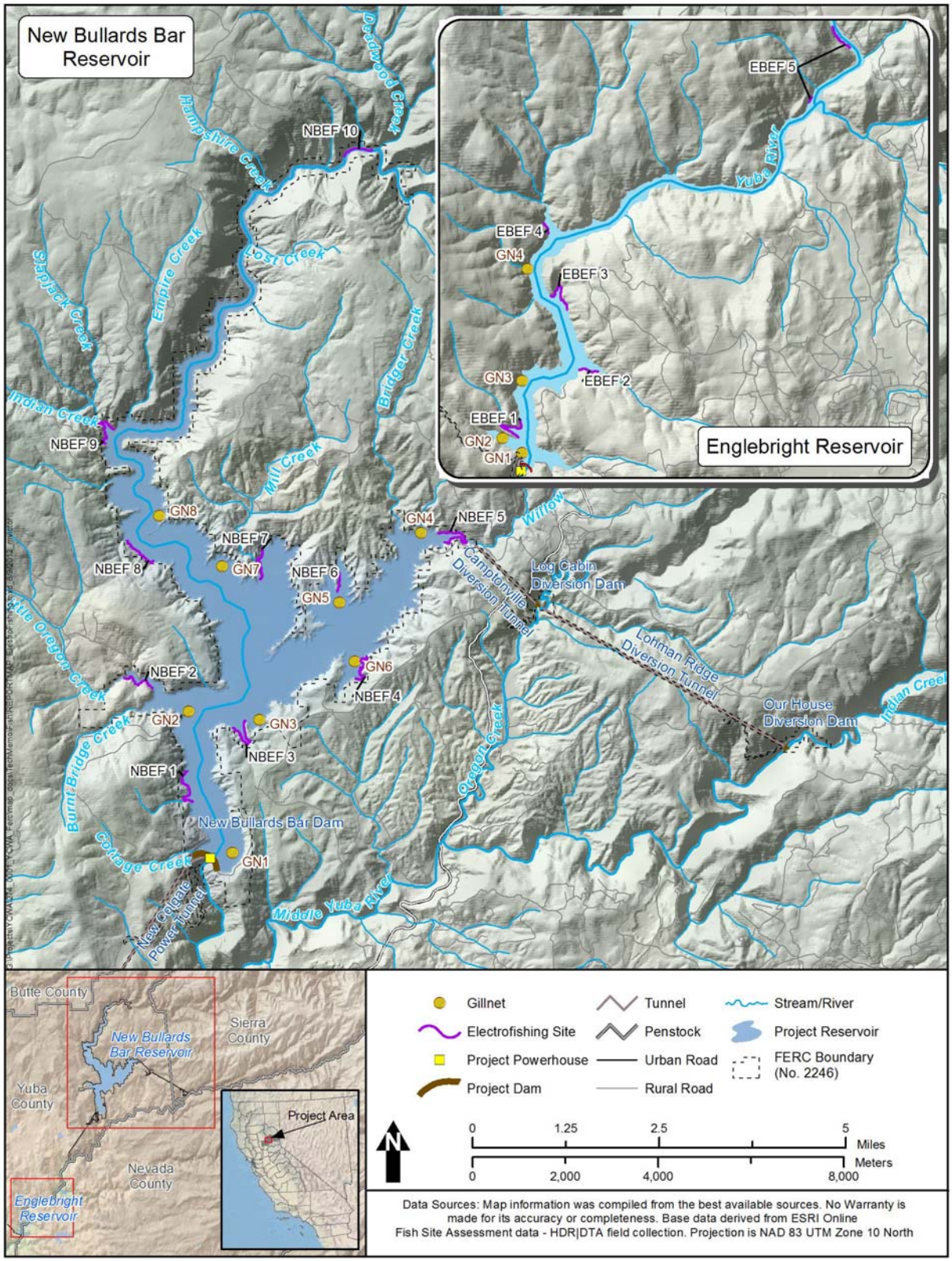

Figure 3.1-1. Overview map of New Bullards Bar and Englebright reservoirs fish population sampling.

3.1.1 New Bullards Bar Reservoir

3.1.1.1 Operational Characteristics

In 2012, New Bullards Bar Reservoir reached its lowest elevation of 1,874 ft on January 19 (Figure 3.1-2), which also corresponded with the last day of gillnet sampling. Beginning in mid-March, the reservoir began to fill and peaked on May 22 at 1,954 ft. Reservoir stage began to slowly decrease following the peak. The 80 ft of stage change resulted in a difference of 332,042 ac-ft of storage. The upper intake has not been used since 1993.

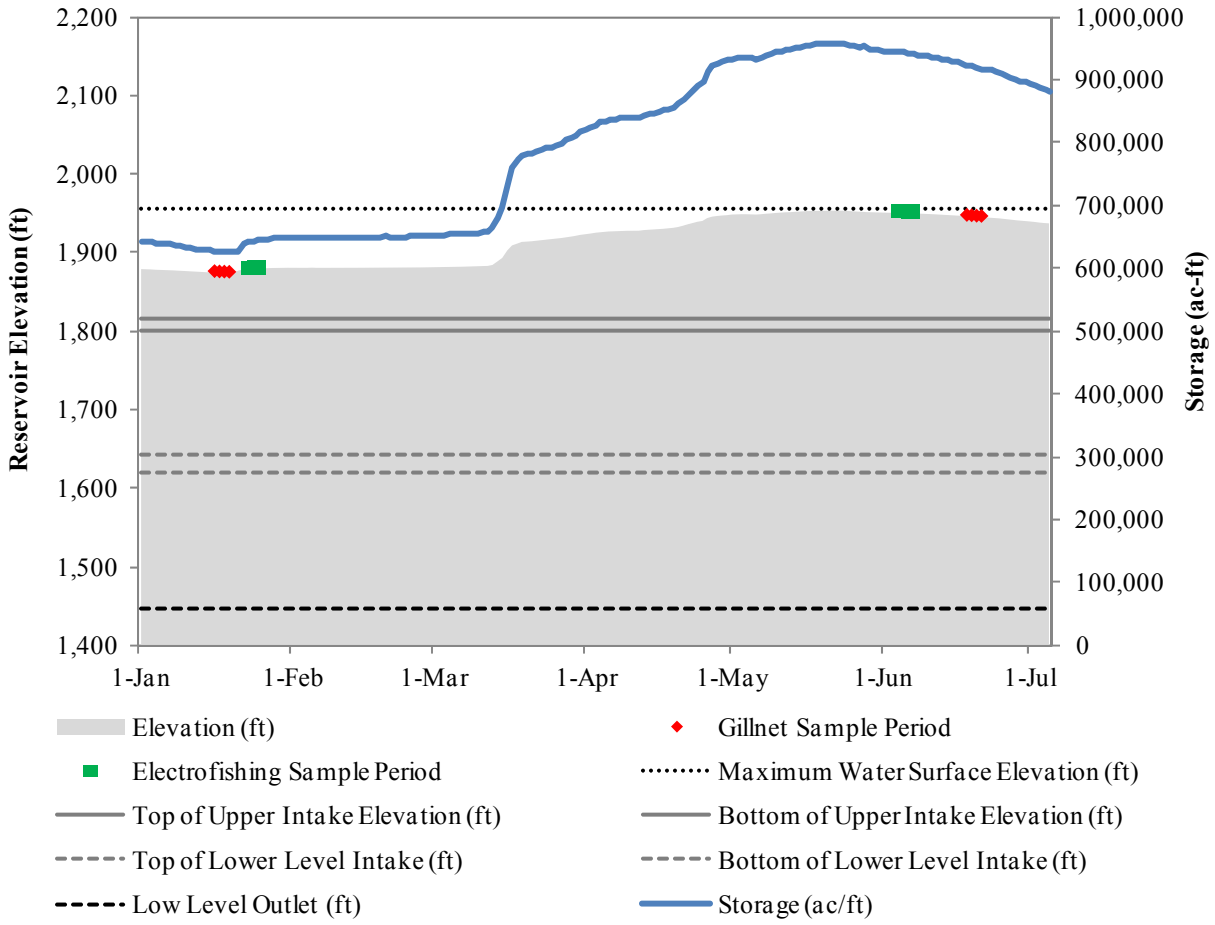

Figure 3.1-2. Summary of reservoir stage and capacity in New Bullards Bar Reservoir along with other notable project features.

Water temperature increased over the course of each of the two sample events (Figure 3.1-3). The thermocline was broadly distributed vertically from elevation 1,620 to 1,720 ft in January during Event 1. Overall temperature ranged from 6.8°C to 10.1°C. In June, during Event 2, the thermocline more sharply transitioned between 1,850 and 1,875 ft. Following the thermocline, the water continued to warm and ranged from 6.8°C to 24.3°C. The upper 12 ft of water

generally exceeded 20.0°C. Figure abbreviations in Figure 3.1-3: Jan=January, WSEL=Water Surface Elevation, El=Elevation.

The DO profiles for Event 1 ranged from 5.5 to 9.2 milligrams per liter (mg/L), but generally trended upwards as the profile approached the surface (Figure 3.1-4). As expected, low values were observed in depths greater than 350 ft. In Event 2, DO was similar to Event 1, ranging from 5.6 to 9.2 mg/L; however the highest concentrations were not at the surface. Depth of peak DO during Event 2 varied, but generally was greater than 40 ft. Figure abbreviations in Figure 3.1-4: Jan=January, WSEL=Water Surface Elevation, El=Elevation.

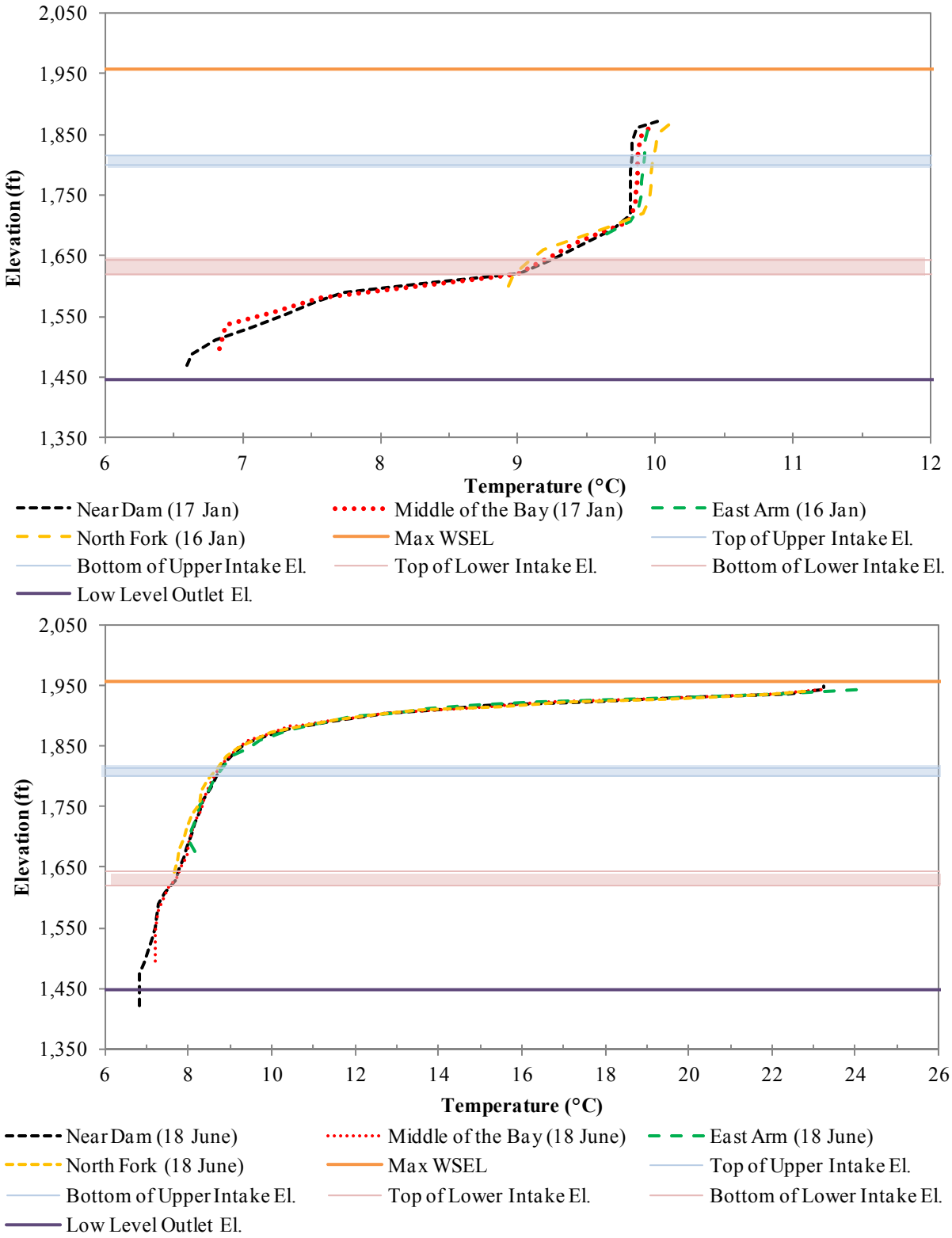

Figure 3.1-3. Profiles of water temperature from Event 1 (top) and Event 2 (bottom) in New Bullards Bar Reservoir, January and June 2012.

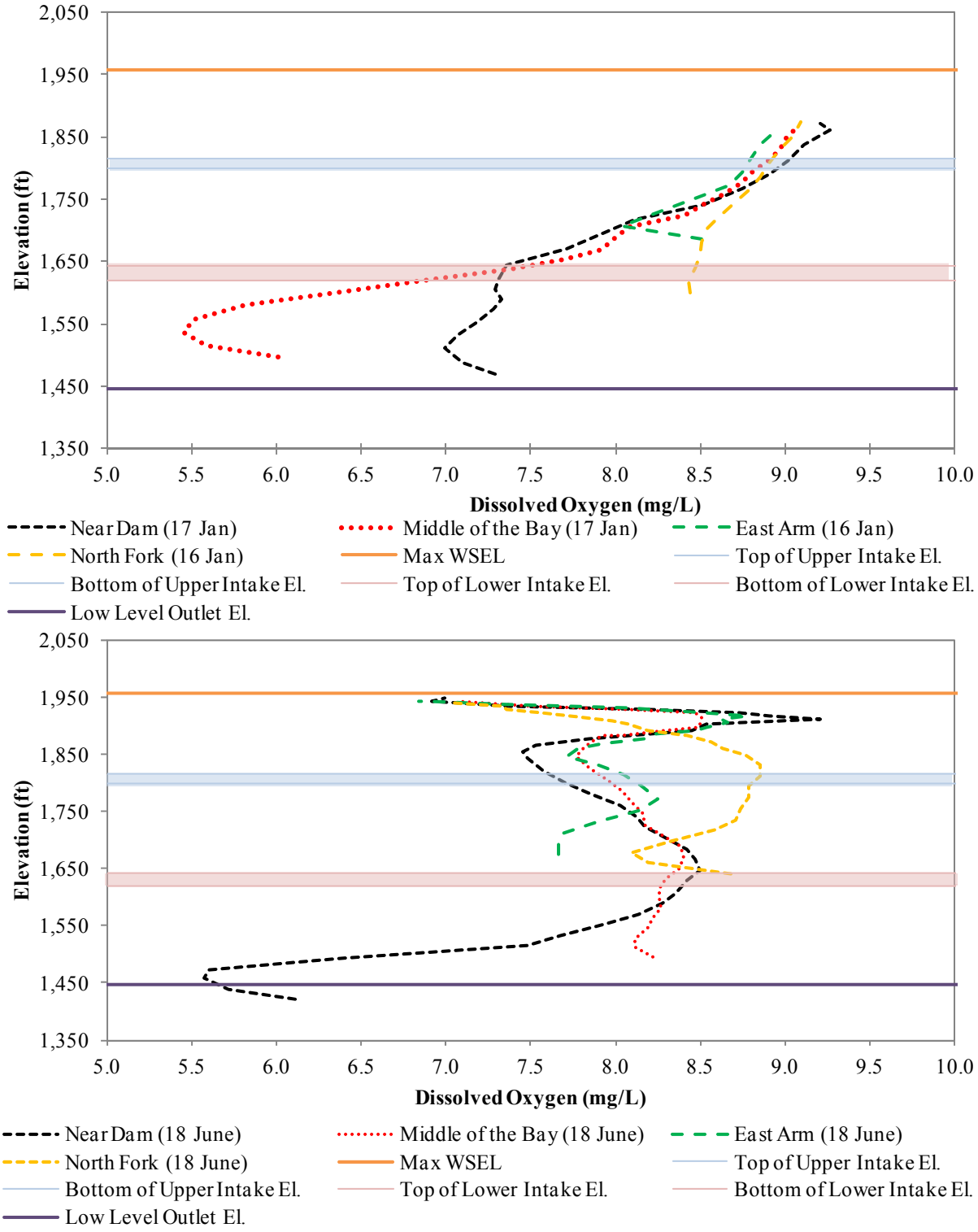

Figure 3.1-4. Profiles of DO from Event 1 (top) and Event 2 (bottom) in New Bullards Bar Reservoir, January and June 2012.

Table 3.1-1. Instantaneous minimum, maximum, and mean water quality measurements in New Bullards Bar Reservoir during gillnetting and electofishing in January and June 2012.

Sample Period	Mean Daily Elevation (ft)	Surface Water Temperature (°C)	Dissolved Oxygen (mg/L)	Conductivity (µmhos/cm)	Secchi Depth (ft)
Event 1 (January 2012)	748-783 (762)	4.3-10.2 (8.9)	10.2-12.0 (10.8)	61.9-68.1 (64.7)	4.0-13.1 (8.1)
Event 2 (June 2012)	812-829 (820)	15.7-21.8 (17.5)	9.0-10.2 (9.8)	63.2-82.5 (73.5)	11.5-18.0 (13.9)

Key: ft = feet

Near-surface instantaneous measurements ranged from 4.3°C to 21.8°C for water temperature and 9.0 to 12.0 mg/L for DO over all sampling events (Table 3.1-1). Conductivity was moderate and ranged from 61.9 to 82.5 µmhos/cm for all surveys. Secchi depth measurements were variable and ranged from 4.0 to 18.0 ft. Secchi depths were greatest during June.

3.1.1.2 New Bullards Bar Reservoir Sample Sites

Sampling sites for gillnetting and boat electrofishing were distributed throughout New Bullards Bar Reservoir to represent available habitat and any differences in fish assemblages (Tables 3.1-2 and 3.1-3). Site locations remained relatively unchanged and only mildly shifted when changes in reservoir stage did not permit sampling in the same location. Sampling locations by site number and event are shown on the overview map of the study area (Figure 3.1-1).

Table 3.1-2. Location and habitat descriptions for gillnet sites in New Bullards Bar Reservoir in January and June 2012.

Gillnet Site	Location	Habitat
1	Shoreline east of Emerald Cove	Steep rocky shoreline. Maximum sampling depth of 100 feet (ft) exceeded less than 150 ft from shore. Shoreline below rim had multiple stumps for potential habitat and more were likely to be present in the sampling area.
2	Point at southern edge of reservoir and east of Moran Cove	Exposed area of shoreline was steep and muddy with numerous stumps, additional stumps were observed to a depth of 15 ft. The steep shoreline leveled off to a level bench, covering an area of approximately 1 acre and a depth of 85 ft during the first round of sampling.
3	A small cove due south of Garden Point, near the Schoolhouse Campground	The shoreline in this part of the reservoir was steep and muddy. Many tree stumps covered the shoreline with elaborate roots that were exposed by erosion.
4	West of the inlet of Willow Creek on the southern side of the cove	At low pool this site averaged 65 ft deep over the area sampled. The shoreline was very steep with virtually vertical bedrock shoreline. Shore nets were set in a small area of sandy low angle shore just west of the pelagic nets.
5	The southern end of Tractor Cove, due east of the bald eagle (*Haliaeetus leucocephalus*) nesting area	This site had a steep shoreline that quickly leveled off at a depth of roughly 75 ft during the low pool sampling event. Sand and mud were the dominant substrate, with only a few tree stumps to provide underwater structure.
6	East of the Dark Day Boat Launch	This narrow cove had steep sides and sandy substrates. The exposed shoreline was a combination of mud and sand, with small tree stumps scattered every 15 to 25 ft. The sampled area had a relatively flat bottom, as compared to other sites.
7	Due west of Houseboat Cove	The shoreline here was steep with steps of white decomposed granite. Driftwood in a variety of sizes littered the shoreline, but nothing else indicated the presence of underwater structure at this site.
8	North east end of Frenchy Point	This site has a steep and rocky shoreline. At low pool, a slight cove had an area of even depth at approximately 90 ft. The shoreline had no tree stumps or soil to indicate the presence of underwater structure.

Table 3.1-3 Location and habitat descriptions for boat electrofishing sites in New Bullards Bar Reservoir, January and June 2012.

Electrofish Sites	Location	Habitat
1	Shore along the western edge of the reservoir near the houseboats at Emerald Cove	Very steep shoreline with muddy bottom at the backs of the weak coves and rocks along the points.
2	North arm of Moran cove and the inlet of Little Oregon Creek	Very steep rock and bed rock shoreline. Most fish were captured in the narrow area around the mouth of Little Oregon Creek.
3	Southern edge of main body of the reservoir, shoreline south of Garden Point and west of Schoolhouse Campground	The shoreline in this part of the reservoir was steep and muddy. Many tree stumps covered the shoreline with elaborate roots that had been exposed by erosion.
4	East of the Dark Day Boat Launch	This narrow cove had steep sides and sandy substrates. The exposed shoreline was a combination of mud and sand with small tree stumps scattered every 15 to 25 ft. The sampled area had a relatively flat bottom as compared to other sites.
5	Cove including the inlet of Willow Creek	Shoreline in this area was highly variable. Generally steep, substrates varied from mud and decomposed granite to bedrock. Submerged large boulders around the inlet of Willow Creek made up the only underwater structure observed.
6	Shoreline along the west side of Tractor Cove	This area was dominated by decomposed granite and mud banks with little in water structure.
7	Shoreline along the western margin of Houseboat Cove	This area was dominated by decomposed granite and mud banks with little in water structure.
8	Shoreline west of Frenchy Point	Very steep rock and mud shoreline, generally lacking submerged tree stumps or any other submerged structure.
9	Shoreline along the western side of the reservoir. This site is located in the belly of a horseshoe bend, where the reservoir begins to open from a narrow river canyon to the broad submerged valley.	The shoreline here was dominated by bedrock and boulders. This part of the reservoir is very steep with near vertical canyon walls.
10	Site located at the end of perceptible current from the inflowing North Yuba River.	Shear canyon walls made for a deep site with little submerged structure.

3.1.1.3 Species Composition

A total of 971 fish, comprising 11 species, were collected during two sampling events on New Bullards Bar Reservoir (Table 3.1-4). Attachment 3-7B presents length-frequency information for each species collected. Spotted bass (*Micropterus punctulatus*) was the most common species detected (n=644), accounting for 66.3 percent of all collected fish (Figure 3.1-5). Other common centrarchids included bluegill (*Lepomis macrochirus*) (n=79, 8.1%) and green sunfish (*L.cyanellus*) (n=63, 6.5%). Salmonid species were represented by rainbow trout (*Oncorhynchus mykiss*) (n=49, 5.0%) and kokanee (*O.nerka*) (n=47, 4.8%), which have been historically stocked in the reservoir by the California Department of Fish and Game (CDFG). Other commonly collected species included common carp (*Cyprinus carpio*) (n=56, 5.8%), Sacramento sucker (*Catostomus occidentalis*) (n=18, 1.9%), and Sacramento pikeminnow (*Ptychocheilus grandis*) (n=9, 0.9%). Special-status fish species were neither observed nor documented.

Table 3.1-4. Summary of relative abundance, length, and weight of all fish species collected at New Bullards Bar Reservoir in January and June 2012 organized by abundance in catch.

Species	N	%	Length (mm)			Weight (g)			Avg. Relative Condition[1]
			Min	Max	Avg	Min	Max	Avg	
Spotted Bass *Micropterus punctulatus*	644	66.3%	43	515	235	0.8	3,400.0	378.6	1.03
Bluegill *Lepomis macrochirus*	79	8.1%	34	221	92	0.6	236.7	41.8	1.02

Table 3.1-4. (continued)

Species	N	%	Length (mm)			Weight (g)			Avg. Relative Condition[1]
			Min	Max	Avg	Min	Max	Avg	
Green Sunfish *Lepomis cyanellus*	63	6.5%	37	230	104	0.4	210.0	34.0	1.02
Common Carp *Cyprinus carpio*	56	5.8%	360	570	443	775.0	3,100.0	1,443.5	0.98
Rainbow Trout *Oncorhynchus mykiss*	49	5.0%	55	421	239	2.1	670.0	227.3	1.03
Kokanee *Oncorhynchus nerka*	47	4.8%	159	295	229	63.0	230.5	142.0	1.01
Sacramento Sucker *Catostomus occidentalis*	18	1.9%	320	430	365	450.0	1,060.0	710.8	1.00
Sacramento Pikeminnow *Ptychocheilus grandis*	9	0.9%	149	478	353	135.0	1,320.0	659.3	1.04
White Catfish *Ameiurus catus*	3	0.3%	285	385	347	392.0	950.0	740.7	--
Brown Bullhead *Ameiurus nebulosus*	2	0.2%	355	395	375	900.0	1,300.0	1,100.0	--
White Crappie *Pomoxis annularis*	1	0.1%	239	239	239	197.0	197.0	197.0	--
Total	**971**	**100.0%**	--	--	--	--	--	--	--

Key: g = grams mm = millimeters
[1] Species with poor fit regressions did not have a reportable condition factor.

Species that were well represented generally were present in multiple size classes. The range of lengths for all fish collected was 34 to 570 mm (Table 3.1-4). Of the six most commonly collected species, only common carp and kokanee did not include individuals of juvenile size.

Spotted bass catch included individuals from an exceptionally wide range of sizes (43 to 515 mm and less than 1 g to 3,400 g), including the largest collected fish (by mass). It comprised the majority of the biomass (total weight) of all collected species (Figure 3.1-5). Common carp was the only other species to comprise more than 20 percent of the biomass, and Sacramento sucker and rainbow trout were the only other species to account for more than 3 percent of the biomass. These four species combined for 93.9 percent of the total biomass captured in the reservoir.

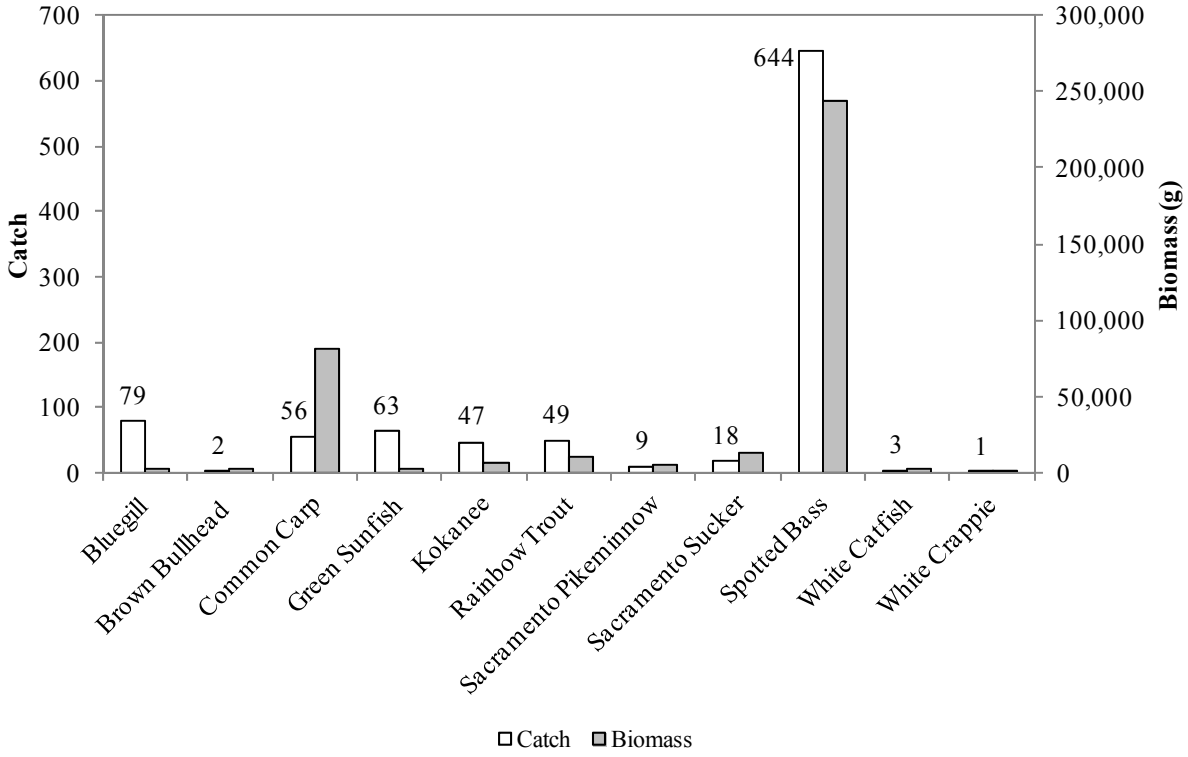

Figure 3.1-5. Catch and biomass by species, combined from gillnet and boat electrofishing at New Bullards Bar Reservoir in January and June 2012.

Most fish appear healthy based upon their relative weight. The average relative condition factor for all fish ranged from 0.98 for common carp to 1.04 for Sacramento pikeminnow (Table 3.1-4.).

3.1.1.4 Summary of Collected Fish by Method, Diel Period, and Event

Overall catch rates for boat electrofishing were substantially higher than for gillnetting. Technicians collected 715 fish from 10 species (73.6% of the total catch) with boat electrofishing, and 256 fish from 9 species (26.4%) with gillnets (Figure 3.1-6; Tables 3.1-5 and 3.1-6). The number of fish caught by electrofishing and gillnetting was relatively similar between events, but was slightly higher during Event 2 (June) than Event 1 (January).

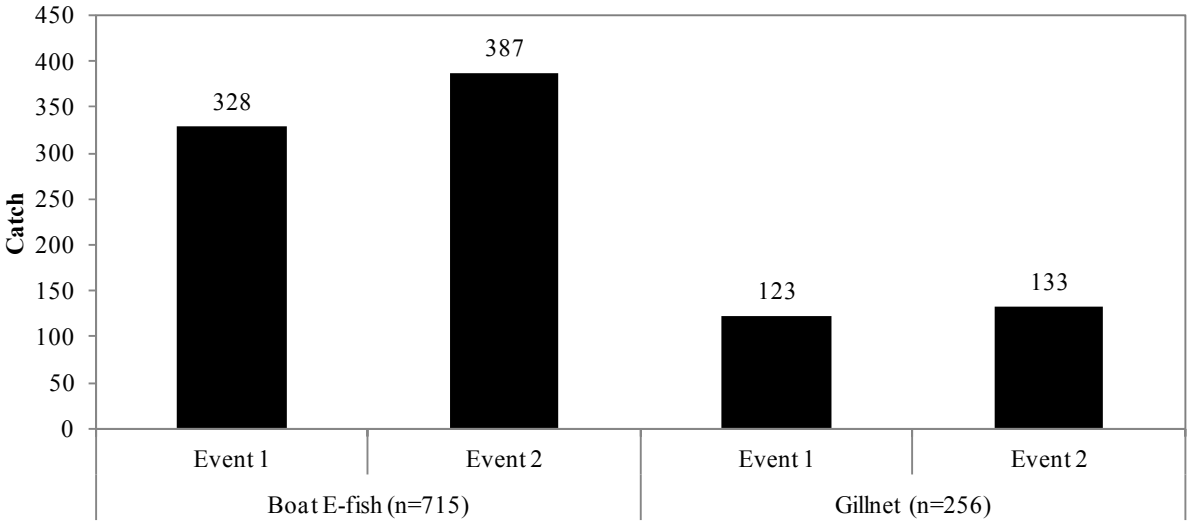

Figure 3.1-6. Number of fish collected by method and event at New Bullards Bar Reservoir in January and June 2012.

Table 3.1-5. Summary of the total gillnet catch, relative abundance, length, and weight of each species by sample period at New Bullards Bar Reservoir in January and June 2012.

Event	Species	N	%	Fish/Hour	Length (mm)			Weight (g)		
					Min	Max	Mean	Min	Max	Mean
1	Spotted Bass *Micropterus punctulatus*	67	54.5%	0.072	203	510	400	92.0	3,050.0	1,520.9
	Kokanee *Oncorhynchus nerka*	24	19.5%	0.026	159	245	216	65.0	185.0	129.5
	Common Carp *Cyprinus carpio*	8	6.5%	0.009	410	557	456	1,350.0	3,100.0	1,831.3
	Sacramento Sucker *Catostomus occidentalis*	8	6.5%	0.009	335	430	374	490.0	1,060.0	796.9
	Rainbow Trout *Oncorhynchus mykiss*	7	5.7%	0.007	233	367	295	115.0	510.0	300.7
	Sacramento Pikeminnow *Ptychocheilus grandis*	7	5.7%	0.007	337	478	397	440.0	1,320.0	804.3
	Brown Bullhead *Ameiurus nebulosus*	2	1.6%	0.002	355	395	375	900.0	1,300.0	1,100.0
Event 1 Subtotal n=123										
2	Spotted Bass *Micropterus punctulatus*	88	66.2%	0.064	105	515	307	16.0	3,400.0	852.9
	Kokanee *Oncorhynchus nerka*	19	14.3%	0.014	180	253	239	63.0	180.0	150.5
	Common Carp *Cyprinus carpio*	15	11.3%	0.011	375	496	426	830.0	1,800.0	1,217.3
	Rainbow Trout *Oncorhynchus mykiss*	5	3.8%	0.004	260	421	328	157.0	610.0	383.4
	Green Sunfish *Lepomis cyanellus*	4	3.0%	0.003	102	230	168	21.0	210.0	111.0
	White Catfish *Ameiurus catus*	2	1.5%	0.001	370	385	378	880.0	950.0	915.0
Event 2 Subtotal n=133 with an overall 2 event total of n=256										

Key: g = grams mm = millimeters

Table 3.1-6. Summary of total boat electrofishing catch, relative abundance, length, and weight of each species by event at New Bullards Bar Reservoir in January and June 2012.

Event	Species	N	%	Fish/Hour	Length (mm)			Weight (g)		
					Min	Max	Mean	Min	Max	Mean
1	Spotted Bass *Micropterus punctulatus*	203	61.9%	98.0	43	450	186	0.8	2,000.0	119.1
	Bluegill *Lepomis macrochirus*	40	12.2%	19.3	36	221	103	0.6	236.7	56.5
	Green Sunfish *Lepomis cyanellus*	36	11.0%	17.4	37	172	106	0.4	104.5	30.0
	Rainbow Trout *Oncorhynchus mykiss*	35	10.7%	16.9	55	395	216	2.1	670.0	190.6
	Sacramento Sucker *Catostomus occidentalis*	6	1.8%	2.9	326	392	368	450.0	920.0	720.0
	Common Carp *Cyprinus carpio*	3	0.9%	1.4	400	490	458	1,050.0	2,000.0	1,575.0
	Kokanee *Oncorhynchus nerka*	2	0.6%	1.0	225	295	260	112.0	230.5	171.3
	Sacramento Pikeminnow *Ptychocheilus grandis*	2	0.6%	1.0	149	245	197	135.0	169.0	152.0
	White Crappie *Pomoxis annularis*	1	0.3%	0.5	239	239	239	197.0	197.0	197.0
Event 1 Subtotal n=328										
2	Spotted Bass *Micropterus punctulatus*	286	73.9%	120.0	60	510	209	2.8	3,000.0	149.2
	Bluegill *Lepomis macrochirus*	39	10.1%	16.4	34	200	82	0.6	197.0	26.8
	Common Carp *Cyprinus carpio*	30	7.8%	12.6	360	570	447	775.0	3,050.0	1,440.0
	Green Sunfish *Lepomis cyanellus*	23	5.9%	9.7	40	175	90	0.6	136.0	26.8
	Sacramento Sucker *Catostomus occidentalis*	4	1.0%	1.7	320	350	341	450.0	550.0	525.0
	Kokanee *Oncorhynchus nerka*	2	0.5%	0.8	246	259	253	174.0	189.0	181.5
	Rainbow Trout *Oncorhynchus mykiss*	2	0.5%	0.8	111	355	233	12.2	432.0	222.1
	White Catfish *Ameiurus catus*	1	0.3%	0.4	285	285	285	392.0	392.0	392.0
Event 2 Subtotal n=387 with an overall 2 event total of n=715										

Key: g = grams mm = millimeters

Most gillnet catch was in adult nets (n=230, 89.8%) with only 26 fish (10.2%) collected in juvenile gillnets (Figure 3.1-7). Catch rates were highest in shore sets for both juvenile and adult nets. The adult shore nets had the highest catch rate at 0.5 fish per hour (fish/hr) (n=142, 55.5% of total net catch). The adult shore nets caught more than four times the number of fish/hr than any other adult net. Similarly, the juvenile shore nets caught substantially more fish/hr (n=22, 84.6% of total juvenile net catch) than other juvenile nets.

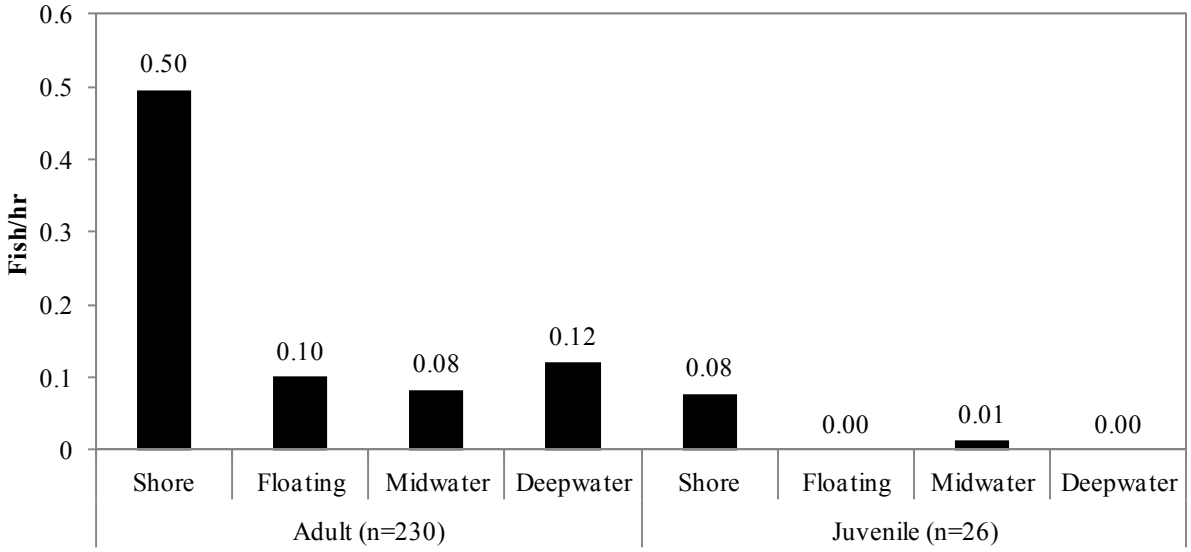

Figure 3.1-7. Catch rate in gillnets by net type and position in New Bullards Bar in January and June 2012.

Diel period did not appear to strongly influence total captures in gillnets (Figure 3.1-8). Nets set in near-shore habitats collected substantially more fish than other nets for both day and night sets. A slight majority of fish were captured during night sets (n=134, 52.3%) with catch rates ranging from 0.05 fish/hr in both the mid- and deep-water gillnets to 0.26 fish/hr in the shore gillnets. Daytime gillnet sampling collected fewer fish (n=122, 47.7%); however, shore sets had the highest catch rate of all gillnets, and both shore and deepwater catch rates were higher than their night-set counterparts.

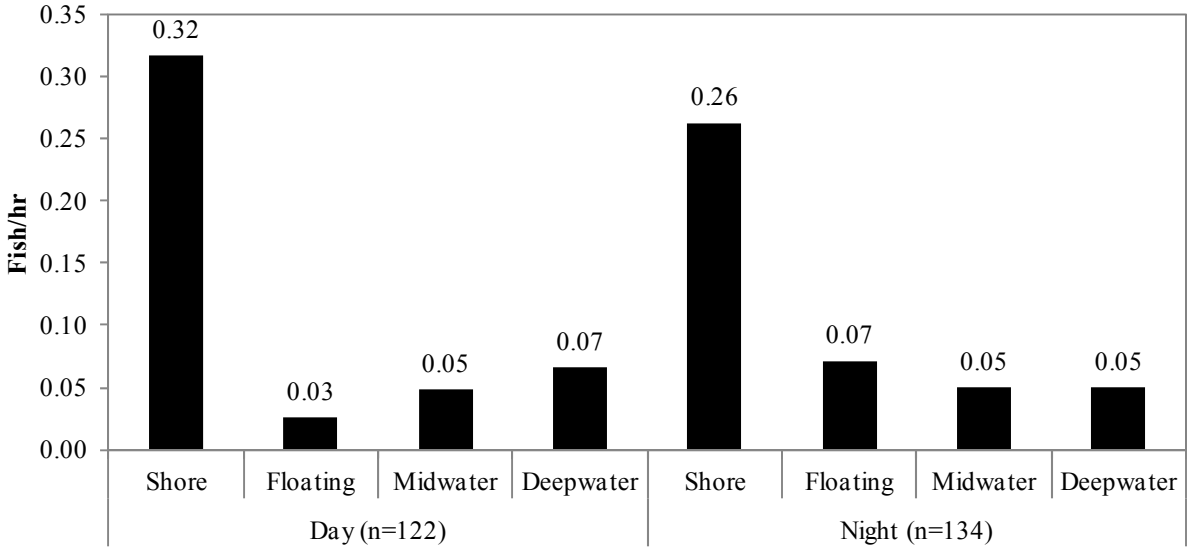

Figure 3.1-8. Catch rate in gillnets by diel period and net position in New Bullards Bar Reservoir in January and June 2012.

Sampling efforts resulted in more species collected in Event 1 (January) than Event 2 (June) for both gillnetting and boat electrofishing (Tables 3.1-5 and 3.1-6). The same species were collected by both fishing methods with the exception of brown bullhead (*Ameiurus nebulosus,* gillnetting exclusively) and bluegill (boat electrofishing exclusively).

During both gillnetting events, spotted bass and kokanee had the highest catch rates (Table 3.1-5). Catch rates of both species were highest during Event 1, with catch rate of kokanee decreasing by almost 50 percent during Event 2. Although Sacramento sucker was the third most common species in Event 1, none were captured in Event 2. Sacramento pikeminnow were also absent from the Event 2 catch.

Spotted bass and bluegill had the highest catch rates during both boat electrofishing events (Table 3.1-6). Rainbow trout were relatively common during Event 1, but catch rate decreased dramatically during Event 2. Catch rate for green sunfish decreased by almost 50 percent during Event 2.

Species composition, from both gears combined, varied somewhat between events (Figure 3.1-9). Brown bullhead, Sacramento pikeminnow, and white crappie (*Pomoxis annularis*) were captured during Event 1 only. White catfish (*Ameiurus catus*) were observed only during Event 2. Rainbow trout and Sacramento sucker were far more common during Event 1 (85.7% and 77.8% of species-specific catch), whereas common carp were far more common during Event 2 (80.4%). Spotted bass, the most numerous species observed, were slightly more common during Event 2 (58.1%). Capture of bluegill, green sunfish, and kokanee changed little between events.

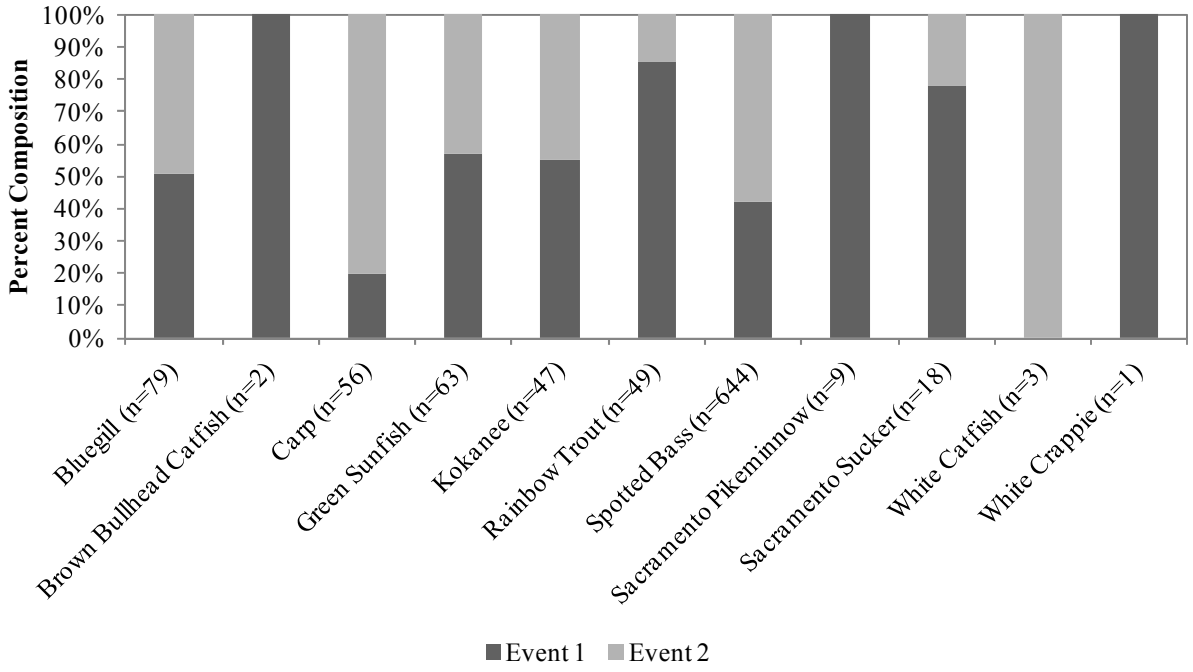

Figure 3.1-9. Percent species composition by event for gillnet and boat electrofishing combined in New Bullards Bar Reservoir in January and June 2012.

Catch by gillnet site was variable with a maximum of 53 and minimum of 18 fish captured at individual sites (Table 3.1-7). Gillnet Site 2, the point at the southern edge of the reservoir and east of Moran Cove, and Site 4, west of the inlet of Willow Creek on the southern side of the cove, were most productive, accounting for 20.7 percent and 19.9 percent of the total catch respectively. Site 2, an exposed area of steep, muddy shoreline with numerous stumps, accounted for 30.3 percent of all spotted bass, while Site 4 with a nearly vertical bedrock shoreline, produced 34.8 percent of all rainbow trout.

Site 1, closest to the dam near the east shoreline of Emerald Cove, had the lowest catch of all sites (Table 3.1-7).

Table 3.1-7. Total catch of fish by species and site for gillnet sampling at New Bullards Bar Reservoir in January and June 2012 in order of abundance.

Species	Site								Total
	1	2	3	4	5	6	7	8	
Spotted Bass *Micropterus punctulatus*	13	47	14	19	9	19	10	24	155
Kokanee *Oncorhynchus nerka*	1	3	6	15	6	8	4	0	43
Common Carp *Cyprinus carpio*	0	1	0	7	4	3	3	5	23
Rainbow Trout *Oncorhynchus mykiss*	3	0	1	4	1	0	1	2	12
Sacramento Sucker *Catostomus occidentalis*	0	1	0	1	1	0	2	3	8
Sacramento Pikeminnow *Ptychocheilus grandis*	0	1	0	5	1	0	0	0	7
Green Sunfish *Lepomis cyanellus*	1	0	1	0	1	0	0	1	4
Brown Bullhead *Ameiurus nebulosus*	0	0	0	0	1	1	0	0	2
White Catfish *Ameiurus catus*	0	0	0	0	0	2	0	0	2
Total	**18**	**53**	**22**	**51**	**24**	**33**	**20**	**35**	**256**

Only one kokanee and one spotted bass were captured in deepwater nets at Site 1, representing 11.1 percent of the overall site-specific catch (Table 3.1-8). Sixteen additional individuals were collected in surface nets, including green sunfish (n=1), rainbow trout (n=3), and spotted bass (n=12).

Table 3.1-8. Summary of catch by gillnet depth at Site 1 near New Bullards Bar Dam in January and June 2012 in order of abundance.

Species	Event 1 (n=2)				Event 2 (n=16)			
	Shore	Floating	Midwater	Deep	Shore	Floating	Midwater	Deep
Spotted Bass *Micropterus punctulatus*	0	0	1	0	11	0	0	1
Rainbow Trout *Oncorhynchus mykiss*	1	0	0	0	2	0	0	0
Green Sunfish *Lepomis cyanellus*	0	0	0	0	1	0	0	0
Kokanee *Oncorhynchus nerka*	0	0	0	0	0	0	0	1
Total	**1**	**0**	**1**	**0**	**14**	**0**	**0**	**2**

Catch by boat electrofishing site was also highly variable (Table 3.1-9). The maximum catch came from Site 5 (n=125), the cove including the inlet of Willow Creek (Figure 3.1-1), while the minimum capture came from Site 1 (n=42), the shore along the western edge of the reservoir near the house boats at Emerald Cove. Catch of spotted bass was relatively evenly distributed over the ten sites. Almost half (48.6%) of the rainbow trout catch came from Site 10.

Table 3.1-9. Total catch of fish by species and site for boat electrofishing at New Bullards Bar Reservoir in January and June 2012 in order of abundance.

Species	Site										
	1	2	3	4	5	6	7	8	9	10	Total
Spotted Bass *Micropterus punctulatus*	30	59	41	39	85	39	50	49	30	67	489
Bluegill *Lepomis macrochirus*	3	8	12	12	15	8	6	5	9	1	79
Green Sunfish *Lepomis cyanellus*	6	12	6	4	15	4	7	1	3	1	59
Rainbow Trout *Oncorhynchus mykiss*	1	7	2	1	5	0	1	1	1	18	37
Common Carp *Cyprinus carpio*	2	3	2	2	4	5	3	1	1	10	33
Sacramento Sucker *Catostomus occidentalis*	0	1	0	0	0	0	0	0	5	4	10
Kokanee *Oncorhynchus nerka*	0	0	0	1	1	0	0	0	1	1	4
Sacramento Pikeminnow *Ptychocheilus grandis*	0	0	0	0	0	1	0	0	1	0	2
White Catfish *Ameiurus catus*	0	0	0	0	0	1	0	0	0	0	1
White Crappie *Pomoxis annularis*	0	0	1	0	0	0	0	0	0	0	1
Total	**42**	**90**	**64**	**59**	**125**	**58**	**67**	**57**	**51**	**102**	**715**

3.1.2 Englebright Reservoir

3.1.2.1 Operational Characteristics

Englebright Reservoir, which is directly downstream of the New Colgate Powerhouse, has storage that may fluctuate from day to day, but that is generally brought back to a preferred target storage level within a week. The average annual inflow to Englebright Reservoir, excluding releases from New Bullards Bar Reservoir, is approximately 400,000 ac-ft. Englebright Reservoir has a total storage capacity of approximately 70,000 ac-ft, but provides only limited conservation storage. PG&E holds an appropriative water right license for the storage of up to 45,000 ac-ft in Englebright Reservoir. The reservoir storage capacity is used primarily to attenuate power peaking releases from New Colgate Powerhouse and to capture storm runoff from the upstream watershed. As a result, reservoir water elevation does not vary considerably and generally changes no more than a 15 ft annually, with less than 5 ft variations monthly.

In 2012, the reservoir fluctuated from 516.8 to 531.6 ft in stage (Figure 3.1-10). While 531.6 ft in stage is 4.6 ft over the NMWSE of 527 ft, the extra height in stage represents when water is spilling over the top of dam's crest. During sampling, the reservoir ranged from 517 to 523 ft, and storage varied between 62,042 and 73,827 ac-ft.

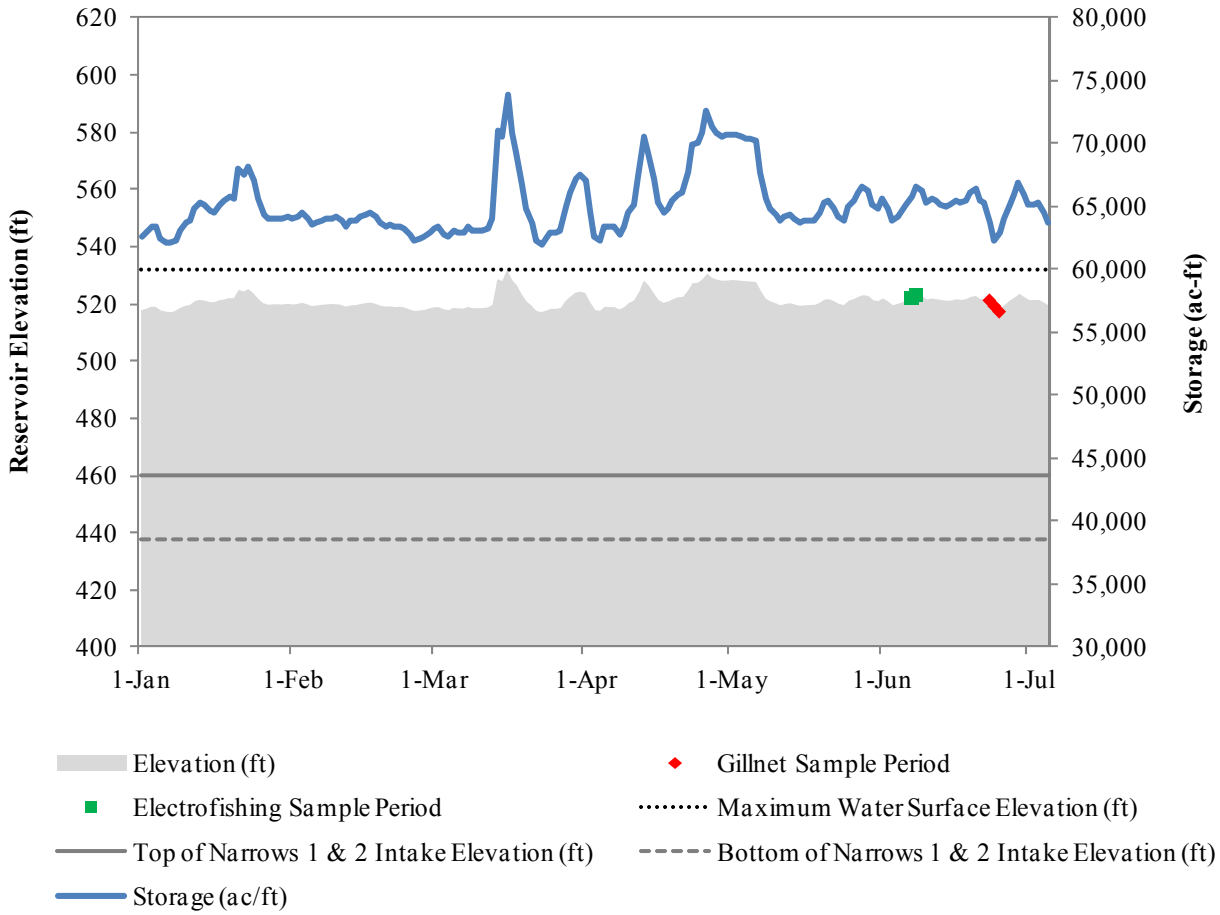

Figure 3.1-10. Summary of reservoir stage and capacity in Englebright Reservoir along with other notable project features.

The June 23 profiles show that water temperature ranged from 8.4°C to 19.7°C (Figure 3.1-11). The thermocline was deepest near the dam and occurred generally near 440 to 460 ft. The upper 12 feet of water generally approached but never exceed 20°C.

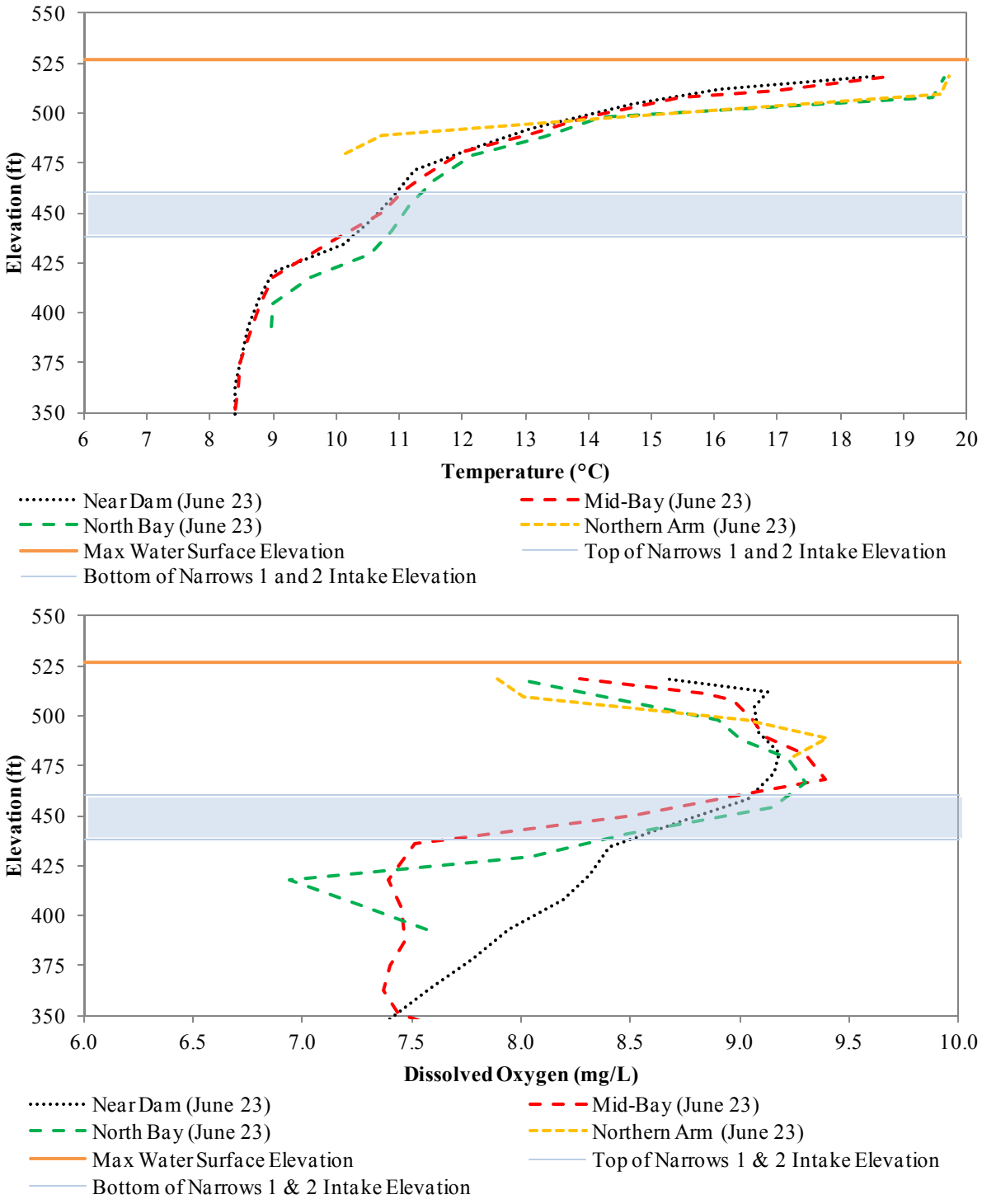

Figure 3.1-11. Profiles of water temperature (top) and dissolved oxygen (bottom) in Englebright Reservoir June 23, 2012

The June 23 DO profiles ranged from 6.9 to 9.4 mg/L and showed a relatively high overall concentration (Figure 3.1-11). Peak DO levels were observed approximately 50 to 75 ft below the surface where water temperature was cooler than the surface. Values decreased at depths greater than 75 ft.

Near-surface instantaneous measurements ranged from 9.0°C to 19.0°C for water temperature and 10.2 to 12.4 mg/L for DO over all sampling events (Table 3.1-10). Conductivity was moderate and ranged from 64.3 to 78.4 micromhos per centimeter (µmhos/cm) for all surveys. Secchi depth measurements were relatively deep and averaged 22.4 ft.

Table 3.1-10. Instantaneous minimum, maximum, and mean water quality measurements at Englebright Reservoir during gillnetting and electrofishing in June 2012.

Mean Daily Elevation (ft)	Surface Water Temperature (°C)	Dissolved Oxygen (mg/L)	Conductivity (µmhos/cm)	Secchi Depth (ft)
517-523 (520)	9.0 -19.0 (16.1)	10.2-12.4 (10.7)	64.3-78.4 (74.1)	19.7-24.6 (22.4)

Key: ft = feet µmhos/cm = micromhos per centimeter mg/L = milligrams per Liter

3.1.2.2 Englebright Reservoir Sample Sites

Sampling sites for gillnet and boat electrofishing were distributed throughout Englebright Reservoir to represent available habitat and any differences in fish assemblages (Tables 3.1-11 and 3.1-12). A single collection event occurred at Englebright Reservoir for both electrofishing (June 7-8) and gillnet sampling (June 22-24). The study did not require two events in Englebright Reservoir, as was the case for New Bullards Bar Reservoir. Sampling locations by site number are shown on the overview map of the study area (Figure 3.1-1).

Table 3.1-11. Location and habitat description for gillnet sites in Englebright Reservoir on June 22-24, 2012.

Gillnet Site	Location	Habitat
1	West side of the dam near Narrows 2 intake, at the mouth of Hogback Ravine	The shoreline here was very rocky and steep, depths reached 85 ft within 125 ft of shore. This site was also in an area with very high boat traffic.
2	The west end of Hogback Ravine	This site was in the back end of one of the largest coves on the reservoir. Shoreline was steep and rocky with a muddy flat bottom over the area of net deployment. There was little sign of underwater structure.
3	Along the western shore just south of the strongly hooked section of the reservoir	This site had moderately sloped shoreline dominated by large angular cobble, no bedrock, and little indication of underwater structure.
4	Rocky Bluff Campground Cove	Very steep shoreline with bedrock cliff face along the southern edge of the cove. A small creek entered the lake at the back of this cove and was flowing on the days of sampling. Flow was estimated to be less than 0.1 cfs.

Table 3.1-12. Location and habitat descriptions for boat electrofishing sites in Englebright Reservoir on June 7-8, 2012.

Electrofish Sites	Location	Habitat
1	Shoreline of Bonanza Cove	The sampled area was shifted to the west and north to avoid campers on the southern point of the cove. Shoreline was very steep and dominated by angular rocks with an average median axis of four to six inches.

Table 3.1-12. (continued)

Electrofish Sites	Location	Habitat
2	Shoreline of Keystone Cove	The sampled area was shifted to the east to avoid a private residence and the boats and traffic associated with it. The shoreline included both mud and medium sized rock. A small creek entered the back of the cove at a small wetland area with tules (*Schoenoplectus* sp.) and other emergent vegetation. This was also the only site with submerged logs along the shoreline.
3	Long's Cove	This site had campers on the shore at the back of the cove. A 150m section of the shoreline was skipped to avoid these campers for safety. The shoreline sampled was moderately sloped with a mixture of mud and small rock for substrate.
4	Black's Ravine	This was the largest finger of the lake extending northwest from the main body of the reservoir. It was a very popular area for camping and mooring houseboats. The shoreline was steep and varied between piled cobble and bedrock. A collection of downed trees made up the only submerged structure observed in the sampled area.
5	Confluence of North and South Yuba Rivers and Rice's Crossing	This site included shallow areas of the reservoir over sandbars at the confluence and head of the reservoir near Rice's Crossing. The area sampled included both flowing and still water. Shoreline vegetation included willows (*Salix* sp.), sedges (*Carex* sp.), and submerged grasses. Substrates were mostly large gravels and sand.

3.1.2.3 Species Composition

A total of 362 fish, comprising of 11 species, were collected during gillnetting and boat electrofishing on Englebright Reservoir in June 2012 (Table 3.1-13). Attachment 3-7B presents length-frequency information for each species collected. Sacramento sucker was the most common species detected, accounting for 31.5 percent (n=144) of all collected fish (Figure 3.1-12). Frequently caught centrarchids included spotted bass (n=96, 26.5%) and bluegill (n=27, 7.5%). Salmonid species were represented by rainbow trout (n=30, 8.3%) and brown trout (n=6, 1.7%). Commonly collected native cyprinids included hardhead (*Mylopharodon conocephalus)* (n=49, 13.5%) and Sacramento pikeminnow (n=25, 6.9%). Hardhead are listed as a Class 3 (Watch List) species and a California Species of Concern by CDFG. They are also listed as a Forest Service Sensitive Species.

Table 3.1-13. Summary of relative abundance, length, and weight of all fish species collected at Englebright Reservoir in June 2012 in order of abundance.

Species Full	N	%	Length (mm)			Weight (g)			Avg. Relative Condition[1]
			Min	Max	Avg	Min	Max	Avg	
Sacramento Sucker *Catostomus occidentalis*	114	31.5%	48	525	289	1.1	1,650.0	543.5	1.03
Spotted Bass *Micropterus punctulatus*	96	26.5%	45	410	219	1.0	1,212.0	224.9	1.04
Hardhead *Mylopharodon conocephalus*	49	13.5%	65	486	234	2.7	1,650.0	368.3	1.00
Rainbow Trout *Oncorhynchus mykiss*	30	8.3%	50	345	224	1.0	400.0	171.4	1.01
Bluegill *Lepomis macrochirus*	27	7.5%	45	154	103	1.2	107.0	34.2	1.01
Sacramento Pikeminnow *Ptychocheilus grandis*	25	6.9%	57	620	238	1.8	2,850.0	338.0	1.01
Common Carp *Cyprinus carpio*	7	1.9 %	470	695	582	1,775.0	6,500.0	3,489.3	1.02
Brown Trout *Salmo trutta*	6	1.7%	176	440	305	67.6	821.0	395.3	1.01
Smallmouth Bass *Micropterus dolomieu*	5	1.4%	55	183	99	2.9	94.2	28.2	1.01

Table 3.1-13. (continued)

Species Full	N	%	Length (mm)			Weight (g)			Avg. Relative Condition[1]
			Min	Max	Avg	Min	Max	Avg	
Green Sunfish *Lepomis. cyanellus*	2	0.6%	95	100	98	19.1	20.0	19.6	--
Redear Sunfish *Lepomis microlophus*	1	0.3%	161	161	161	86.9	86.9	86.9	--
Total	**362**	**100.0%**	--	--	--	--	--	--	--

Key: g = grams mm = millimeters
[1] Species with poor fit regressions did not have a reportable condition factor.

Species that were well represented generally were present in multiple size classes. The range of lengths for all fish collected was 45 to 695 mm (Table 3.1-13). Sacramento sucker, Sacramento pikeminnow, hardhead, spotted bass, and rainbow trout catches included individuals from exceptionally wide ranges of size classes. No common carp smaller than 470 mm were collected; however, the largest collected fish (by mass) was a common carp 695 mm in length that weighed 6,500 g.

No species accounted for the majority of biomass (total weight), but biomass of Sacramento sucker was more than double that of any other species (Figure 3.1-12). Common carp, spotted bass, and hardhead were other species accounting for at least 10 percent of the biomass each. These four species combined for 88.3 percent of the total biomass captured in the reservoir.

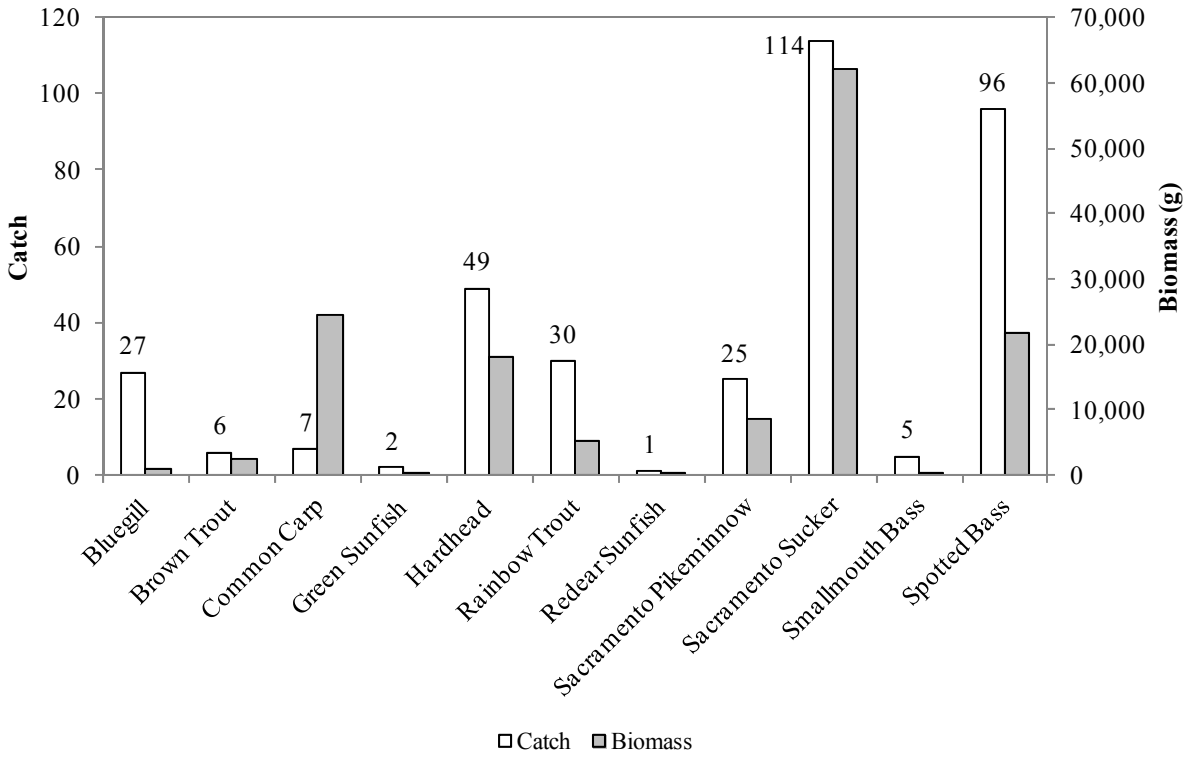

Figure 3.1-12. Catch and biomass by species, combined from gillnet and boat electrofishing activities during four sampling events at Englebright Reservoir in June 2012.

3.1.2.4 Summary of Collected Fish by Method and Diel Period

Overall catch rate for boat electrofishing was substantially higher than for gillnetting. Sampling effort resulted in 283 collected fish, representing 11 species (78.2% of the total catch) from boat electrofishing and 79 fish from 7 species (21.8%) from gillnets (Figure 3.1-13; Tables 3.1-14 and 3.1-15). Species captured by electrofishing, but not gillnetting were bluegill, common carp, redear sunfish (*Lepomis microlophus*), and smallmouth bass.

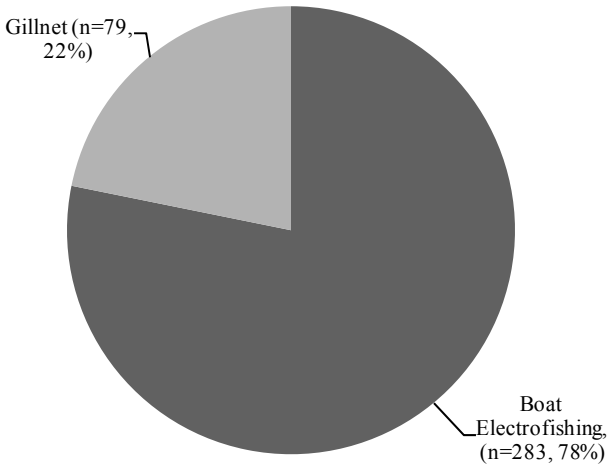

Figure 3.1-13. Proportions of fish collected by method at Englebright Reservoir in June 2012.

Table 3.1-14. Summary of the total gillnet catch, relative abundance, length, and weight of each species by event at Englebright Reservoir from June 22-24, 2012.

Species	N	%	Fish/Hour	Length (mm)			Weight (g)		
				Min	Max	Mean	Min	Max	Mean
Sacramento Sucker *Catostomus occidentalis*	27	34.2%	0.019	267	488	424	252.0	1,430.0	965.1
Spotted Bass *Micropterus punctulatus*	23	29.1%	0.016	97	397	247	13.0	945.0	280.9
Hardhead Minnow	11	13.9%	0.008	234	486	394	170.0	1,650.0	890.7
Sacramento Pikeminnow *Ptychocheilus grandis*	9	11.4%	0.006	154	620	368	63.0	2,850.0	760.4
Rainbow Trout *Oncorhynchus mykiss*	7	8.9%	0.005	217	305	247	99.0	320.0	148.6
Brown Trout *Salmo trutta*	1	1.3%	0.001	220	220	220	105.0	105.0	105.0
Green Sunfish *Lepomis cyanellus*	1	1.3%	0.001	100	100	100	20.0	20.0	20.0
Total	79	100.0%	.056	--	--	--	--	--	--

Key: g = grams mm = millimeters

Table 3.1-15. Summary of the total boat electrofishing catch, relative abundance, length, and weight of each species by event at Englebright Reservoir from June 7-8, 2012.

Species	N	%	Fish/Hour	Length (mm)			Weight (g)		
				Min	Max	Mean	Min	Max	Mean
Sacramento Sucker *Catostomus occidentalis*	87	30.7%	80.6	48	525	247	1.1	1,650.0	412.6
Spotted Bass *Micropterus punctulatus*	73	25.8%	67.6	45	410	210	1.0	1,212.0	207.2
Hardhead Minnow *Mylopharodon conocephalus*	38	13.4%	35.2	65	460	188	2.7	1,210.0	217.1
Bluegill *Lepomis macrochirus*	27	9.5%	25.0	45	154	103	1.2	107.0	34.2
Rainbow Trout *Oncorhynchus mykiss*	23	8.1%	21.3	50	345	217	1.0	400.0	178.4
Sacramento Pikeminnow *Ptychocheilus grandis*	16	5.7%	14.8	57	400	164	1.8	645.0	100.3
Common Carp *Cyprinus carpio*	7	2.5%	6.5	470	695	582	1,775.0	6,500.0	3,489.3
Brown Trout *Salmo trutta*	5	1.8%	4.6	176	440	322	67.6	821.0	453.3
Smallmouth Bass *Micropterus dolomieu*	5	1.8%	4.6	55	183	99	2.9	94.2	28.2
Green Sunfish *Lepomis cyanellus*	1	0.4%	0.9	95	95	95	19.1	19.1	19.1
Redear Sunfish *Lepomis microlophus*	1	0.4%	0.9	161	161	161	86.9	86.9	86.9
Total	283	100.0%	262.0	--	--	--	--	--	--

Key: g = grams mm = millimeters

Most gillnet catch was in adult nets (n=67, 84.8%) with only 12 fish (15.2%) collected in juvenile nets (Figure 3.1-14). Catch rates were considerably higher in the shore sets for both juvenile and adult nets. The adult shore net had the highest catch rate. For the juvenile nets, only shore sets were successful in capturing fish.

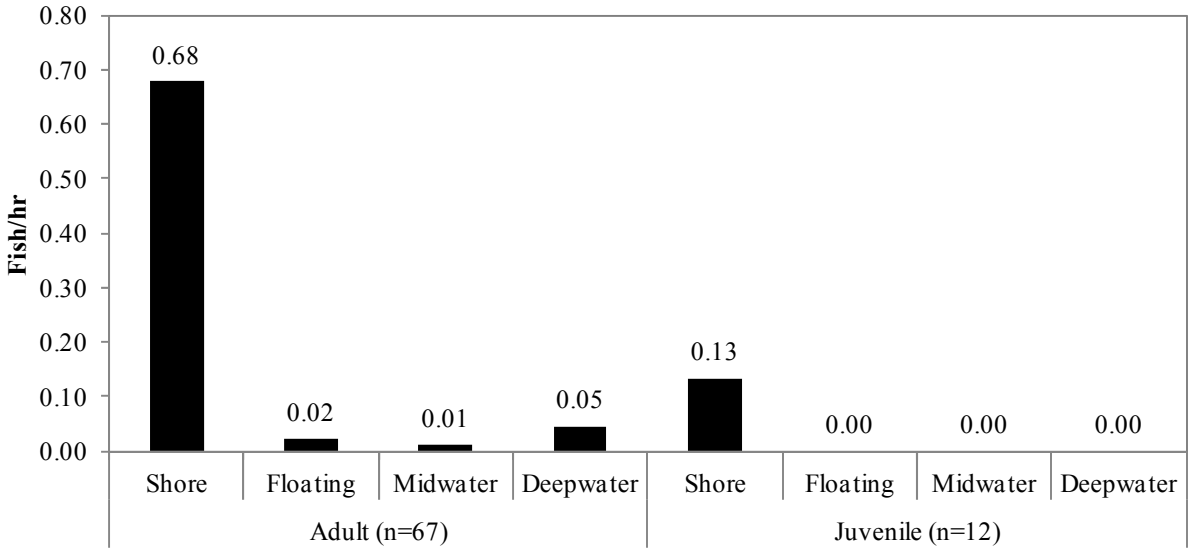

Figure 3.1-14. Fish collected in gillnets by net type and position in Englebright Reservoir on June 22-24, 2012.

Diel period appeared to strongly influence captures in gillnets (Figure 3.1-15). The majority of fish were captured at night (69.6%), with almost all of these being caught in shore sets. Similarly, almost all fish collected during the day were captured in shore sets.

Sacramento sucker and spotted bass had the highest and second highest catch rate for both gillnetting and electrofishing (Tables 3.1-14 and 3.1-15). These two species accounted for greater than half of the total catch for both capture methods (63.3% gillnetting, 56.5% electrofishing).

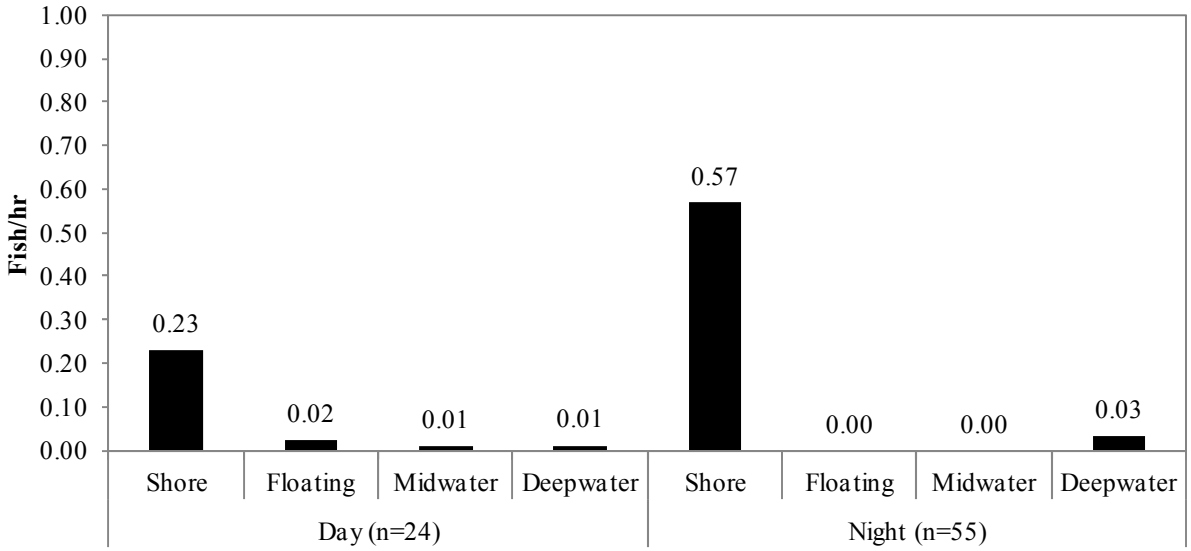

Figure 3.1-15. Catch rate in gillnets by diel period and net position in Englebright Reservoir on June 22-24, 2012.

Catch in gillnets varied somewhat among locations (Table 3.1-16). Site 3, along the western shore just south of the strongly hooked section of the reservoir (Figure 3.1-1), had the highest catch, 45.8% of which was Sacramento sucker. Site 1, on the west side of the dam near the Narrows 2 intake (Figure 3.1-1), had the lowest catch. The shoreline here is very rocky and steep; depths reached 85 ft within 125 ft of shore. This site was also in an area with very high boat traffic.

Table 3.1-16. Total catch of fish by species and site for gillnet sampling at Englebright Reservoir from June 22-24, 2012 in order of abundance.

Species	Site				Total
	1	2	3	4	
Sacramento Sucker *Catostomus occidentalis*	2	9	11	5	27
Spotted Bass *Micropterus punctulatus*	4	5	8	6	23
Hardhead *Mylopharodon conocephalus*	3	3	3	2	11
Sacramento Pikeminnow *Ptychocheilus grandis*	1	1	2	5	9
Rainbow Trout *Oncorhynchus mykiss*	3	2	0	2	7

Table 3.1-16. (continued)

Species	Site				Total
	1	2	3	4	
Brown Trout *Salmo trutta*	1	0	0	0	1
Green Sunfish *Lepomis cyanellus*	1	0	0	0	1
Total	**15**	**20**	**24**	**20**	**79**

Site 1 was closest to the Narrows 1 and 2 intakes at Englebright Dam. The top of the intakes are located at an elevation of 460 ft. In 2012, the depth of the intake ranged from 56.8 to 71.6 ft (mean=60.9 ft). Only two rainbow trout and one brown trout were captured in deepwater nets at Site 1, representing 20 percent of the total site-specific catch (Table 3.1-17). Twelve additional individuals, from six species, were collected in surface and floating nets. The 15 fish collected at Site 1 represented 19 percent of the overall gillnet catch (Table 3.1-16).

Table 3.1-17. Summary of catch by gillnet depth at Site 1 near Englebright Dam from June 22-24, 2012.

Species	Shore	Floating	Midwater	Deepwater
Brown Trout *Salmo trutta*	0	0	0	1
Green Sunfish *Lepomis cyanellus*	1	0	0	0
Hardhead *Mylopharodon conocephalus*	3	0	0	0
Rainbow Trout *Oncorhynchus mykiss*	0	1	0	2
Spotted Bass *Micropterus punctulatus*	4	0	0	0
Sacramento Pikeminnow *Ptychocheilus grandis*	1	0	0	0
Sacramento Sucker *Catostomus occidentalis*	2	0	0	0
Total	**11**	**1**	**0**	**3**

Catch by boat electrofishing site was also somewhat variable (Table 3.1-18). The maximum catch occurred at Site 2 (n=75) near the shoreline of Keystone Cove (Figure 3.1-1). The shoreline here consisted of mud and medium sized rock. A small creek was present at the back of the cove at a small wetland area. This was the only site with submerged logs along the shoreline. The greatest catch of any one species occurred at this site (spotted bass, n= 28). Catch was lowest at Site 3 (n=41) near Long's Cove (Figure 3.1-1). This area had a moderately sloped shoreline with a mixture of mud and small rock for substrate.

Table 3.1-18. Total catch of fish by species and site for boat electrofishing at Englebright Reservoir on June 22-24, 2012 in order of abundance.

Species	Site					Total
	1	2	3	4	5	
Sacramento Sucker *Catostomus occidentalis*	15	21	15	22	14	87
Spotted Bass *Micropterus punctulatus*	13	28	20	12	0	73
Hardhead *Mylopharodon conocephalus*	11	10	3	14	0	38

Table 3.1-18. (continued)

Species	Site					Total
	1	2	3	4	5	
Bluegill *Lepomis macrochirus*	5	7	1	14	0	27
Rainbow Trout *Oncorhynchus mykiss*	1	0	0	2	20	23
Sacramento Pikeminnow *Ptychocheilus grandis*	2	3	2	3	6	16
Common Carp *Cyprinus carpio*	0	5	0	2	0	7
Smallmouth Bass *Micropterus dolomieu*	2	0	0	0	3	5
Brown Trout *Salmo trutta*	0	0	0	0	5	5
Green Sunfish *Lepomis cyanellus*	1	0	0	0	0	1
Redear Sunfish *Lepomis microlophus*	0	1	0	0	0	1
Total	**50**	**75**	**41**	**69**	**48**	**283**

3.2 New Bullards Bar Reservoir Tributary Assessment

The majority of fish passage assessments took place from April 3–5, 2012. Over this time period the pool level of New Bullards Bar Reservoir averaged 1,927 ft. The NMWSE of New Bullards Bar Reservoir is 1,956 ft equating to a drawdown of 29 ft at the time of surveys. One exception was Slate Creek which was assessed on September 20, 2011. At the time of the Slate Creek survey, the stream flowed directly into the North Yuba River upstream of New Bullards Bar Reservoir.

Fish composition assessments utilizing backpack electrofishing or snorkeling took place in accessible streams from June 5–7, 2012. Over this time period, the pool level of New Bullards Bar Reservoir averaged 1,951 ft equating to a drawdown of 5 ft from the NMWSE. As a result, fish composition assessments took place primarily upstream of the NMWSE of New Bullards Bar Reservoir.

Technicians examined 13 tributaries (Figure 3.2-1) and determined that nine contained accessible gradient and adequate flow to be used by adfluvial spawning fish (Table 3.2-1). Photographs corresponding to survey points are available in Attachment 3-7C. All field data collected in support of this study are available in Attachment 3-7E.

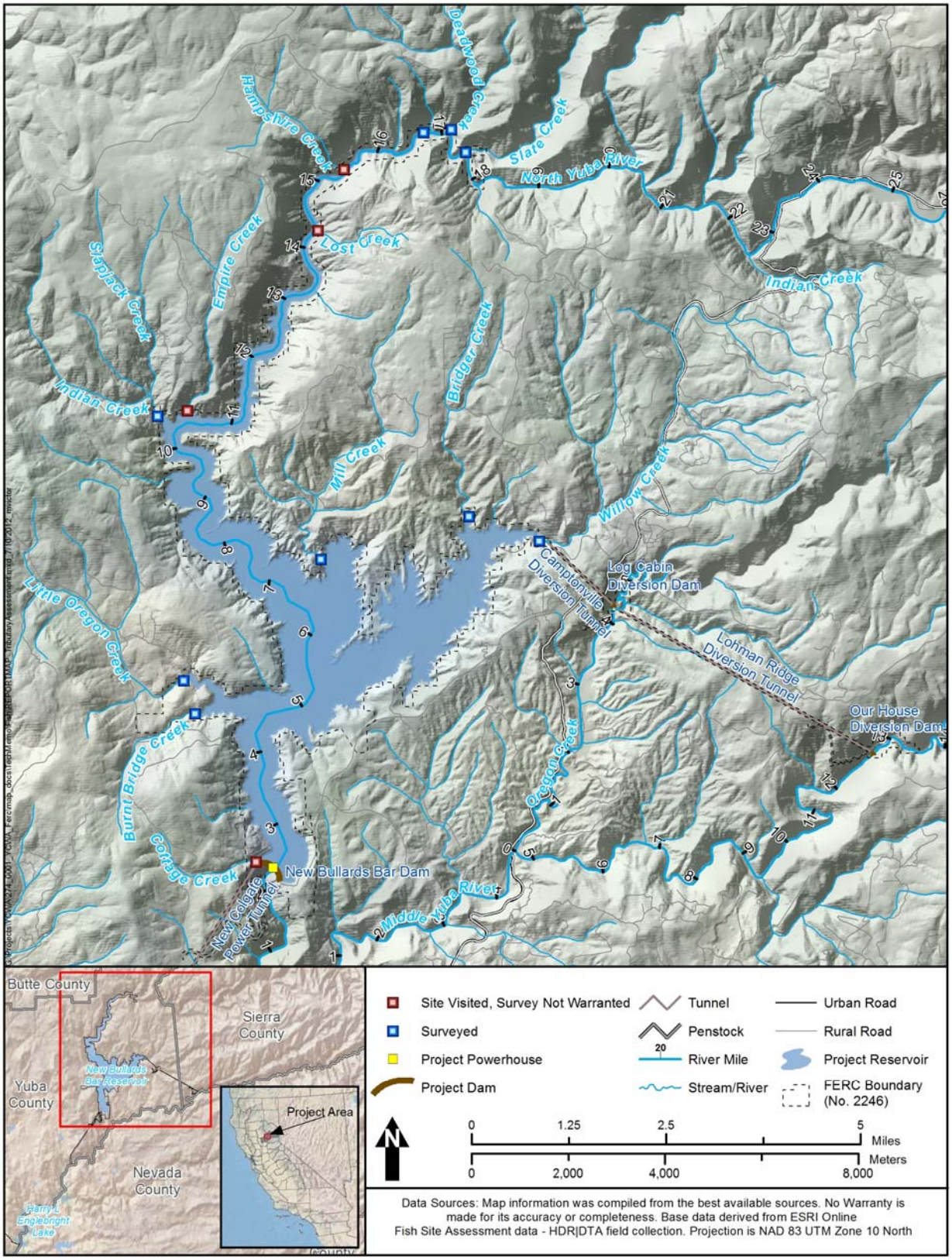

Figure 3.2-1. Overview of surveyed tributaries of New Bullards Bar Reservoir in 2012.

Table 3.2-1. Physical information for tributaries assessed to determine fish accessibility.[1]

Tributary	Approximate survey distance (ft)[2]	Flow (cfs)	Gradient (%)	Number of Barriers
ACCESSIBLE TRIBUTARIES				
North Yuba River	4,100	1,900	2	0
Slate Creek	2,640	25	3	0
Deadwood Creek	300	8[3]; 4[4]	5	1
Slapjack/Indian Creeks	600	26.5	4	0
Bridger Creek	200	11.5	4	2
Willow Creek	900	30.5	4	0
Mill Creek	250	13.7	12	2
Little Oregon Creek	1,000	23.7	3	0
Burnt Bridge Creek	380	5.8	7	3
INACCESSIBLE TRIBUTARIES				
Hampshire Creek	--	2	>30	--
Lost Creek	--	3	>30	--
Empire Creek	--	2	>30	--
Cottage Creek	--	2	>20	--

[1] Flows were estimated in streams determined inaccessible and in Slate and Deadwood creeks, but measured elsewhere. Gradients are estimated averages. Slate Creek was assessed in September 2011, all others were assessed in April 2012.
[2] Inaccessible tributaries had no survey distance and were documented visually from their confluence.
[3] Above powerhouse
[4] Below powerhouse

Streams considered inaccessible all had waterfalls over bedrock and very steep average gradients combined with low flows. Hampshire Creek had a series of waterfalls approximately 10-15 ft in height. Lost Creek also had a series of waterfalls. Empire Creek had two waterfalls of approximately 20 ft. Cottage Creek had one waterfall over 30 ft in height.

Technicians found eight potential barriers to fish passage on four of the nine tributaries considered accessible (Table 3.2-1). Seven of these potential barriers were leaping barriers (Table 3.2-2) and one was a shallow water barrier (Table 3.2-3). Only Burnt Bridge Creek contained both types of potential barriers.

Table 3.2-2. Dimensions, substrate, and UTM coordinates of potential leaping barriers identified from fish passage assessments in April 2012.[1]

Tributary, Point ID	Plunge Pool Depth	Landing Pool Depth	Height	Wet Width	Horizontal Distance	Substrate		UTM Coordinates	
						Dominant	Sub-dominant	East	North
Deadwood Creek 1	>10	1	16	20	28	bedrock	bedrock	663646	4377293
Bridger Creek 1	>10	1.3	10	10	6	bedrock	bedrock	664073	4369307
Bridger Creek 2	1.3	1.0	9	10	8	bedrock	bedrock	664073	4369307
Mill Creek 1	2	0.6	4	20	8	boulder	organic debris	660962	4368419
Mill Creek 2	2	0.4	8	17	12	bedrock	boulder	660952	4358422
Burnt Bridge Creek 1	1.4	0.4	4.3	25	4.5	bedrock	organic debris	658385	4365209
Burnt Bridge Creek 2	1.1	0.6	3.3	4.3	5.4	bedrock	bedrock	658366	4365217

[1] All stream measures reported in feet (ft).

Table 3.2-3. Dimensions, substrate, and UTM coordinates of one potential shallow water barrier from fish passage assessments, April 2012.

Tributary, Point ID	Max Depth	Depth Range	Height	Wet Width	Horizontal Distance	Substrate		UTM Coordinates	
						Dominant	Sub-dominant	East	North
Burnt Bridge Creek 3	0.2	0.1 – 0.2	2.4	6.4	13	bedrock	bedrock	658351	4365223

Technicians observed or collected fish in all nine of the accessible tributaries; however, species composition was limited to brown trout, rainbow trout, and Sacramento sucker (Table 3.2-4). Brown trout were limited to Mill Creek. Only the North Yuba River and Willow Creek contained both rainbow trout and Sacramento sucker. Technicians found rainbow trout only in six of the nine tributaries.

Table 3.2-4. Species composition, relative abundance, and population statistics for fish observed or collected during surveys of accessible tributaries, June, 2012.

Tributary, Species	Count	% of Total	Observations/ 100 Meters	Length (mm)			Weight (g)		
				Min	Max	Mean	Min	Max	Mean
NORTH YUBA RIVER[2]									
Rainbow Trout *Oncorhynchus mykiss*	23	60.5	8.8	127	483	260	--	--	--
Sacramento Sucker *Catostomus occidentalis*	15	39.5	5.8	279	432	361	--	--	--
SLATE CREEK									
Rainbow Trout	6	100	0.46	87	116	104	8.2	18.2	13.2
DEADWOOD CREEK									
Rainbow Trout	6	100	0.81	94	148	112	10.2	46.0	19.3
INDIAN/SLAPJACK CREEKS									
Rainbow Trout	10	100	1.46	73	194	117	4.8	89.9	25.5
BRIDGER CREEK									
Rainbow Trout	7	100	0.83	98	176	121	12.2	70.2	24.7
WILLOW CREEK									
Rainbow Trout	7	87.5	1	77	126	104	5.2	24.2	13.1
Sacramento Sucker	1	12.5	0.14	179	179	179	83.7	83.7	83.7
MILL CREEK									
Brown Trout *Salmo trutta*	17	100	1.64	47	218	140	1.2	108.8	40.8
LITTLE OREGON CREEK									
Rainbow Trout	25	100	1.64	78	207	110	6.0	98.0	20.1
BURNT BRIDGE CREEK									
Rainbow Trout	11	100	0.96	69	164	108	5.7	51.5	20.0

Key: g = grams mm = millimeters

[1] The North Yuba River was assessed by snorkeling, all others by electrofishing.

[2] All fish measurements were reported by in. during snorkeling and then converted to mm.

3.2.1 North Yuba River

3.2.1.1 North Yuba River Passage Assessment

On April 4, 2012, technicians walked approximately 1,200 ft of the North Yuba River from the confluence with New Bullards Bar reservoir upstream. The remaining area of the North Yuba River within the NMWSE was visible from the Project helicopter video. Review of this video

did not identify any potential barriers in the remaining area of the North Yuba River within the NMWSE. Neither leaping nor shallow water barriers were encountered in the surveyed area.

3.2.1.2 North Yuba River Species Composition Assessment

Technicians used qualitative snorkeling for the assessment because depths precluded electrofishing. Snorkeling was conducted on June 6, 2012 at three sites throughout the length of the stream from the confluence with the reservoir upstream approximately 2,000 ft (Table 3.2-5).

Table 3.2-5. Stream attributes collected at snorkel sites on the North Yuba River on June 6, 2012.

Stream Attribute		Site		
		1	2	3
Temperature (°C)	Air	21.1	21.1	21.1
	Water	13.0	13.0	13.0
Site Dimensions (ft)	Length	300	250	300
	Mean Width	110	85	70
	Mean Depth	6	8	7
	Max Depth	9	16	10
Substrate (%)	Silt	0	0	0
	Sand	0	0	0
	Gravel	20	20	10
	Cobble	50	40	30
	Boulder	10	20	30
	Bedrock	20	20	30
Habitat (%)	Riffle	0	0	0
	Pool	70	80	100
	Run	30	20	0
Instream Cover (%)	Surface Turbulence	0	20	20
	Boulder	20	20	30
	Overhanging Vegetation	0	0	0

Snorkeling occurred on a sunny day with visibility estimated at 13 ft. Canopy cover was low at all three sites (10%). Stream discharge data were obtained from California Data Exchange (CDEC 2012) and reported as 1,100 cfs. Overall gradient at the sites averaged 2 percent. DO level was 9.55 mg/L and specific conductivity was 77.1 µmhos/cm.

Technicians observed 38 fish from two species while snorkeling: rainbow trout and Sacramento sucker (*Catostomus occidentalis*) (Table 3.2-4). Relative fish abundance for all stream sections combined was 14.6 observations/100 m, with rainbow trout accounting for the majority of observations. The mean and maximum lengths of rainbow trout exceeded those from other tributaries.

3.2.2 Slate Creek

3.2.2.1 Slate Creek Passage Assessment

Slate Creek passage from a previous study conducted by YCWA on September 20, 2011 was summarized. At the time of assessment, the stream flowed directly into the North Yuba River

upstream of the existing pool level of New Bullards Bar Reservoir. The NMWSE of New Bullards Bar Reservoir is estimated to reach just downstream or at the confluence of Slate Creek with the North Yuba River and therefore the majority of the assessment occurred upstream of the NMWSE. Instantaneous water temperature on the day of the assessment was 15.0°C.

Neither leaping, nor shallow, water barriers were encountered in the surveyed area during the assessment. The creek had good fish habitat with spawning gravels and deep long bedrock formed pools. Trout and kokanee were incidentally observed.

3.2.2.2 Slate Creek Species Composition Assessment

On June 6, 2012, technicians used backpack electrofishing to assess Slate Creek from the confluence with the North Yuba River/New Bullards Bar Reservoir upstream approximately 660 ft. Approximately 160 ft was not electrofished, due to swift water conditions. According to Dreamflows (2012), discharge was 125 cfs.

Channel substrate in the stream section comprised sand (10%), gravel (20%), cobble (30%), boulders (30%), and bedrock (10%). The stream channel had an average wetted width of 35 ft, with an average depth of 1.7 ft, and a maximum depth of 3 ft. Gradient over the sampled stream length averaged 2 percent. Habitat was characterized by riffle (50%), run (30%), and pool (20%) with 30 percent canopy cover. In-stream cover was provided by surface turbulence (10%), boulder (20%), and overhanging vegetation (10%). Instantaneous air and water temperature on the sampling date were 21.1°C and 13.0°C, respectively. DO level was 9.09 mg/L and specific conductivity was 44.5 µmhos/cm.

Technicians collected six fish, all rainbow trout (Table 3.2-4). All were from a narrow range of lengths. CPUE for the sampled section was 0.46 fish/minute.

3.2.3 Deadwood Creek

3.2.3.1 Deadwood Creek Passage Assessment

On April 4, 2012, technicians assessed passage on Deadwood Creek from the confluence with the North Yuba River upstream approximately 300 ft to a point above the NMWSE of New Bullards Bar Reservoir. At the time of assessment, the stream flowed directly into the North Yuba River upstream of New Bullards Bar Reservoir. One potential leaping barrier (ID 01) was observed within the NMWSE of the reservoir, located at the confluence with the North Yuba River (Table 3.2-2). The potential barrier consisted of a falls over bedrock spilling directly into the reservoir pool. The potential barrier would be fully inundated at the NMWSE of New Bullards Bar Reservoir. Instantaneous water temperature on the day of the assessment was 7.0°C. Good fish habitat, with a complex of riffle and pool, was available within the observed portion of the stream. Approximately 300 ft upstream of the NMWSE, outside of the surveyed area, technicians observed two large falls exceeding 20 ft that would prevent further upstream passage.

3.2.3.2 Deadwood Creek Species Composition Assessment

On June 6, 2012, technicians used backpack electrofishing to assess Deadwood Creek from the confluence with New Bullards Bar Reservoir upstream approximately 250 ft. Flow was estimated at 7 cfs.

Channel substrate in the stream section comprised gravel (10%), cobble (30%), boulders (40%), and bedrock (20%). The stream channel had an average wetted width of 10 ft, with an average depth of 0.9 ft and a maximum depth of 3.8 ft. Gradient in the surveyed area averaged 6 percent. Habitat was characterized by riffle (60%) and pool (50%), with 90 percent canopy cover. In-stream cover was provided by surface turbulence (30%), woody debris/boulders (20%), undercut bank (10%) and overhanging vegetation (10%). Instantaneous air and water temperature on the day of sampling were 15.6°C and 7.9°C, respectively. DO level was 10.38 mg/L and specific conductivity was 43.2 µmhos/cm.

Technicians collected six fish, all rainbow trout (Table 3.2-4). All were from a relatively narrow range of lengths. CPUE was 0.81 fish/minute.

3.2.4 Indian/Slapjack Creeks

3.2.4.1 Indian/Slapjack Creek Passage Assessment

Indian and Slapjack Creeks converge together approximately 1,000 ft upstream of the NMWSE of New Bullards Bar Reservoir. On April 3, 2012, technicians assessed passage from the confluence with New Bullards Bar Reservoir upstream, approximately 600 ft to the NMWSE of the reservoir. Instantaneous water temperature on the day of the assessment was 10.0°C. Neither leaping nor shallow water barriers were encountered in the surveyed area during the assessment. Overall, the stream had good fish habitat with a complex of pool and riffle habitat.

3.2.4.2 Indian/Slapjack Creeks Composition Assessment

On June 5, 2012, technicians used backpack electrofishing to assess Indian/Slapjack Creeks from the confluence with New Bullards Bar Reservoir upstream approximately 500 ft. Flow was estimated at 9 cfs.

Substrate in the stream section comprised gravel (20%), cobble (40%), boulders (30%), and bedrock (10%). The stream channel had an average wetted width of 18 ft, with an average depth of 0.9 ft and a max depth of 5.0 ft. The surveyed area gradient averaged 6 percent. Habitat was characterized by riffle (60%) and pool (40%) with 100 percent canopy cover. In-stream cover was provided by surface turbulence (30%), boulder (30%), and overhanging vegetation (10%). Instantaneous air and water temperature on the day of sampling were 18.9°C and 10.8°C, respectively. DO level was 9.75 mg/L, and conductivity was 90.4 µmhos/cm.

Technicians collected 10 fish, all rainbow trout (Table 3.2-4). CPUE for the sampled section was relatively high at 1.46 fish/minute.

3.2.5 Bridger Creek

3.2.5.1 Bridger Creek Passage Assessment

On April 5, 2012, technicians assessed Bridger Creek from the confluence with New Bullards Bar Reservoir upstream approximately 200 ft to the NMWSE. Instantaneous water temperature on the day of the assessment was not available. Two potential leaping barriers (ID 01 and ID 02), located at the confluence of Bridger Creek with New Bullards Bar Reservoir, were observed (Table 3.2-2). The two potential barriers consisted of falls spilling over bedrock and were separated by a 20 ft pool/cascade section. Combined, they had a vertical height of 19 ft. The two potential barriers would be fully inundated at the NMWSE of New Bullards Bar Reservoir. Overall, the stream had good fish habitat.

3.2.5.2 Bridger Creek Species Composition Assessment

On June 7, 2012, technicians used backpack electrofishing to assess Bridger Creek from the confluence with New Bullards Bar Reservoir upstream approximately 300 ft. Dense vegetation in the stream channel prevented field crews from sampling further upstream. Flow was estimated at 4 cfs.

Substrate in the stream section comprised sand (20%), gravel (10%), cobble (30%), boulders (30%), and bedrock (10%). The stream channel had an average wetted width of 11 ft, with an average depth of 0.7 ft and a maximum depth of 2.5 ft. Overall gradient in the surveyed area averaged 3 percent. Habitat was characterized by riffle (60%), glide (10%), and pool (30%) with 80 percent canopy cover. In-stream cover was provided by surface turbulence (10%), boulders (20%), undercut bank (10%) and overhanging vegetation (10%). Instantaneous air and water temperature on the day of sampling were 27.8°C and 12.3°C, respectively. DO level was 8.95 mg/L, and conductivity was 63.7 µmhos/cm

Technicians collected seven fish, all rainbow trout (Table 3.2-4). CPUE for the sampled section was 0.83 fish/minute.

3.2.6 Willow Creek

3.2.6.1 Willow Creek Passage Assessment

On April 5, 2012, technicians assessed passage on Willow Creek from the confluence with New Bullards Bar Reservoir upstream approximately 900 ft to the NMWSE. The Camptonville Diversion Tunnel outlet is located on Willow Creek below the NMWSE. On the day of the survey, the lower portion of the stream (approximately 150 ft) contained hundreds of cfs from the tunnel. Stream flow upstream of the tunnel was measured at 30.5 cfs. Instantaneous water temperature on the day of assessment below the tunnel was 6.0°C, water temperature information above the tunnel was not available. Neither leaping nor shallow water barriers were encountered in the surveyed area during the assessment. The stream had good fish habitat. Approximately 200 ft upstream of the NMWSE, outside of the surveyed area, technicians observed a 15 ft tall

falls that would prevent further upstream passage. The falls were documented during the species composition assessment.

3.2.6.2 Willow Creek Species Composition Assessment

On June 7, 2012, technicians used backpack electrofishing to assess Willow Creek from the confluence with New Bullards Bar Reservoir (just upstream of the diversion) upstream approximately 225 ft. Flow was estimated to be 13 cfs.

Channel substrate in the stream section comprised sand (10%), gravel (20%), cobble (30%), boulder (20%) and bedrock (20%). The stream channel had an average wetted width of 15 ft, with an average depth of 1.2 ft and a maximum depth of 4 ft. Gradient in the surveyed area averaged 6 percent. Habitat was characterized by riffle (30%) and pool (70%), with 90 percent canopy cover. In-stream cover was provided by surface turbulence (20%), boulders and woody debris (30%), undercut bank (10%), and overhanging vegetation (10%). Instantaneous air and water temperature on the day of sampling were 23.3°C and 10.3°C, respectively. DO level was 10.14 mg/L and conductivity was 58.5 µmhos/cm.

Technicians collected eight fish from two species: rainbow trout and a single Sacramento sucker (Table 3.2-4). All rainbow trout were from a relatively narrow range of lengths. CPUE for the sampled section was 1.14 fish/minute, with rainbow trout captured at 1.0 fish/minute.

3.2.7 Mill Creek

3.2.7.1 Mill Creek Passage Assessment

On April 5, 2012 technicians assessed passage on Mill Creek from the confluence with New Bullards Bar Reservoir upstream approximately 250 ft to the NMWSE. Instantaneous water temperature on the day of the assessment was not available. Two potential leaping barriers (ID 01 and 02) were identified approximately 250 ft upstream of the confluence, near the NMWSE of New Bullards Bar Reservoir (Table 3.2-2). ID 01 consisted of falls spilling over and through logs and large boulders. The substrate of ID 01 could be movable during extreme flow events, and therefore has the potential to be more or less passable in the future. ID 01 would be inundated at the NMWSE of New Bullards Bar Reservoir. ID 02 consisted of falls spilling over boulders and bedrock. The NMWSE of the reservoir would only partially inundate ID 02.

3.2.7.2 Mill Creek Species Composition Assessment

On June 7, 2012, technicians used backpack electrofishing to assess Mill Creek from the confluence with New Bullards Bar Reservoir upstream approximately 370 ft. Flow was estimated to be 5 cfs.

Channel substrate in the stream section comprised sand (20%) gravel (20%), cobble (20%), boulders (30%), and bedrock (10%). The stream channel had an average wetted width of 10 ft, with an average depth of 1.0 ft and a max depth of 3.5 ft. Overall gradient in the surveyed area averaged 6 percent. Habitat was characterized by riffle (40%) and pool (60%) with 70 percent

canopy cover. In-stream cover was provided by surface turbulence (20%), boulders (20%), undercut bank (10%) and overhanging vegetation (10%). Instantaneous air and water temperature on the day of sampling were 27.8°C and 13.1°C, respectively. DO level was 9.18 mg/L and conductivity was 70 µmhos/cm.

Technicians collected 17 fish, all brown trout (Table 3.2-4). Individuals represented a relatively wide range of sizes. CPUE of brown trout for the sampled section was a relatively high 1.64 fish/minute.

3.2.8 Little Oregon Creek

3.2.8.1 Little Oregon Creek Passage Assessment

On April 3, 2012, technicians assessed fish passage on Little Oregon Creek from the confluence with New Bullards Bar Reservoir upstream, approximately 1,000 ft to the NMWSE. Instantaneous water temperature on the day of the assessment was 10.0°C. Neither leaping nor shallow water barriers were encountered in the surveyed area during the assessment. Overall, the stream had good fish habitat.

3.2.8.2 Little Oregon Creek Species Composition Assessment

On June 5, 2012, technicians used backpack electrofishing to assess Little Oregon Creek from the confluence with New Bullards Bar Reservoir upstream approximately 500 ft. Flow was estimated at 7 cfs.

Channel substrate in the stream section comprised sand (10%), gravel (20%), cobble (30%), boulders (20%), and bedrock (20%). The stream channel had an average wetted width of 11 ft, with an average depth of 0.7 ft and a maximum depth of 4 ft. Gradient throughout the surveyed section averaged 3 percent. Habitat was characterized by riffle (40%), glide (10%), and pool (50%), with 40 percent canopy cover. In-stream cover was provided by surface turbulence (20%), woody debris/boulder (20%), undercut bank (10%) and overhanging vegetation (20%). Instantaneous air and water temperature on the day of sampling were 18.9°C and 11.9°C, respectively. DO level was 9.05 mg/L and conductivity was 74.0 µmhos/cm.

Technicians collected 25 fish, all rainbow trout (Table 3.2-4). Individuals represented a relatively wide range of sizes. CPUE for rainbow trout in the sampled section was relatively high at 1.64 fish/minute.

3.2.9 Burnt Bridge Creek

3.2.9.1 Burnt Bridge Creek Passage Assessment

On April 3, 2012, technicians assessed fish passage on Burnt Bridge Creek from the confluence with New Bullards Bar Reservoir upstream approximately 380 ft to the NMWSE. Instantaneous water temperature on the day of the assessment was 8.0°C. Three potential barriers (two leaping [ID 01 and 02] and one shallow water barrier [ID 03]) were observed in the surveyed area

located approximately 100, 160, and 200 ft respectively upstream of the confluence (Tables 3.2-2 and 3.2-3). ID 01 consisted of a 4.3 ft high falls spilling over bedrock with some boulder and woody debris piled up along the left bank (looking downstream). Although ID 01 did not appear passable at the time of survey, higher flows and/or shifting substrates may create a passage route through the boulders and woody debris along the left bank. ID 02 consisted of sheet-flow over bedrock with a horizontal distance of 5.4 ft and a drop of 3.3 ft. ID 03 was considered a shallow water barrier and consisted of sheet-flow over bedrock. ID 03 had a horizontal distance of 13 ft with a drop of 2.4 ft and a depth range of 0.1 to 0.2 ft.

3.2.9.2 Burnt Bridge Creek Species Composition Assessment

On June 5, 2012, technicians used backpack electrofishing to assess Burnt Bridge Creek from the confluence with New Bullards Bar Reservoir upstream approximately 300 ft. Flow was estimated at 5 cfs.

Channel substrate in the stream section comprised silt (10%), sand (10%), gravel (20%), cobble (40%), boulders (10%), and bedrock (10%). The stream channel had an average wetted width of 8 ft, with an average depth of 0.7 ft and a maximum depth of 2.5 ft. Gradient in the sampled section averaged 5 percent. Habitat was characterized by riffle (40%), glide (10%), and pool (50%), with 80 percent canopy cover. In-stream cover was provided by surface turbulence (20%), woody debris (30%), undercut bank (10%) and overhanging vegetation (20%). Instantaneous air and water temperature on the day of sampling were 26.7°C and 10.3°C, respectively. DO level was 9.5 mg/L and specific conductivity was 56.8 µmhos/cm.

Technicians collected 11 fish, all rainbow trout (Table 3.2-4). CPUE for the sampled section was 0.96 fish/minute.

4.0 Discussion

The following section reviews the results of the 2012 sampling effort in light of available historic information for each reservoir. In addition, a review of results from the New Bullards Bar Reservoir is discussed.

4.1 New Bullards Bar Reservoir

4.1.1 Operational Characteristics

New Bullards Bar Reservoir is a mid-elevation reservoir with moderate Secchi readings, conductivity, and DO. Water clarity as measured by Secchi readings (means of 8.1 and 13.9 ft) was within the range of 6 to 33 ft considered typical for lakes and reservoirs (Bledzki 2010). Water clarity increased in June. This may indicate relatively low productivity in the reservoir, as increased concentrations of phytoplankton expected to accompany increasing temperatures often decrease water clarity.

Conductivity readings (means of 64.7 and 73.5 µmhos/cm) were within or near the range found in other northern California reservoirs and rivers (USBR 2003). Conductivity was measured at 31-85 µmhos/cm in Oroville Reservoir on the Feather River, and at 105-131 µmhos/cm in Lake Shasta on the Sacramento River. Conductivity in the North Yuba River near New Bullards Bar Reservoir ranged from 20 to 30 µmhos/cm, whereas conductivity in the lower Yuba River ranged from 44 to 105 µmhos/cm. These levels are all low relative to the California state maximum contaminant load range of 900 to 1,600 µmhos/cm (CDPH 2012).

Water temperature exceeded 20°C near the surface in June, but DO was never less than 5 mg/L. January temperatures were cooler, but DO ranges varied little between seasons. Peak DO in June was generally highest at depths exceeding 40 ft, which is common because of warm surface water temperature. Vertical water profiles showed that the reservoir was stratified for both sampling events, but the thermocline was more pronounced in June than in January. The range of temperatures was wider in June because deep water remained cool as water near the surface warmed.

Reservoir storage typically peaks in May and June and reaches its lowest point in December and January. Changes in reservoir elevation are usually gradual. This pattern was followed in 2012. Capacity changes are relatively small compared to water elevation changes because of steep reservoir shorelines. The relatively high reservoir stage elevations following spring runoff provide access to tributaries for spawning. The increasing reservoir elevations also ensure that the nests of spawning warmwater fishes are not dewatered. The gradual change in reservoir elevations also suggests that fish stranding or isolation is unlikely.

4.1.2 Historical and Current Species Composition

Prior to YCWA's study, 22 species of fish were documented as occurring in New Bullards Bar Reservoir at least once (Table 4.1-1). Many of these species were considered rare or were rarely documented, such as threadfin shad (*Dorosoma petenense*), fathead minnow (*Pimphales promelas*), and golden shiner (*Notemigonus crysoleucas*) (Central Valley Hatchery 1959; CDFG 2008). Thirteen species were classified as common in a summary of fish surveys conducted from 1959 through 1974 (CDFG 2008). None of the species that are known to currently occur in the reservoir are listed under the federal or State of California Endangered Species Acts.

Table 4.1-1. Fish species documented to have occurred in New Bullards Bar Reservoir prior to YCWA's Relicensing study.

Family	Species	Occurrence Record			Notes[2]
		Native	Found in 2012	Previous Abundance[1]	
Clupeidae	Threadfin Shad *Dorosoma petenense*	--	--	--	Planted prior to 1960; not found 1959-74
Salmonidae	Rainbow Trout *Oncorhynchus mykiss*	X	X	Common	Planted in most years since 1969
	Cutthroat Trout *Onchorhynchus clarkii*	X	--	--	Planted in 1971
	Kokanee *Oncorhynchus nerka*	--	X	Common	Planted in most years since 1969
	Brown Trout *Salmo trutta*	--	--	Rare	

Table 4.1-1. (continued)

Family	Species	Occurrence Record			Notes[2]
		Native	Found in 2012	Previous Abundance[1]	
Salmonidae (continued)	Brook Trout *Salvelinus fontinalis*	--	--	--	Planted in 1992
Cyprinidae	Common Carp *Cyprinus carpio*	--	X	Common	
	Sacramento Pikeminnow *Ptychocheilus grandis*	X	X	Common	
	Golden Shiner *Notemigonus crysoleucas*	--	--	--	Observed only in 1959
	Fathead Minnow *Pimphales promelas*	--	--	--	Planted prior to 1960; not found 1959-74
Catostomidae	Sacramento Sucker *Catostomus occidentalis*	X	X	Common	
Ictaluridae	Channel Catfish *Ictalurus punctatus*	--	--	--	Planted prior to 1960; not found 1959-74
	White Catfish *Ameiurus catus*	--	X	Rare	
	Brown Bullhead *Ameiurus nebulosus*	--	X	Common	
Centrarchidae	Largemouth Bass *Micropterus salmoides*	--	--	Common	
	Smallmouth Bass *Micropterus dolomieu*	--	--	Common	
	Spotted Bass *Micropterus punctulatus*	--	X	--	Planted in 1984
	Redear Sunfish *Lepomis microlophus*	--	--	Common	
	Crappie *Pomoxis* sp	--	X	Common	
	Green Sunfish *Lepomis cyanellus*	--	X	Common	
	Bluegill *Lepomis macrochirus*	--	X	Common	
	Warmouth *Lepomis gulosus*	--	--	Common	

[1] Cited from CDFG 2008, part of records from 1974
[2] From Central Valley Fish Hatchery (1959); CDFG 2008

New Bullards Bar Reservoir has a long history of annual fish stocking activities by CDFG dating back to 1959 (Central Valley Fish Hatchery 1959; CDFG 2008). Between 1969 and 2011 over 5.2 million kokanee salmon and nearly 1.8 million rainbow trout were planted in the reservoir by CDFG (Figures 4.1-1 and 4.1-2). The first documented CDFG capture of trout was reported in 1970, and kokanee were first documented during CDFG survey efforts in 1972 (CDFG 2008). Recent annual plantings have averaged about 50,000 rainbow trout and 50,000 to 100,000 kokanee.

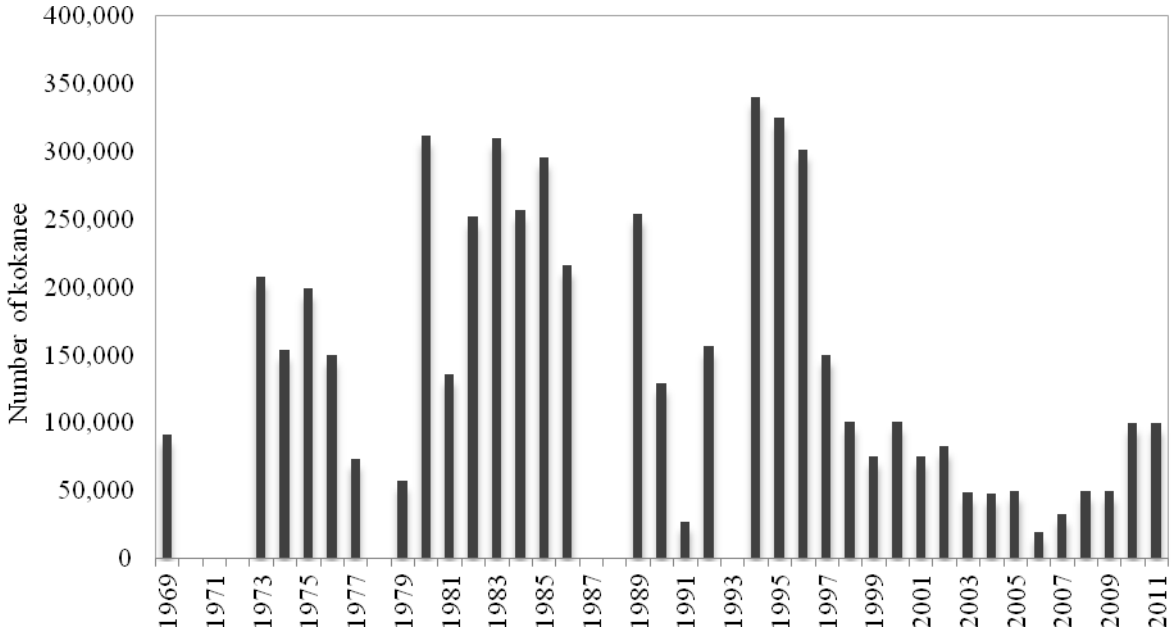

Figure 4.1-1. Numbers of kokanee planted in New Bullards Bar Reservoir by CDFG, 1969-2011. All fish were fingerlings.

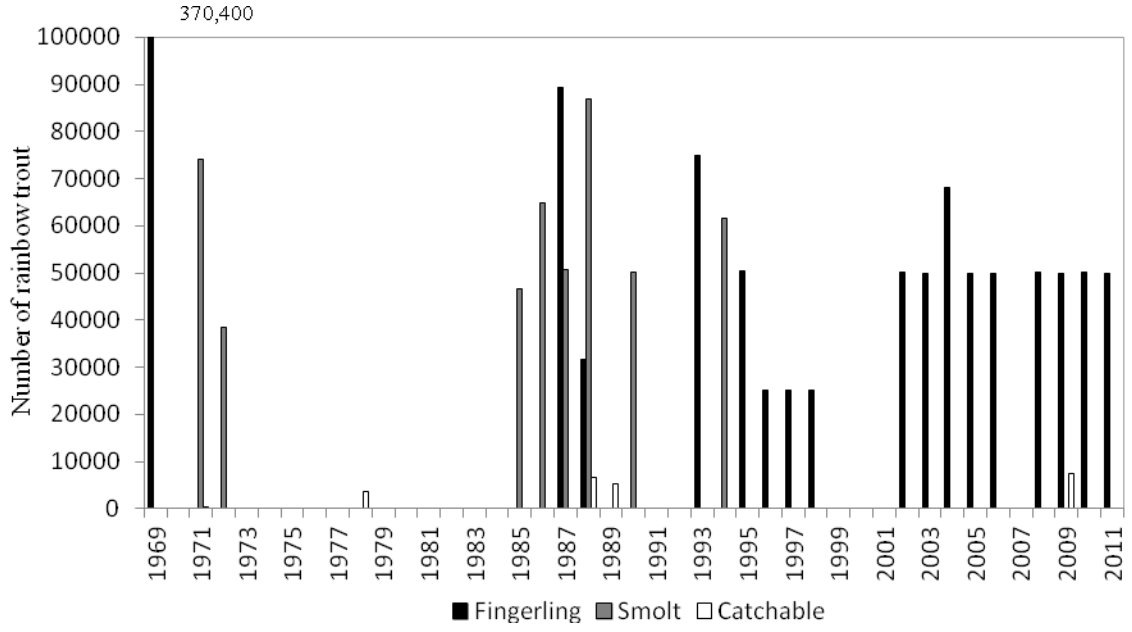

Figure 4.1-2. Numbers of rainbow trout planted in New Bullards Bar Reservoir by CDFG, 1969-2011.

Of the 1.8 million rainbow trout planted between 1969 and 2011, approximately 407,000 were Eagle Lake rainbow trout (*Onchorhynchus mykiss aquilarum*) (Table 4.1-2). Additional plantings included approximately 40,200 Eastern brook trout (*Salvelinus fontinalis*) and an unknown number of Kamloops rainbow trout (*Salmo kamloops*). Small numbers of cutthroat trout (*Oncorhynchus clarkii*) and spotted bass (*Micropterus punctulatus*) were also planted during single events. Although the number of fish planted was very small, spotted bass have evidently been very successful in New Bullards Bar Reservoir, accounting for the bulk of the catch in 2012.

Table 4.1-2. Infrequently or irregularly stocked fish species in New Bullards Bar Reservoir.

Species	Years	Mean	Min-Max
Eagle Lake Rainbow Trout *Onchorhynchus mykiss aquilarum*	1979, 1982,1983, 1985, 1999, 2000, 2001, 2007, 2008, 2009	40,704	3,120-75,012
Kamloops Rainbow Trout *Salmo kamloops*	Unknown	--	--
Eastern Brook Trout *Salvelinus fontinalis*	1992	40,215	40,215
Cutthroat Trout *Oncorhynchus clarkii*	1971	200	200
Spotted Bass *Micropterus punctulatus*	1984	185	185

Sources: CDFG 2008; J. Rowan, CDFG, personal communication, 2012)

Sampling, conducted over two events in January and June 2012, found 11 fish species, including 9 of the 13 species previously considered common, 1 of the 2 species considered rare (white catfish), and one species not present in 1974 (spotted bass). The species previously considered common that were not collected in 2012 were all centrarchids; however, the current fish assemblage appears to be dominated by centrarchids, including spotted bass, bluegill, and green sunfish. It is possible, but uncertain, that competition has influenced the relative abundance of smaller centrarchids, such as bluegill, green sunfish, redear sunfish, and warmouth (*Lepomis gulosus*). The assemblage of all centrarchids, including largemouth bass and smallmouth bass, has likely been affected by the planting and subsequent proliferation of spotted bass.

Effort from two sampling events using two gears should not be expected to capture every species residing in the reservoir. All sampling gears are selective to some degree because of intrinsic or extrinsic factors (Lagler 1978). Intrinsic factors, such as fish behavior or habitat preferences, determine which fish encounter the gear. Extrinsic factors, including gear specifications and method of operation, determine if fish encountering the gear are captured. Technicians attempted to minimize bias due to intrinsic factors by sampling at different times of the year and in or near various habitats, and set gillnets at various depths and distances from shore. Extrinsic factors were addressed by using two basic gear types (electrofishing and gillnetting), two types of gillnets (adult and juvenile), and incorporating panels of varying mesh size into each gillnet. Confidence in the ability to detect dominant species is enhanced by the fact that spotted bass accounted for the majority of the catch for both gears. Despite this, findings also indicated that the two basic gear types had different selectivity. Centrarchids dominated the electrofishing catch, whereas the most common species in gillnets, after spotted bass, were kokanee and common carp. Nevertheless, it is unlikely that all species and size selectivity could be eliminated; therefore, species composition and size distribution information should not be

considered all encompassing. Regardless, the results provide a good representation of abundant and moderately abundant species.

Although catch varied somewhat by time of year, many similarities were apparent. Spotted bass dominated the catch in both seasons, and catch of other centrarchids, such as bluegill and green sunfish, varied little between seasons. Surface temperatures in June were within the range preferred by spotted bass, and in winter, spotted bass often seek out the warmest water available (Coutant 1975; Vogele 1975).

Although catch of rainbow trout was higher in January than in June, catch of kokanee varied little. The substantial decrease in catch of rainbow trout by electrofishing from January to June indicates the fish moved to deeper water, most likely in search of preferred water temperatures. Rainbow trout prefer temperatures from 13° to 21°C (Moyle 2002), which were exceeded in the upper portion of the water column in June. Rainbow trout may also have sought the higher levels of DO found at depths greater than 40 ft in June. It is also possible that some rainbow trout may have still been in spawning tributaries in June. Kokanee catch varied little because even in January, they were caught primarily in gillnets; changes in distribution due to changes in water temperatures and DO, therefore had minimal effect on catch.

Species composition of the catch varied among sites for both gillnetting and electrofishing. Gillnet catch was highest at Site 2, primarily because of spotted bass, but catch at Site 4 was high because of the diversity of the catch, which included the greatest catch of kokanee, Sacramento pikeminnow, and common carp. High electrofishing catches at Sites 2 and 5 were primarily due to centrarchids, whereas the high catch at Site 10 included good numbers of rainbow trout and common carp. Reasons for differences in catch among sites are not readily apparent from available information for sampled habitat (Tables 3.1-2 and 3.1-3); however, differences in species composition among sites increases confidence in the ability to minimize sampling bias caused by intrinsic factors.

The lowest gillnet catch was at Site 1, nearest the deepwater intakes at New Bullards Bar Dam. Sampling was as deep as 100 ft, but intakes were never shallower than 231.4 ft throughout both sampling events. Catch in deepwater nets included one kokanee and one spotted bass (11% of all collected fish at Site 1). Both species are known to potentially occur in water exceeding 100 ft, but sampling results showed the abundance of these species generally decreased in deeper water. The absence of light limits available prey for many freshwater lake fish species in relatively deepwater and reduces the biological need to expel energy to travel to significant depths over 100 ft. All the remaining fish were collected near the surface, which was the general trend throughout the reservoir. Given the low catch of fish in depths near 100 ft, it is unlikely that many fish are present at depths over 230 ft.

4.1.3 New Bullards Bar Reservoir Tributary Assessments

Most tributaries to New Bullards Bar Reservoir have relatively low gradients with sufficient flow to support fish populations. Reservoir operations would have little affect on the four streams determined to be inaccessible to fish. Each of these streams had impassable waterfalls, steep gradients, and low flows. However, reservoir operations may influence passage in four of the

nine tributaries considered accessible that contained potential barriers: Deadwood Creek, Bridger Creek, Mill Creek, and Burnt Bridge Creek. Most of the potential passage barriers in the surveyed reaches of these streams would be inundated at NMWSE. Only Mill Creek included a barrier that would not be fully inundated during spring and summer. Passage may therefore be enhanced in spring, when rainbow trout and other native species spawn.

Results of the fish species composition study suggested relatively low species diversity among the nine accessible tributaries sampled. Of the 11 species collected in New Bullards Bar Reservoir, only two, rainbow trout and Sacramento sucker, were found in tributaries. An additional species, brown trout, was found in one tributary, but was not collected within the reservoir. Brown trout are considered rare within the reservoir (CDFG 2008). Mill Creek, the only tributary containing brown trout, is also the only tributary in which no rainbow trout were collected. Mill Creek had one of the highest average gradients of all tributaries considered accessible (6% within the electrofished reach), and contained one passage barrier that would not be completely inundated at NMWSE. However, when brown trout are present in northern California streams, they usually dominate only in streams with relatively low gradients (Gerstung 1973). Furthermore, isolation of trout species in tributaries because of reservoir operations is unlikely because the change in reservoir elevations is usually gradual. Differences in spawning times between rainbow trout (spring) and brown trout (fall), combined with usual differences between spring and fall reservoir levels, may have some effect on distribution; however, the primary mechanism underlying the distribution of rainbow trout and brown trout among tributaries remains unknown.

It was unexpected to find no centrarchids in any of the tributaries, even in the lowest reaches. Spotted bass in particular is considered primarily a stream species, preferring moderate currents, rocky substrates, and alternating pools and riffles (McMahon et al. 1984). Although gradient and habitat in the North Yuba River near New Bullards Bar Reservoir may be suitable for spotted bass, it is likely that low water temperatures limit their distribution. Steeper gradients and cold water probably preclude spotted bass and other centrarchids from utilizing other tributaries.

4.2 Englebright Reservoir

4.2.1 Operational Characteristics

Englebright Reservoir is a low-elevation system that benefits from the deepwater cold releases from New Bullards Bar Reservoir upstream. Water clarity as measured by Secchi readings (mean of 22.4 ft) was greater than that in New Bullards Bar Reservoir, but still within the range considered typical for lakes and reservoirs (Bledzki 2010). Conductivity (mean of 74.1 µmhos/cm) was similar to that of New Bullards Bar Reservoir and within or near the range found in other northern California reservoirs and rivers (USBR 2003). Water temperature never exceeded 20°C, and DO levels always exceeded the minimum levels preferred by fish species present in the reservoir. Vertical water profiles showed that the reservoir was stratified during the June 23 measurement.

Historic project operations show a consistent mildly fluctuating reservoir elevation throughout the year. Limited capacity relative to New Bullards Bar Reservoir results in annual total fluctuations of less than 15 ft in reservoir stage. Mild fluctuations occurred during the 2012 sampling period and were generally representative of normal operations. Given the small magnitude of the fluctuations and the steep banks of the reservoir, the potential for fish stranding is low. The relatively stable water levels also result in a low risk of dewatering nests of spawning fish.

4.2.2 Historical and Current Species Composition

Prior to YCWA's Relicensing study, 18 species of fish were documented as occurring in Englebright Reservoir at least once (Table 4.2-1). Thirteen species were documented in creel surveys conducted in 2003 and 2004 (CDWR 2006), of which 10 were introduced. Englebright Reservoir has at one time contained at least three species not documented in New Bullards Bar Reservoir, including lake trout (*Salvelinus namaycush*), hardhead, and yellow perch (*Perca flavescens*). Conversely, fish documented to occur at one time in New Bullards Bar Reservoir, but not in Englebright Reservoir, include threadfin shad, cutthroat trout, golden shiner, fathead minnow, white catfish, brown bullhead, and warmouth. Hardhead is the only special-status species (a California Species of Concern and Forest Service Sensitive Species) known to be present in Englebright Reservoir (J. Rowan, CDFG, pers. comm., 2011). This designation is for species that occupy much of their native range, but were formerly more widespread or abundant within that range. Such species are assessed periodically and are included in long-term plans for protected waterways (CDFG 2012).

Table 4.2-1. Fish species documented to have occurred in Englebright Reservoir prior to YCWA's Relicensing study.

Family	Species	Occurrence Record			Notes[2]
		Native	Found in 2012	Documented in 2003-04[1]	
Salmonidae	Rainbow Trout *Oncorhynchus mykiss*	X	X	X	Planted in most years since 1969
	Kokanee *Oncorhynchus nerka*	--	--	X	Planted in 1965, 1966, and 1977
	Brown Trout *Salmo trutta*	--	X	X	Planted periodically 1965-2008
	Brook Trout *Salvelinus fontinalis*	--	--	--	Planted in 1986
	Lake Trout *Salvelinus namaycush*	--	--	--	Planted in 1965 and 1966
Cyprinidae	Common Carp *Cyprinus carpio*	--	X	X	
	Sacramento Pikeminnow *Ptychocheilus grandis*	X	X	X	
	Hardhead *Mylopharodon conocephalus*	X	X	--	
Catostomidae	Sacramento Sucker *Catostomus occidentalis*	X	X	X	
Ictaluridae	Channel Catfish *Ictalurus punctatus*	--	--	X	
Centrarchidae	Largemouth Bass *Micropterus salmoides*	--	--	X	
	Smallmouth Bass *Micropterus dolomieu*	--	X	X	
	Spotted Bass *Micropterus punctulatus*	--	X	X	

Table 4.2-1. (continued)

Family	Species	Occurrence Record			Notes[2]
		Native	Found in 2012	Documented in 2003-04[1]	
Centrarchidae (continued)	Redear Sunfish *Lepomis microlophus*	--	X	--	
	Crappie *Pomoxis* sp.	--	--	X	Planted in 1984
Centrarchidae (continued)	Green Sunfish *Lepomis cyanellus*	--	X	--	
	Bluegill *Lepomis macrochirus*	--	X	X	
Percidae	Yellow Perch *Perca flavensis*	--	--	X	

[1] From CDWR (2006)
[2] From CDFG (2008)

Stocking records indicate that fish plantings in Englebright Reservoir have occurred since 1950 (CDFG 2008; Figure 4.2-1). Rainbow trout were stocked annually, with over 756,000 planted from 1965 through 2007. Stocking by CDFG ceased for a period after 2007, pending a pre-stocking evaluation (CDFG 2008), but resumed in 2011, with the planting of 16,400 triploid (sterile) rainbow trout.

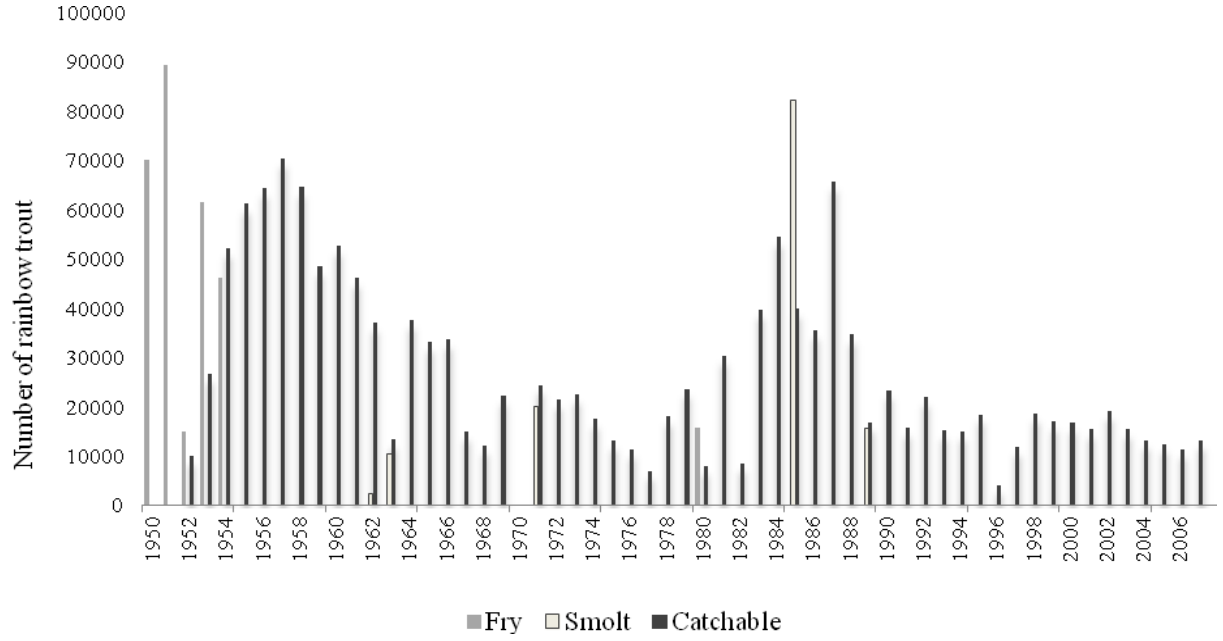

Figure 4.2-1. Historical CDFG rainbow trout planting at Englebright Reservoir.

Skippers Cove Marina (N. Rogers, CEO, pers. comm., 2012) received approval to raise triploid rainbow trout in net pens on Englebright Reservoir on October 10, 2011. They raised approximately 600 fish in four pens, of which 15 were tagged. Fish started in net pens at 2 pounds and were raised to between 4 to 6 pounds prior to release. The first triploid rainbow

trout plant occurred in spring 2012. Five of the 15 tags were returned, providing some insight into fishing success.

Other species have been planted with less regularity than rainbow trout (Table 4.2-2). Brown trout have been stocked periodically since 1965, with about 38,000 planted through 2008. Other species have been planted only 1-3 times each since 1965, with no species other than rainbow trout or brown trout planted since 1999.

Table 4.2-2. Infrequently or irregularly stocked fish species in Englebright Reservoir (from CDFG 2008).

Species	Year(s) Planted	Mean	Min-Max
Black Crappie *Pomoxis nigromaculatus*	1984	80	80
Brown Trout *Salmo trutta*	1965, 1969, 1973, 1981, 1983, 1984, 1986, 1997, 2006, 2007, 2008	3,459	418-6180
Eagle Lake Rainbow Trout *Onchorhynchus mykiss aquilarum*	1999	4,000	4000
Eastern brook trout *Salvelinus fontinalis*	1986	990	990
Kokanee salmon *Oncorhynchus nerka*	1965, 1966, 1977	76,107	40,320-100,000
Lake Trout *Salvelinus namaycush*	1965, 1966	3,487	3,000-3973
White Crappie *Pomoxis annularis*	1984	45	45

Sampling limited to June 2012 found 11 species, including 8 of the 13 species documented in creel surveys conducted in 2003 and 2004 (CDWR 2006). Species not collected in 2012 included kokanee, channel catfish, largemouth bass, crappie, and yellow perch. Sampling did reveal the presence of redear sunfish and green sunfish, which were not previously documented. Hardhead were also collected, but it is not unusual that this native, non-game cyprinid was not included in results from previous creel surveys.

Unlike New Bullards Bar Reservoir, catch in Englebright Reservoir was not dominated by any one species, and native non-game species accounted for the majority of the biomass. Hardhead were the third-most common species collected, and ranked fourth in biomass. The length-frequency distribution of hardhead displayed a wide range of ages present in the reservoir, including age-0 and adult fish, indicating the occurrence of natural reproduction. Hardhead are commonly found in low to mid-elevation sections of rivers, in warm, low-gradient margin habitat (Moyle 2002). This hardhead population likely was present in the river when the dam was constructed and has successfully persisted in similar lucastrine habitat.

Centrarchids accounted for only about 36 percent of the catch in Englebright Reservoir, compared to over 80 percent in New Bullards Bar Reservoir. This was due primarily to lower catches of spotted bass. The origin of spotted bass in Englebright Reservoir is unknown, but could have occurred from a number of possible scenarios including undocumented stocking records or illegal transfers from recreational anglers. "Bass," including spotted bass, smallmouth bass, and largemouth bass, accounted for about 28 percent of the reported sport catch in Englebright Reservoir in 2003-04 (CDWR 2006). These same species also composed about 28

percent of the catch in 2012. Although care must be taken when comparing catches from two very different methods, it appears unlikely that relative abundance of spotted bass and other centrarchids has changed dramatically since 2004.

Although gillnetting and electrofishing have different selectivity, Sacramento sucker, spotted bass, and hardhead were the most common species caught by both gears in Englebright Reservoir. This adds confidence to the strength of the collected data to characterize the dominant fish assemblage in the reservoir.

Unlike New Bullards Bar Reservoir, rainbow trout were relatively common in the electrofishing catch during June in Englebright Reservoir. Temperatures near the surface never exceeded 20^{o}C in Englebright Reservoir, making it likely that rainbow trout did not need to seek deeper water to find preferred temperature and DO conditions.

Although total catch did not vary greatly among sites, catch of individual species did. Most notably, no spotted bass were collected by electrofishing at Site 5, but more rainbow trout were collected there than at any other site. This is also the only electrofishing site where brown trout were found. This was the only site with both flowing and still water, with extensive shallow areas, and at which substrates were primarily sand and gravel. Differences in species composition among sites illustrates the importance of incorporating various habitat types when attempting to characterize fish assemblages in a reservoir.

The lowest gillnet catch was at Site 1, nearest the Englebright Dam intakes. The depth of the intakes ranged from 56.8 to 71.6 ft from January through early July 2012 and field technicians were able to set gillnets at these depths to characterize fish presence. Catch in deepwater nets included two rainbow trout and one brown trout, representing 20 percent of all fish collected at Site 1. All other fish were found near the surface, which was the general trend throughout the reservoir. The low catch in deep water suggests that only a small portion of fish capable of frequenting deep water would be found in proximity to the intakes.

5.0 Study-Specific Consultation

The FERC-approved study included one study-specific consultation and collaboration:

> YCWA will collaborate regarding sampling location for Englebright Reservoir with CDFG and for New Bullards Bar Reservoir with the Forest Service and CDFG. YCWA will accept comments from all Relicensing Participants regarding sampling locations for each methodology, nonetheless.

Relicensing Participants attended two site selection events on November 10, 2011 (New Bullards Bar Reservoir) and January 31, 2012 (Englebright Reservoir). Comments were received during the day and collaborative adjustment to some sites occurred

6.0 Variances from FERC-Approved Study

This study was conducted according to the FERC-approved Reservoir Fish Populations Study (Study 3.7) with one variance. A sample location at Gillnet Site 6 was moved. There was a high number of recreational houseboats in the area and placing nets posed a safety risk that was not acceptable. The alternative location represented similar habitat, but did not pose any safety concerns. This variance does not significantly alter the results of the study.

7.0 Attachments to This Technical Memorandum

This Technical Memorandum includes five attachments:

Attachment 3-7A	Relative Condition Factors [1 Microsoft Excel file: 195 kB]
Attachment 3-7B	Length-Frequency Tables by Reservoir and Species. [1 Adobe pdf file: 9,083 kB; 18 pages formatted to print on 8-½ by 11 inch paper]
Attachment 3-7C	Representative Photographs. [1 Adobe pdf file: 9,083 kB; 18 pages formatted to print on 8-½ by 11 inch paper]
Attachment 3-7D	Length-Weight Regression. [1 Adobe pdf file: 9,083 kB; 18 pages formatted to print on 8-½ by 11 inch paper]
Attachment 3-7E	Field Data. [1 Microsoft Excel file: 469 kB]

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