TECHNICAL MEMORANDUM 3-1

Stream Fish Populations
2008 Progress Report

Yuba-Bear Hydroelectric Project
FERC Project No. 2266-096

Drum-Spaulding Project
FERC Project No. 2310-173

March 2009

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Stream Fish Populations - 2008 Progress Report Executive Summary

This technical memorandum presents data collected in 2008 under the Stream Fish Populations study (Study 2.3.1) for NID's Yuba-Bear Hydroelectric Project and PG&E's Drum-Spaulding Project. In 2008, stream fish populations were surveyed at 26 Level II and 44 Level I sites. During Level II and Level I sampling, a total of 4,218 fish representing 15 species were collected or observed (i.e., snorkeling) during fish sampling from July through October 2008. The species collected in order of abundance for both Level II and Level I methodologies include: rainbow trout (n=2,335, 55.4%), Sacramento pikeminnow (n=792, 18.8%), brown trout (n=726, 17.2%), Sacramento sucker (n=183, 4.3%), brook trout (n=65, 1.5%), speckled dace (n=50, 1.2%), Lahontan redside (n=23, .5%), green sunfish (n=14, .3%), California roach (n=9, .2%), riffle sculpin (n=7, .2%), brown bullhead (n=5, .1%), unknown minnow (n=4, .1%), mosquitofish (n=4, .1%), and pumpkinseed (n=1, <.1%).

Overall, species composition was dominated by trout (*i.e.* rainbow, brown and brook trout). Rainbow trout was the most common fish by abundance and were found primarily in montane (2,000-4,000 feet elevation) and sub-alpine regions (4,000+ feet elevation). Brown trout (17.2%) were found throughout the sampled stream reaches, but were less common in montane regions. Brook trout (1.5%) were found only in Jackson Lake, Lake Sterling, and White Rock Lake Dam reaches (6,000+ feet elevation). The more common non-trout fishes were Sacramento pikeminnow (18.8%) and Sacramento sucker (4.3%) found only in foothill (0-2000 feet elevation) and montane regions. No ESA-listed, CESA-listed or special-status fish species were found.

A total of six variances to the study proposal occurred. These variances included:

- Removing an inaccessible site (lower Drum Afterbay Dam Reach) in exchange for an additional reference reach on the lower North Yuba River,
- Not using block nets at the lower Bear River Canal Diversion Dam Reach quantitative snorkel site as a result of high streamflow conditions,
- Using quantitative snorkeling and not electrofishing methods on Milton Diversion Dam Reach as a result of high streamflow conditions,
- Delaying sampling at Wise Powerhouse to obtain a 4(d) collection permit from NOAA due to the potential for ESA-listed steelhead,
- Sampling upstream of the reach Canyon Creek above Towle as a result of unsafe flow conditions in the desired reach, and
- During the Level I surveys, the lower South Yuba River was snorkeled and as a result weights were not collected.

The study is on schedule.

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Attachment 3-1B	Level II Fish Population Monitoring Site Locations, Physical Dimensions, And Aquatic Habitat Data (Word File)
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Stream Fish Populations - 2008 Progress Report[1]

1.0 Goals and Objectives

The goal of the Stream Fish Populations Study (Study 2.3.1) is to provide information on fishes in stream reaches affected by the projects to allow for an evaluation of:

- The health of fish populations, especially special-status fishes;
- Differences between stream reaches affected by the projects and unimpaired streams of similar size; and
- Potential affects of the projects on the health and size of fish populations.

To gather data to perform the above evaluations, the study objectives included:

- Characterizing fish species composition and relative spatial distribution;
- Estimating total or relative abundance;
- Analyzing fish population size-structure and age-class structure; and
- Calculating fish condition factor.

2.0 Methods and Analysis

To achieve the identified goals and objectives, "representative" and "focused" sampling methodologies were employed. These methods provided both qualitative and quantitative information in regards to fish population composition, abundance, and density. The purpose of the representative sampling was to describe the fish community inhabiting the sampled stream or reach (Meador, et al. 1993). Representative sampling methods were divided into two levels: qualitative and quantitative. Quantitative sampling (referred to as Level II in this study proposal) was used to develop statistical metrics of fish populations. Qualitative sampling (Level I) was used to broadly characterize fish population composition. The purpose of "focused" sampling was a site specific and detailed investigation regarding a specific information need.

Sampling Site Selection

The Stream Fish Populations Study Plan (Study 2.3.1) specifies 26 Level II, closed sample sites and 44 Level I qualitative, open sample reaches. Figure 1, located at the end of this document, provides an overview of the geographic location of each sampled Level II or Level I location.

[1] This technical memorandum presents the 2008 results for Study 2.3.1, Stream Fish Populations, as submitted to FERC in Licensees' Revised Study Plan. This study applies to NID's Yuba-Bear Hydroelectric Project and PG&E's Drum-Spaulding Project. The study does not apply to PG&E's Rollins Transmission Line Project because that project does not include any reservoirs, impoundments or stream diversions.

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Site selection for either Level II or Level I sampling was based upon several factors. These factors include spatial location, project influence, available habitat, habitat complexity, stream access, stream geomorphology and safety. Streams with greater homogeneity received fewer number of sample sites. Those stream reaches with special-status species, more complex communities, or potential issues received a higher number of sites.

Level II sampling was a closed sampling methodology and required specific upstream and downstream boundaries to be selected. As a result, multiple site selection reconnaissance surveys were undertaken. The first site selection survey was conducted by the Licensees during the week of June 23, 2008, and identified feasible access points and documented potential sampling locations. Two additional site selection trips were conducted during the weeks of July14 and July 28, 2008 with interested Relicensing Participants, who provided comments on and confirmed final site locations for Level II sampling.

During the Level II site selection trips, reaches were assessed using the following criteria: stream representativeness, relative geographic location to project facilities, accessibility, and suitability to meet overall survey objectives. Site length was based upon stream size and habitat present, and was generally extended in larger streams to ensure sufficient representative habitat was represented.

An alternative site selection process was used for the Level I methodology, as a result of the numerous sites and the open sampling scheme. Licensees first identified potential access points in each Level I reach. Maps, aerial photos, and habitat mapping information were used to prioritize multiple locations within a reach likely to have representative habitat. These access points and a calendar of when the sites were to be surveyed was made available to all Relicensing Participants. Relicensing Participants were invited into the field during the survey days to observe and comment on sampled habitat. The day of sampling, a field crew traveled to the stream through accessible areas; if the first access point was not deemed feasible, an additional area was selected. Representative habitats within the reach that was accessed was sampled. Larger reaches were sampled through multiple access points to ensure sufficient habitat was represented. This site selection and subsequent sample method was used for all 44 Level I stream reaches.

Level II Data Collection

Fish Sampling

Fish population sampling was conducted using a combination of backpack electrofishing and snorkeling methods. Where possible, multiple pass depletion sampling using backpack electrofishing equipment was used to obtain population estimates with less than a 10 percent standard error. Snorkeling supplemented with qualitative electrofishing, was used at sites that did not lend themselves to only electrofishing, as described below and indicated in Table 1.

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Table 1. Methods used at Level II fish population survey sites, July-August 2008.

Stream	Site Name	Method[a]
MiddleYuba River	Jackson Meadows Dam Reach	EF/SN
	Milton Diversion Dam Reach – Upper	EF/SN
	Milton Diversion Dam Reach – Middle	EF/SN
	Milton Diversion Dam Reach – Lower	SN/QF
Canyon Creek	Bowman Spaulding Diversion Dam Reach – Upper	EF
	Bowman Spaulding Diversion Dam Reach – Lower	EF/SN
Fordyce Creek	Fordyce Lake Dam Reach – Upper	EF/SN
	Fordyce Lake Dam Reach – Middle	EF/SN
	Fordyce Lake Dam Reach – Lower	EF/SN
SouthYuba River	South Yuba River – Upper	EF/SN
	South Yuba River – Middle	EF/SN
	South Yuba River – Lower	SN/QF
Bear River	Bear River Reach #2 – Upper	EF
	Bear River Reach #2 – Middle	EF
	Bear River Reach #2 – Lower	EF
	Drum Afterbay Dam Reach – Upper	EF/SN
	Dutch Flat Afterbay Dam Reach – Upper	EF/SN
	Dutch Flat Afterbay Dam Reach – Lower	EF
	Bear River Canal Diversion Dam Reach – Upper	EF
	Bear River Canal Diversion Dam Reach – Lower	SN/QF
North Fork of North Fork American River	Lake Valley Reservoir Dam Reach	EF
	Lake Valley Canal Diversion Dam Reach – Upper	EF
	Lake Valley Canal Diversion Dam Reach – Lower	EF/SN
North Yuba River	North Yuba River – Upper	EF
	North Yuba River – Middle	EF
	North Yuba River – Lower	SN/QF

[a] EF=Quantitative electrofishing; SN=Snorkeling; SN/QF=A combination of quantitative snorkeling and supplemental electrofishing; EF/SN=A combination of quantitative electrofishing and supplemental snorkeling

Quantitative Electrofishing. In general, electrofishing field methods used procedures identified by Meador et al. (1993), Reynolds (1996), Stangl (2001), and Temple *et al.* (2007). Level II electrofishing followed Temple *et al.* (2007), who recommends one backpack electroshock crew for streams less than 7.5 meters (m) wide and two backpack electrofishing crews for streams from 7.5–15 m wide. In wadeable streams wider than 15 m, the number of electroshocking crews was increased as necessary to ensure effective and accurate sampling. A minimum of three passes were made at each sample site using backpack electrofishing units (Smith-Root Model Type 12). Sample sites averaged 109 m in length, but ranged from 50 m to 200 m. The upstream and downstream ends of the sample sites were blocked with .250 to .375 inch fine mesh block nets spanning the full width and depth of the stream, except where an upstream fish passage barrier obviated the need for head-end blocking. If necessary, salt blocks were placed in the stream immediately above the electrofishing station to increase conductivity. Salt blocks were used when fish were observed escaping the direct path of the electric field generated by the electrofishing unit at elevated settings or when specific conductivity was generally below 40–50 microsiemens.

Captured fish were retained in aerated buckets and/or plastic tubs until each pass was completed. Fish were sedated using tablet form carbon dioxide. All fish were identified to species and

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counted. All fish captured were measured to the nearest millimeter (fork length) and weighed with a digital scale to the nearest 0.1 gram. Scale samples were taken from game fish (*i.e.,* rainbow and brown trout) larger than 200 mm fork length for validating length-age indices. Scales were removed from fish anterior to the posterior insertion of the dorsal fin and above the lateral line with the blade of a knife. Fish were released immediately below the sampling area following completion of each electrofishing pass, or, if densities and water quality conditions permitted, were released back into the sampling area once sampling was completed. Mortalities and fish condition (*e.g.*, spinal trauma, burning) were recorded prior to release. Efforts were made to ensure that sampling activities minimized the potential for injury or mortality to aquatic species (*e.g.*, aeration, use of PolyAqua, frequent water changes, maximum bucket densities).

To facilitate crew safety and sampling efficiency during electrofishing surveys on the Middle Yuba River below Jackson Meadows Reservoir (Jackson Meadows Dam Reach) and Fordyce Creek below Fordyce Lake (Fordyce Lake Dam Reach – Upper), sampling was scheduled to coincide with reduced flows of 12 cfs and 25 cfs, respectively.

Snorkeling. Level II snorkeling was conducted exclusively at four sample sites (Table 1) and was used to supplement electrofishing at 12 specific and limited locations where Level II electrofishing was not possible, such as deep pools. The Level II snorkeling surveys were conducted at four sites or portions of sites that did not lend themselves to electrofishing, based on depth, flow, and other morphological considerations. Supplemental snorkeling surveys in deep pool units allowed estimates of fish density and relative size abundance of fish species using pool habitats.

Snorkeling techniques generally followed those outlined by Thurow (1994), Dolloff *et al*. (1996), and O'Neal (2007). Surveys were conducted during the day and during periods with low annual turbidity levels. The number and width of snorkeling lanes were determined by the width of the wetted channel and visibility at each sample site. Sites ranged from 4 m to 24 m in width and resulted in a general range of 1 to 5 lanes of snorkelers. Snorkeling lanes ran the full length of the sample site. One observer was assigned to a single lane to record species composition, size, and abundance. Fish were identified, counted, and visually categorized into predefined two inch length-classes (*e.g.*, 0-2, >2-4, >4-6 inches, etc.). Observers calibrated estimated fish lengths by viewing painted wooden dowels with two inch length increments underwater. Visual estimates of length were made in English units and later converted to metric units to avoid error.

Maximum sight distance for accurate determination of fish species was recorded on the field data forms. Two to three replicate snorkeling surveys were performed using the same diving team to assess efficiency, obtain an estimate of survey variance, and determine a level of confidence for use in abundance estimation (Hankin and Reeves 1988; Slaney and Martin 1987; Snedecor and Cochran 1980). In most cases, replicate surveys were conducted no sooner than 1 hour after the initial survey to allow the fish to redistribute themselves within the site. An exception to the 1-hour rule was made for smaller, isolated pools or when light conditions limited the period of time of maximum visibility.

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If snorkeling surveys were performed within a section of stream where electrofishing occurred, the snorkeling surveys were conducted immediately after the electrofishing was complete.

Each snorkeling site, where safe, was also complemented with qualitative electrofishing near shallower stream margins to verify the species represented at the site and to obtain a representative number of fish for evaluating the condition factor. Fish were identified, counted, weighed to the nearest gram, and measured to the nearest millimeter (fork length).

Physical Habitat Parameters

Physical habitat, channel metrics, and water quality were collected at each survey site. Dissolved oxygen, specific conductivity, and water temperature were measured with an YSI Model 85 water quality meter. Air temperature and general weather conditions were also recorded. The upstream and downstream boundaries of the sample sites were recorded with a handheld GPS to document the boundaries of the sample site. Where possible, monuments (*e.g.*, tree tags, reflectors, flagging, or rock tags) were established at the upstream and downstream boundaries of each site including a description of notable physical features (*e.g.*, road crossing and gaging sites). Photo-documentation included pictures of each monitoring site from the bottom looking upstream and downstream and from the top looking downstream and upstream (Attachment 3-1G).

The following physical characteristics were measured for each meso-habitat unit at a sampling site: unit length, average width, estimated average pool depth, maximum pool depth, pool-tail embeddedness, amount and type of cover, dominant and sub-dominant substrate, dominant bank substrate, channel confinement, number and size of pieces of large woody debris (LWD), and presence and approximate area (square feet) of spawning gravel. Mesohabitat types were defined according to McCain *et al.* (1990). The physical habitat data collected were generally consistent with data collected in previous habitat mapping studies.

Level I Data Collection

Where prescribed through collaborative consultation, Level I qualitative sampling was conducted. Level I qualitative fish population sampling was conducted by identifying non-contiguous fish habitat 'spots'. The number of spots that were desired to sample was identified during study plan development through consultation with Relicensing Participants (see Attachment 1 of Stuy Plan 2.3.1 for the number of spots prescribed by reach). At each stream access point several parameters were collected: GPS location, average site length and depth, air and water temperature, dissolved oxygen, conductivity, percent canopy and gradient, habitat and cover characteristics, substrate, and estimated stream flow.

During sampling, the field crew lead moved through the stream channel using a backpack electrofisher (*i.e*. Smith Root Model 12) at identified fish habitat (*i.e.* spot) locations. One to two netters collected fish in buckets. Sampling continued until the field crew lead determined that sufficient habitat was sampled to represent the stream. The field crew traveled to additional reach access locations, if one access point did not provide sufficient habitat or habitat variability.

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Captured fish were retained in buckets and monitored. Fish were identified to species and measured to the nearest millimeter (fork length, FL). Captured fish were released back into the stream following completion of the electrofishing effort. Mortalities and fish condition (*e.g.*, spinal trauma, burning) were noted and recorded prior to release.

Snorkeling was implemented in habitat units that did not lend themselves to electrofishing, based on excessive depths, flows, and other morphological considerations. One to two divers snorkeled designated transects (lanes) recording species composition and abundance. Fish were identified, counted, and visually categorized into predefined two inch length-classes (*e.g.*, 0-2, >2-4, >4-6 inches, etc.).

Level II Data Analysis

Fish Populations and Biomass

Standing stock estimates of fish population abundance and biomass were calculated for each species at each monitoring site. Electrofishing data were analyzed using the software package MicroFish 3.0, which is based on the removal-depletion population estimation model (Van Deventer and Platts 1989). Maximum likely population estimates, capture probabilities (the proportion of fish captured in a given electrofishing pass), and confidence intervals were generated for each monitoring site using the fish capture data. Fish density and biomass were computed for each site using the summed total weight of each species. For comparative purposes, standing stock estimates are reported for each species at each site as: 1) numbers and weight (g) of fish by species per 100 m of stream; 2) numbers of fish by species per mile; 3) pounds of fish by species per acre of stream surface; and 4) kilograms of fish by species per hectare.

For snorkeling sites, population estimates are the average total number of fish recorded for each species observed during each pass, recognizing that these values may be underestimates. Biomass was estimated based on length/weight relationships developed for fish captured at all snorkeling sites during qualitative and quantitative electrofishing at other monitoring sites in the respective watershed or sub-watershed. For example, biomass estimates for South Yuba River – Lower site were calculated using a regression equation generated from fish captured at the three South Yuba River Level II fish population monitoring sites.

For sites where quantitative electrofishing and snorkeling surveys occurred, biomass estimates were computed for both the snorkeling and electrofishing sections. Additionally, an abundance and biomass estimate was computed for both sections combined. This was done by summing the estimated number and biomass of fish species captured and observed and the total reach length to compute biomass and density indices such as fish/100m, fish/mile, lbs/acre, and kg/ha.

Confidence intervals for quantitative electrofishing sites were calculated and reported from MicroFish software. The confidence intervals for snorkeling survey sites and sections were computed from the observations among passes. The confidence intervals for electrofishing and snorkeling sites were computed from a pooled estimate of variance for the two samples (Hayes *et al.* 2007; Snedecor and Cochran 1980).

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Fish Size and Condition

Fish size and weight data were summarized by species for each monitoring site. Metrics including minimum, maximum, and mean fork length and weight were calculated. Length and weight data were used to compute a relative condition factor (K_n) (Anderson and Gutreuter 1983) that was used to provide a general indication of the health of the fish, where factors greater than 1.0 indicate healthy fish. Relative condition factors for quantitative electrofishing sites were calculated from the length and weight data of fish captured at all quantitative electrofishing sites. Relative condition factors for snorkeling survey sites were calculated using the pooled qualitative and quantitative electrofishing data for all sampling sites in their respective drainage (refer to Table 1 for a complete list of snorkeling sites).

Age Structure

Length frequency distributions were analyzed to evaluate the age-class structure at each monitoring site. Age classes were determined using a length frequency analysis for smaller, more abundant trout, and augmented by scale analysis for larger, less abundant trout. Length-age indices are relatively accurate for smaller fish; however, confidence intervals reduce with larger fish. Scales collected as described above were read to assist in identifying age class breaks. Scales were cleaned and mounted between glass microscope slides and examined by two independent viewers. A third independent examination was performed when the results of the first two examinations were inconsistent.

Length frequencies were analyzed by species, site, drainage, and ecological zone (elevation range). Three ecological zones (ecozones) or elevation ranges were used to compare the size distribution of fish among sites within the same ecozone. The three ecozones were 0–2,000 feet (foothill), 2,000–4,000 feet (montane), and 4,000 feet and higher (montane/sub-alpine). The underlying assumption is that the conditions affecting growth and condition are similar within similar elevational ranges. Length frequencies for ecozones and drainages were used to facilitate the calculation of age classes of trout at individual sites, particularly those where the small numbers of trout captured limited the ability to accurately determine length-age indices for smaller fish. The results of scale data analyses were also used to bolster the determination of age classes of trout at individual monitoring sites. When component age groups were not well separated and age data from scales suggested an overlap in the size of age classes, older fish were lumped together as a single age group (*e.g.*, age 3+ fish). If age data were available from scale samples, these fish were categorized as 3-, 4-, or 5-year-old fish.

Fish identified during snorkeling surveys were identified in 2-inch size groups; therefore, the 2-inch size groups did not necessarily match the length-at-age size classes identified in the scale and length frequency analyses. The 2-inch size groups were assigned an age based on the closest length-at-age.

Age class was determined for rainbow and brown trout. Removal of species by electrofishing generally does not provide an even distribution of all age classes (Attachment 3-1C, Table C-1 and C-2). This irregular removal pattern creates modeling challenges and variable results.

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Therefore, to identify the age demographic at individual sites, the relative proportions of age classes were used. The relative proportions of age classes were applied to the population estimates to obtain relative numbers of trout by age class at each site.

To provide an additional index of size structure at each monitoring site, traditional relative stock densities (RSD) of each species were calculated. The RSD is presented on a scale of 0 to 100 (Anderson and Neumann 1996). RSD was calculated as the proportion of fish sampled that were more than 6 inches (*i.e.*, RSD = (number of fish >6-inches in sample) / (number of fish in sample) x 100). The 6-inch length was chosen because it is often used as the smallest size of fish desired by anglers. A high RSD indicates that a greater proportion of the population consists of fish in the size class desirable to anglers.

Level I Data Analysis

The Level I sampling methodology is a qualitative approach allowing for minimal potential statistical analyses. Fish length was reported using minimum, maximum, and average summary statistics. For areas where snorkeling was conducted, the mid-point of each length class was used to represent the fork length (*i.e.*, 1 inch represented 0-2 inches) to be able to generate an average length. Catch Per Unit Effort (CPUE) was calculated by dividing the total number of collected fish by the actual shocking time and was then standardized as the number of fish collected per minute. Length frequency summaries were also developed based upon the number of fish representing an individual fork length. While fish observed during snorkel surveys were identified during the survey in 2 inch increments, numbers were converted to millimeters for consistency in reporting.

Poorman Creek Temperature Refuge Focus Study

In addition to the qualitative and quantitative fish sampling described above, a focussed study was conducted in Poorman Creek and the South Yuba River (see Figure 1 for sample locations). Poorman Creek is a tributary to the South Yuba River near the town of Washington, California. An investigation into the potential for a habitat usage shift by stream fish populations from the South Yuba River into the potentially cooler Poorman Creek tributary as temperatures warmed in mid to late summer was conducted.

The first survey was conducted in late-June when water temperatures in the South Yuba River (below the Poorman Creek confluence with the South Yuba reach) were relatively cooler. The second survey occurred when water temperatures in the same location were greater than 20°C in mid-August. Water temperature loggers were used to monitor temperature between surveys.

The investigation involved conducting two quantitative snorkel surveys. During the surveys, block nets were set at the top and bottom of each sample. Two to three divers (as determined by the wetted stream channel width at each site) snorkeled the site and recorded species composition and abundance. Fish were identified, counted, and visually categorized into pre-defined length-classes (0-2 in., >2-4 in., >4-6 in., etc.). A minimum of three replicate snorkel surveys were performed using the same diving team to assess efficiency, obtain an estimate of survey variance,

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and determine a level of confidence for an abundance estimation. In addition to population data, observations of fish behavior were documented and described. Habitat matrices were also included as part of the assessment.

As required within the study plan, a complete documentation of the assessment and subsequent results is included in Attachment 3-1A.

Data Quality Assurance

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

Field Preparation

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

Data Collection

Equipment, maps, notes to access sites, time constraints, etc., were organized prior to leaving for the field. A checklist was followed for equipment, supplies, safety call-in, and other necessary pre-field tasks. Measuring instruments were checked in the field prior to use and frequently during the day. In addition to data forms, field notes were kept and included descriptions of all photos, site/habitat descriptions, unusual observations, etc. At the conclusion of the survey before leaving the field site, each field data sheet was checked by another crew member (*i.e.,* usually the crew leader unless the crew leader recorded the data) for completeness, consistency, and legibility.

Data Entry and Review

All field notes were organized and checked for missing pages and then photocopied in the evening following return from the field each day. The originals and copies were kept in separate locations until the end of the week when the originals were delivered for storage in a fire-proof safe. All digital photos were downloaded daily. A disk of the organized photos was developed at the end of the field period.

Data were entered into a spreadsheet and then checked for transcription error by two persons, one reading the values one-by-one aloud from the original notes, while the other checked the numbers in the spreadsheet. Any discrepancies were corrected and the original note taker was consulted if there was any uncertainty about the entry.

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A summary checklist of collected data is provided in Attachment 3-1H for reference. The table provided a real-time check, to ensure that all data was being gathered and reviewed.

3.0 Results

The following section provides a general summary of results for all Level II quantitative and Level I Qualitative sampling results conducted in 2008.

Level II Quantative Results

Physical Habitat

Summaries of the physical habitat data are presented below for each monitoring site (see Table 2) and in Attachment 3-1B. Basic site dimensions, weather, and water quality are provided in Table 2. Attachment 3-1B provides tables that include upstream and downstream GPS coordinates (Table C-1), a summary of selected physical aquatic habitat data including elevation and unit dimensions (Table B-2), and proportions of physical aquatic habitat types (Table B-3).

Species Composition and Relative Abundance From Level II Sampling

Efforts from Level II sampling resulted in the collection of 1,897 fish from electrofishing. An additional 1,019 fish were observed during Level II snorkeling surveys in 2008. The six fish species captured or observed in 2008 Level II sampling are listed in Table 3. Species composition and relative abundance from Level II sampling of the fish community in the project area, including the North Yuba River sites, was numerically dominated by trout, specifically rainbow trout (65.1%) and brown trout (16.3%) (Figure 2). The next most numerically abundant family of fish was Cyprinidae, specifically Sacramento pikeminnow (13.3%). Sacramento sucker (Catistomidae) totaled 139 fish or 4.8 percent of the sampled population. Additional detailed fish population and biomass estimates including fish size and condition for all Level II sites are included in Attachment 3-1B.

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Table 2. Summary of physical dimensions, water quality, and ambient weather conditions for Level II fish population monitoring sites, 2008.

Stream	Site Name	Elevation (ft)	Site Length (m)	Average Width (m)	Average Depth (m)	Area (m^2)	Air Temp. °C	Water Temp. °C	Conductivity (µS)	DO (mg/l)	Weather
Middle Yuba River	Jackson Meadows Dam Reach[a]	5,750	136	14.5	0.3	21,276	12	7.1	24.9	9.98	Cloudy / Cool
	Milton Diversion Dam Reach – Upper Site	5,550	61	4.6	0.6	3,014	15	12.4	46.9	7.83	Sunny
	Milton Diversion Dam Reach – Middle Site	3,000	76	13.6	0.5	11,054	21.4	18.4	116.7	10.44	Sunny / Hot
	Milton Diversion Dam Reach – Lower Site	2,000	142	10.5	0.4	15,968	22.5	21	152.8	8.45	Sunny / Warm
Canyon Creek	Bowman Spaulding Diversion Dam Reach – Upper	4,750	94	6.9	0.3	6,944	20.5	15.8	30.5	7.98	Sunny
	Bowman Spaulding Diversion Dam Reach – Lower	3,200	127	7.2	0.3	9,849	20.5	17.9	49.5	7.75	Sunny
Fordyce Creek	Fordyce Lake Dam Reach – Upper[a]	6,200	128	11.7	0.4	16,098	21.3	8.8	10	7.62	Sunny
	Fordyce Lake Dam Reach – Middle	5,700	128	14.2	0.8	19,644	19	8	n/a	n/a	Sunny
	Fordyce Lake Dam Reach – Lower	5,450	179	15.9	0.4	30,454	26.5	13.8	12.3	6.28	Sunny / Clear
South Yuba River	South Yuba River – Upper	4,300	164	12.3	0.5	21,641	17.5	14.4	60.3	8.42	Sunny / Clear
	South Yuba River – Middle	2,500	119	13.7	0.5	17,439	23	20.2	80.5	9.66	Light Clouds
	South Yuba River – Lower	1,900	93	8.4	1.2	8,424	24	23.2	n/a	6.7	Clear
Bear River	Bear River Reach #2 – Upper	4,500	86	6.1	0.5	5,640	17.5	11.4	n/a	7.99	Sunny
	Bear River Reach #2 – Middle	4,050	50	8.7	0.9	4,674	22.5	15	n/a	8.4	Sunny
	Bear River Reach #2 – Lower	3,600	79	6.4	0.5	5,470	29.5	17	58	8.37	Sunny / Hot
	Drum Afterbay Dam Reach – Upper	3,200	74	7.9	0.6	6,290	15.7	14.1	31.2	9.04	Sunny
	Dutch Flat Afterbay Dam Reach – Upper	2,550	178	6.5	0.5	12,525	n/a	14.3	25.5	9.62	Sunny
	Dutch Flat Afterbay Dam Reach – Lower	2,450	149	7	0.4	11,149	20	14.2	n/a	8.93	Sunny
	Bear River Canal Diversion Dam Reach – Upper	1,800	52	22.7	0.3	12,804	22.5	16.6	30.3	9.29	Sunny
	Bear River Canal Diversion Dam Reach – Lower	1,650	128	12.5	1.2	17,216	n/a	n/a	n/a	n/a	Sunny / Hot
North Fork North Fork American River	Lake Valley Reservoir Dam Reach	5,550	116	7.1	0.4	8,816	17.5	11.7	10.9	8.04	Sunny
	Lake Valley Canal Diversion Dam Reach – Upper	5,250	69	8.5	0.4	6,285	15.9	15.5	25.2	7.26	Sunny
	Lake Valley Canal Diversion Dam Reach – Lower	4,800	98	6	0.6	6,360	24.1	16.9	29.5	7.61	Sunny
North Yuba River	North Yuba River – Upper	5,350	77	9.9	0.3	8,127	17.5	11.5	n/a	8.83	Cloudy/Sunny @ 1/2 day
	North Yuba River – Middle	4,300	63	7.1	0.5	4,833	16.5	12.5	67.5	8.84	Sunny / Clear
	North Yuba River – Lower	2,150	183	24.8	1.5	49,000	18.5	18.2	156	8	Sunny

[a] Physical habitat measurements were collected at reduced flows.

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Fish Size, Age, and Condition

Fish size varied by stream, species, and age class. The size of trout captured during quantitative electrofishing ranged from 21 to 503 mm FL with an average of 110 mm. Mean fork lengths for rainbow trout and brown trout were 109 and 112 mm, respectively. Histograms of rainbow and brown trout fork lengths are presented in Figure 3. The size classes of trout observed during snorkeling surveys ranged from 0–50 mm to 306–355 mm, with a majority of the trout in the 51–203 mm size class. The average RSD for all trout species at Level II fish population monitoring sites in 2008 was 20 percent. The RSD of trout ranged from 0 to 100 percent for rainbow and brown trout.

Length frequency analysis and scale age determination were used to identify size at age groups. Forty scale samples (from fish larger than 200 mm fork length) were collected and read to assist in separating lengths of fish older than 3 years. Rainbow trout ages ranged from 0 to 4 years and brown trout ages ranged from 0 to 5 years. Age 1 trout was the most abundant age class of rainbow and brown trout. The relative abundance of age classes of rainbow and brown trout captured and observed at Level II fish population monitoring sites is presented in Figures 4 and 5. Large trout (250+ mm) were observed, but due to the small numbers of fish of this size captured, the exact age, and thus abundance of these fish, is not clear. At a majority of the monitoring sites, length frequency analysis and scale data identify significant overlap in the size of older fish (age 3+). Length frequency diagrams containing age data from scale samples and size ranges for their respective age classes are presented in Table 4 for rainbow trout and Table 5 for brown trout. Due to the overlap in age distribution between sites, there is no way to accurately identify the size of older groups without strong assumptions about the population structure. Therefore, in the absence of additional information, the interval boundaries were set so that most of the older fish (age 3+) were lumped together as a single age group (MacDonald 1987). When individual fish at monitoring sites were aged from scale data as age 3, 4, or 5 fish, they were placed into their respective age classes for density estimates. Length-at-age results from length frequency and scale data analyses for trout observed at Level II sites are listed in Table 6.

Length and weight data were used to calculate a relative condition factor (K_n) (Anderson and Gutreuter 1983) to provide a general indication of fish health. The relative condition factor for all fish captured during quantitative electrofishing surveys ranged from 0.31 to 4.45 and averaged 0.97. The average relative condition factor for rainbow and brown trout at electrofishing sites was 0.98 and 0.85, respectively. The average relative condition factor for rainbow and brown trout at snorkeling survey sites was 1.09 and 0.94, respectively. Average relative condition factors were almost all nearly 1.00, suggesting that the fish captured during 2008 were generally of good health. No external signs of disease or ectoparasites were identified for any of the trout captured or observed in 2008. Among ecozones, the average relative condition factor of rainbow trout was 1.12, 1.02, and 0.96 for the foothill, montane, and montane/sub-alpine ecozones, respectively (Attachment 3-1C, Table C-13). The average relative condition factor of brown trout was 0.85, 0.95, and 0.84 for the foothill, montane, and montane/sub-alpine ecozones, respectively.

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A relatively low proportion of fish were injured during Level II samping. A total of nine fish suffered from physical injury including saddle burns and/or trauma, equating to an overall percentage of 0.5. Of the 1,897 fish captured, 42 were dead or moribund, equating to 2.2 percent. Additional information on physical injury and mortality by species is provided in Attachment 3-1C.

Table 3. Overall fish species composition determined by electrofishing and snorkeling surveys at Level II fish population monitoring sites, July–August 2008.

Family	Common Name	Native (N) / Introduced (I)	Electrofishing (collected)	Snorkeling (observed)	Composition
Salmonidae	Rainbow Trout	N	1283	614	65%
	Brown Trout	I	468	7	16%
Cyprinidae	California Roach	N	2	0	0%
	Sacramento Pikeminnow	N	31	358	13%
	Speckled Dace	N	13	0	0%
Catostomidae	Sacramento Sucker	N	100	40	5%
Total			1897	1019	100%

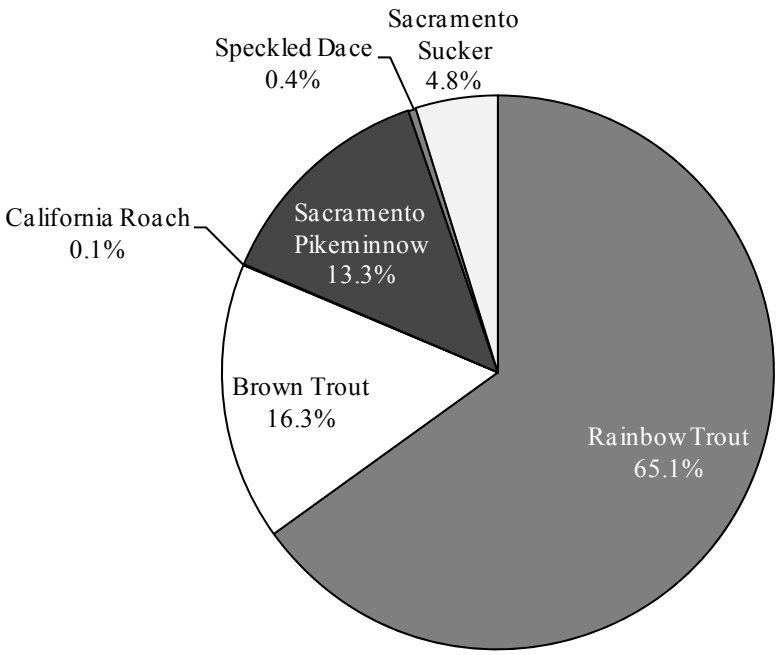

Figure 2. Relative composition of fish species captured and/or observed at Level II fish population monitoring sites in 2008.

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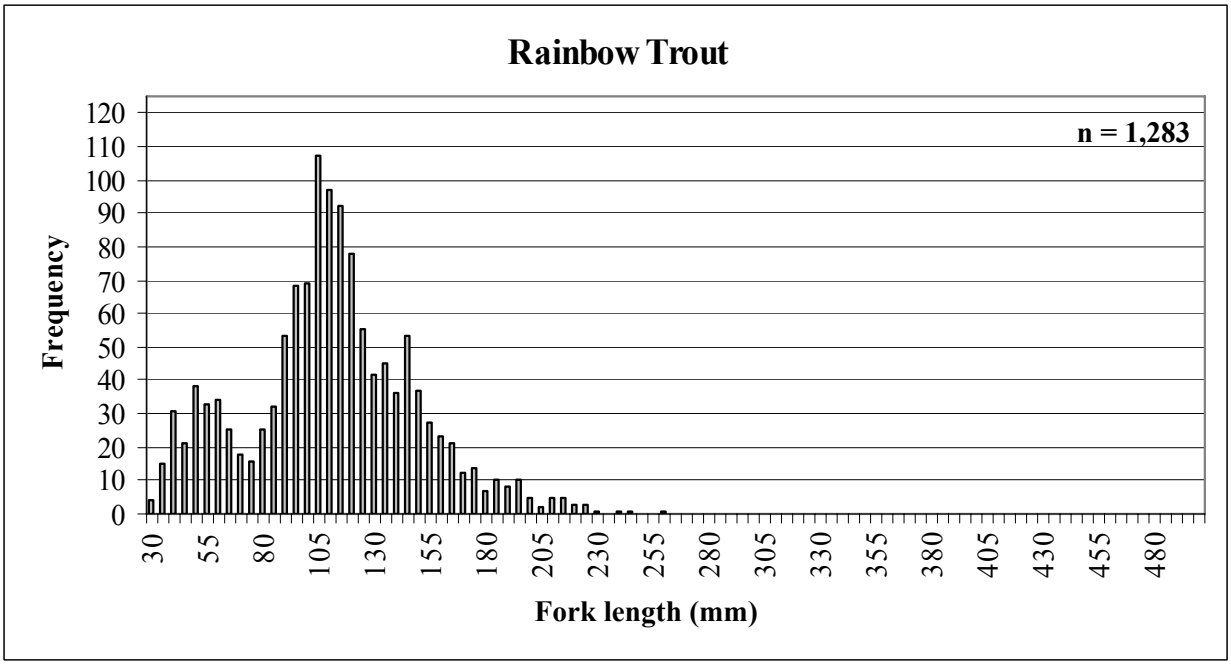

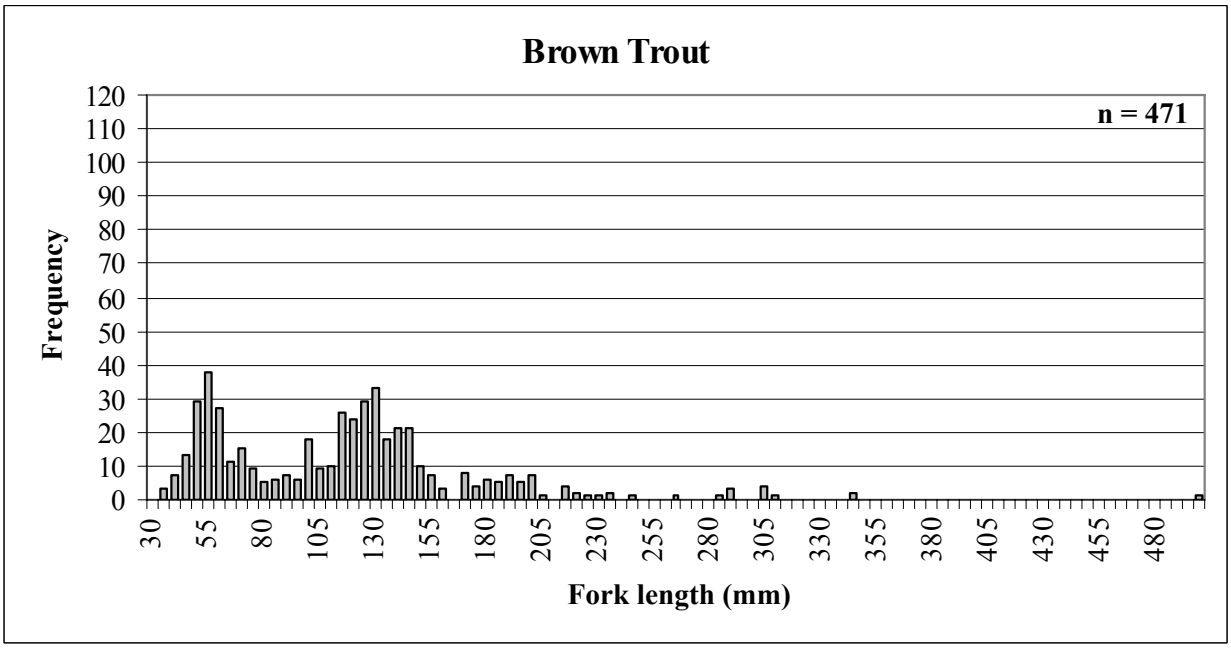

Figure 3. Length-frequency distributions for rainbow and brown trout captured at Level II fish population monitoring sites, July–August 2008.

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Table 4. Approximate length-at-age based on length frequency analysis and scale-age determination for rainbow trout at Level II fish population monitoring sites, July–August 2008.

Stream	Site	Size Range (mm fork length)					
		Age 0	Age 1	Age 2	Age 3	Age 4	Age 5
Middle Yuba River	Jackson Meadows Dam Reach	0-70	71-130	131-205	≥206	-	-
	Milton Diversion Dam Reach – Upper	0-80	81-135	136-205	≥206	-	-
	Milton Diversion Dam Reach – Middle	0-80	81-135	136-205	≥206	-	-
	Milton Diversion Dam Reach – Lower	-	-	-	-	-	-
Canyon Creek	Bowman Spaulding Diversion Dam Reach – Upper	0-80	81-135	136-185	≥186	-	-
	Bowman Spaulding Diversion Dam Reach – Lower	0-80	81-135	136-185	≥186	-	-
Fordyce Creek	Fordyce Lake Dam Reach – Upper	0-70	71-125	126-170	171-215	≥216	-
	Fordyce Lake Dam Reach – Middle	0-70	71-125	126-170	171-215	≥216	-
	Fordyce Lake Dam Reach – Lower	0-70	71-125	126-170	171-215	≥216	-
South Yuba River	South Yuba River – Upper	0-95	96-145	146-215	≥215	-	-
	South Yuba River – Middle	0-95	96-145	146-215	≥215	-	-
	South Yuba River – Lower	0-95	96-145	146-215	≥215	-	-
Bear River	Bear River Reach #2 – Upper	0-85	86-135	136-205	≥205	-	-
	Bear River Reach #2 – Middle	0-85	86-135	136-205	≥205	-	-
	Bear River Reach #2 – Lower	0-85	86-135	136-205	≥205	-	-
	Drum Afterbay Dam Reach – Upper	0-85	86-135	136-205	≥205	-	-
	Dutch Flat Afterbay Dam Reach – Upper	0-85	86-135	136-205	≥205	-	-
	Dutch Flat Afterbay Dam Reach – Lower	0-85	86-135	136-205	≥205	-	-
	Bear River Canal Diversion Dam Reach – Upper	0-85	86-135	136-205	≥205	-	-
	Bear River Canal Diversion Dam Reach – Lower	-	-	-	-	-	-
North Fork North Fork American River	Lake Valley Reservoir Dam Reach	0-70	71-135	136-185	≥186	-	-
	Lake Valley Canal Diversion Dam Reach – Upper	0-70	71-135	136-185	≥186	-	-
	Lake Valley Canal Diversion Dam Reach – Lower	0-70	71-135	136-185	≥186	-	-
North Yuba River	North Yuba River – Upper	0-70	71-165	165-215	≥215	-	-
	North Yuba River – Middle	0-80	81-175	175-215	≥215	-	-
	North Yuba River – Lower	-	-	-	-	-	-

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Table 5. Approximate lengths-at-age based on length frequency analysis and scale-age determination for brown trout at Level II Fish population monitoring sites, July–August 2008.

Stream	Site	Size Range (mm fork length)					
		Age 0	Age 1	Age 2	Age 3	Age 4	Age 5
Middle Yuba River	Jackson Meadows Dam Reach	0-70	71-135	136-205	≥206	-	-
	Milton Diversion Dam Reach – Upper Site	0-80	81-165	166-205	≥206	-	-
	Milton Diversion Dam Reach – Middle Site	0-80	81-165	166-205	≥206	-	-
	Milton Diversion Dam Reach – Lower Site	-	-	-	-	-	-
Canyon Creek	Bowman Spaulding Diversion Dam Reach – Upper	0-80	81-165	166-205	≥206	-	-
	Bowman Spaulding Diversion Dam Reach – Lower	0-80	81-165	166-205	≥206	-	-
Fordyce Creek	Fordyce Lake Dam Reach – Upper	0-80	81-165	166-200	≥201	-	-
	Fordyce Lake Dam Reach – Middle	0-80	81-165	166-200	≥201	-	-
	Fordyce Lake Dam Reach – Lower	0-80	81-165	166-200	≥201	-	-
South Yuba River	South Yuba River – Upper	-	-	-	-	-	-
	South Yuba River – Middle	-	-	-	-	-	-
	South Yuba River – Lower	-	-	-	-	-	-
Bear River	Bear River Reach #2 – Upper	0-80	81-165	166-205	≥206	-	-
	Bear River Reach #2 – Middle	0-80	81-165	166-205	≥206	-	-
	Bear River Reach #2 – Lower	0-80	81-165	166-205	≥206	-	-
	Drum Afterbay Dam Reach – Upper	0-80	81-165	166-205	≥206	-	-
	Dutch Flat Afterbay Dam Reach – Upper	0-80	81-165	166-205	≥206	-	-
	Dutch Flat Afterbay Dam Reach – Lower	0-80	81-165	166-205	≥206	-	-
	Bear River Canal Diversion Dam Reach – Upper	0-80	81-165	166-205	≥206	-	-
	Bear River Canal Diversion Dam Reach – Lower	0-80	81-165	166-205	≥206	-	-
North Fork	Lake Valley Reservoir Dam Reach	0-80	81-165	166-215	≥216	-	-
North Fork	Lake Valley Canal Diversion Dam Reach – Upper	0-80	81-165	166-215	≥216	-	-
American River	Lake Valley Canal Diversion Dam Reach – Lower	0-80	81-165	166-215	≥216	-	-
North Yuba River	North Yuba River – Upper	0-80	81-165	166-205	≥206		
	North Yuba River – Middle	0-80	81-165	166-205	≥206		
	North Yuba River – Lower	-	-	-	-	-	-

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Table 6. Approximate length-at-age based on length frequency analysis and scale-age determination for trout observed at all Level II fish population monitoring sites combined, July–August 2008.

Species	Size Range (mm fork length)					
	0-50	51-102	103-152	153-203	204-254	255+
Rainbow Trout	Age 0	Age 0	Age 1	Age 2	Age 3+	Age 3+
Brown Trout	Age 0	Age 1	Age 1	Age 2	Age 3+	Age 3+

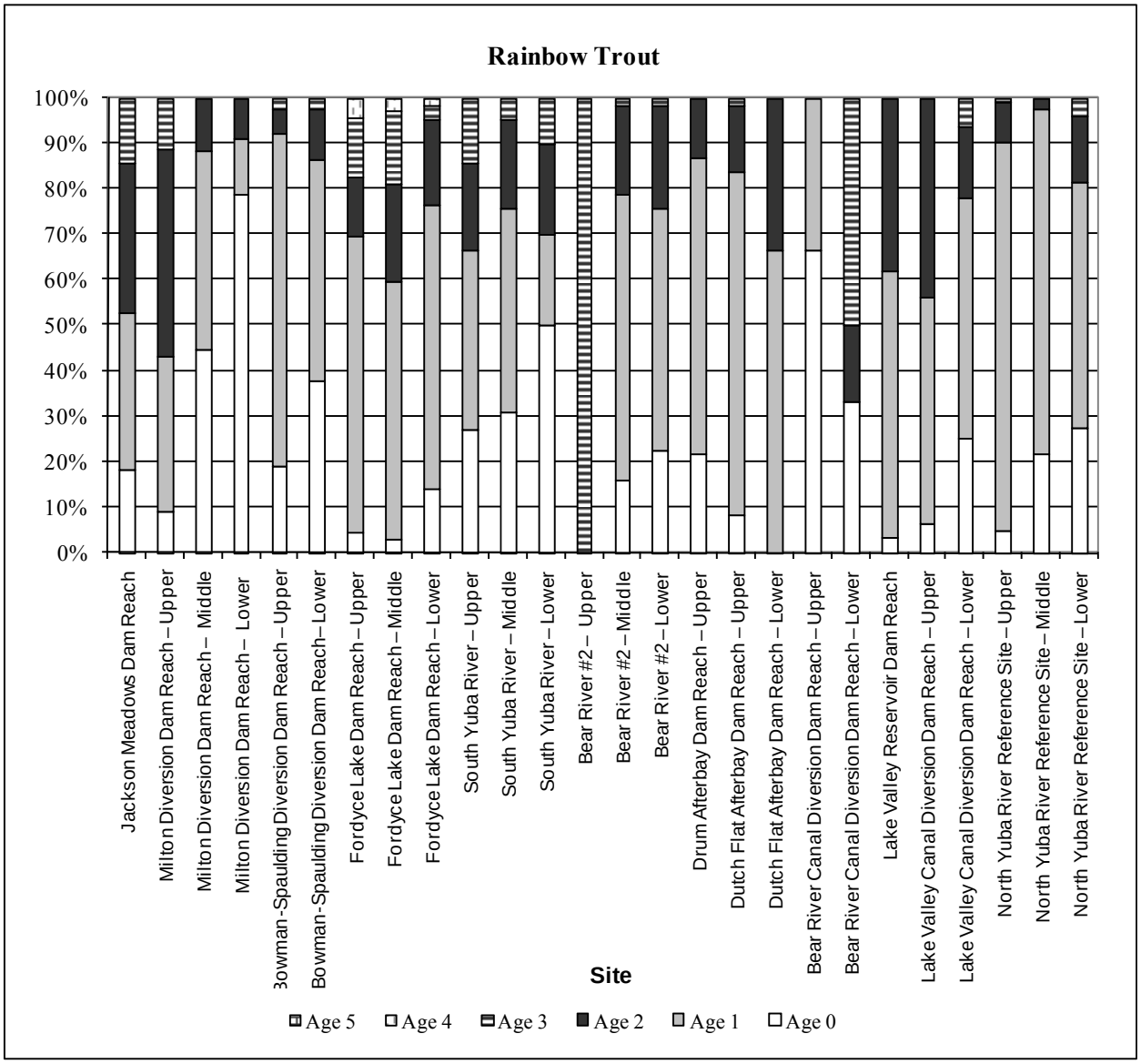

Figure 4. Comparison of Age-Class Composition of Rainbow Trout at Level II Fish Population Monitoring Sites, July–August 2008.

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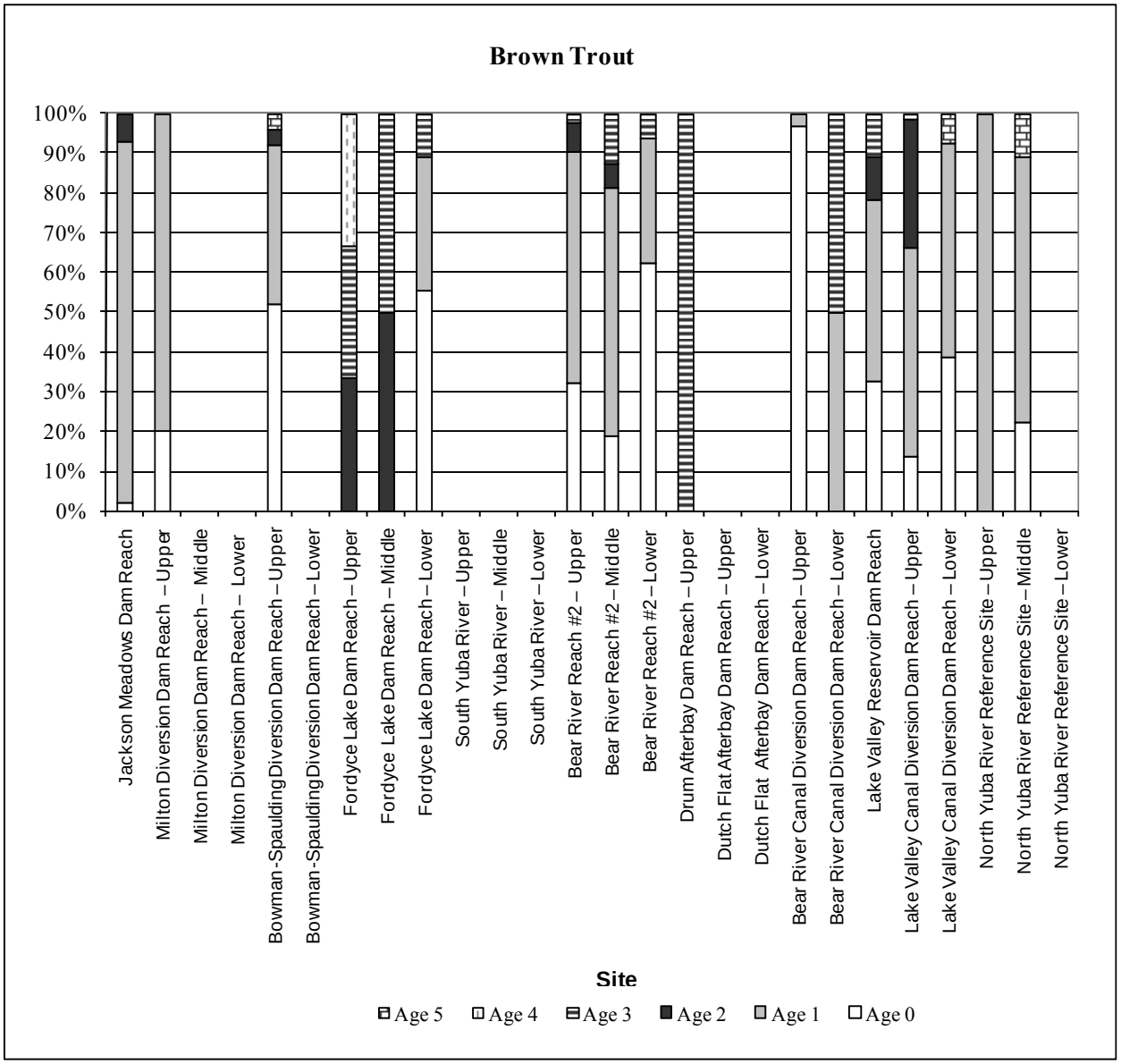

Figure 5 Comparison of age class composition of brown trout at Level II fish population monitoring sites, July–August 2008.

Fish Abundance and Biomass

Fish abundance and biomass estimates for Level II fish population monitoring sites were calculated by species, reach and elevation. Table 7 provides estimates of fish abundance and biomass for all species and Table 8 provides similar data for all trout combined. Figures 6 through 8 and Table 9 provide relative abundance for rainbow trout, brown trout, and all trout combined by site and ecozones. Figures 9 tthrough 11 and Table 10 provide fish biomass for rainbow trout, brown trout, and all trout combined by site and ecozones.

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The highest estimated abundances of rainbow trout in project-affected stream reaches was on Canyon Creek at Bowman Spaulding Diversion Dam Reach – Lower (2,568 fish/mile; Table 7; Figure 6). The highest estimated abundances of brown trout was on the Bear River at Bear River Reach #2 – Upper (3,232 fish/mile; Table 7; Figure 7). The highest combined abundance for all trout in project-affected reaches was Bear River at Bear River Reach #2 – Upper (3,251 fish/mile; Table 8; Figure 8). The lowest estimated abundances of rainbow trout in project-affected stream reaches was on the Bear River at Bear River Reach #2 – Upper site (19 fish/mile) (Table 7; Figure 6) which incidentally had the highest estimated abundance and biomass of brown trout (Table 7; Figure 7).

The highest estimated abundances of rainbow and brown trout within the North Yuba River reference stream reaches were at the North Yuba River - Middle site with 5,994 fish/mile and 230 fish/mile, respectively (Tables 7; Figures 6 to 7). The combined abundance for all trout on the North Yuba River – Middle was 6,224 fish/mile (Table 8; Figure 8). The lowest estimated abundances of rainbow and brownt trout were at the North Yuba River – Lower with 0 fish/mile and 1,696 fish/mile, respectively (Tables 7 and 8; Figures 6 to 8).

The average estimated abundances of rainbow trout at Level II sites were approximately equal between the 2,000–4,000 (montane) and 4,000+ ft (montane/sub-alpine) ecozones and lowest in the 0–2,000 ft (foothill) ecozone (Table 9; Figure 6). The highest estimated abundances of brown trout at Level II fish population monitoring sites were at the 4,000+ ft (montane/sub-alpine) ecozones (Table 9, Figure 7).

Sacramento pikeminnow and sucker were the most abundant sampled non-salmonid species. In project-affected reaches, the highest estimated abundance for pikeminnow was on the South Yuba River – Lower with 1,420 fish/mile (Table 7). Sacramento sucker highest estimated abundance was on the Bear River at Bear River Canal Diversion Dam Reach – Upper (368 fish/mile; Table 7). Both fishes were primarily located in foothill ecozones with lower abundance in montane regions and no presence found in montane/subalpine (4000+ ft). Sacramento pikeminnow and sucker were only found at the North Yuba River Reference – Lower where abundance was 2,363 fish/mile and 35 fish/mile, respectively (Table 7).

The highest abundance for all species combined in project-affected stream reaches was on the Bear River at Bear River Reach #2 – Upper (3,251 fish/mile; Table 11). The Middle Yuba River at Milton Diversion Dam Reach – Upper closely followed in highest total abundance (3,044 fish/mile; Table 9). The lowest abundance for all fish species in project-affected reaches was on the Bear River at the Bear River Canal Diversion Dam Reach – Lower (138 fish/mile; Table 11).

The highest abundance for all species combined in the North Yuba River reference reaches was at North Yuba River – Middle (6,224 fish/mile; Table 11). The North Yuba River – Upper and Lower locations both had similar abundance of 4,186 fish/mile and 4,094 fish/mile (Table 11), respectively.

The highest estimated biomass of rainbow trout in project-affected stream reaches was on the Middle Yuba River at the Milton Diversion Dam Reach – Upper site with 111.3 lbs/acre

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followed by Bowman Spaulding Diversion Dam Reach – Lower (32.0 lbs/acre) on Canyon Creek (Table 7; Figure 9). The highest estimated biomass of brown trout was at Bear River Reach #2 – Upper (65.8 lbs/acre; Table 7; Figure 10). The highest combined biomass for all trout in project-affected reaches was the Middle Yuba River at Milton Diversion Dam – Upper (161.2 lbs/acre; Table 8; Figure 11). The lowest estimated biomass of rainbow trout in a project-affected stream reach was on the Bear River at the Bear River Canal Diversion Dam Reach – Upper site with 0.2 lb/acre (Table 7; Figure 9). The lowest estimated abundances and biomass of brown trout in Project-affected stream reaches were zero at all three South Yuba River sites, the Bowman-Spaulding Diversion Dam Reach – Lower, Milton Diversion Dam Reach – Lower, Dutch Flat Afterbay Dam Reach - Upper and Lower, and North Yuba River – Lower site (Table 7; Figures 8 and 10).

The highest estimated biomass of rainbow and brown trout in North Yuba River reaches was at the North Yuba River – Middle site with 86.1 lbs/acre and 39.8 lbs/acre, respectively (Tables 7 and 8; Figures 9 to 11). The combined biomass for all trout on the North Yuba River – Middle was 125.9 lbs/acre (Table 8; Figure 11). The lowest estimated biomass of rainbow and brown trout was at the North Yuba River – Lower site with 0 lbs/acre and 7.2 lbs/acre, respectively (Tables 7 and 8; Figures 9 to 11).

The average estimated biomass of rainbow trout at Level II sites decreased with elevation and was highest at 4,000+ ft (montane/sub-alpine) ecozones and lowest in the 0–2,000 ft (foothill) ecozone (Table 10; Figure 9). The estimated biomass of brown trout at Level II fish population monitoring site was similar to rainbow trout in that biomass decreased with elevation. The highest brown trout biomass was at the 4,000+ elevation (montane/sub-alpine) ecozone and was lowest and the 0-2,000 ft (foothill) ecozone (Table 10, Figure 10).

Sacramento pikeminnow and sucker had the highest biomass of sampled non-salmonid species. In project-affected reaches, the highest estimated abundance for pikeminnow was on the South Yuba River – Lower with 11.2 lbs/acre (Table 7). Sacramento sucker with the highest estimated biomass was on the South Yuba River – Middle (1.3 lbs/acre; Table 7). Sacramento pikeminnow and sucker were only found at the North Yuba River Reference – Lower where biomass was .2 lbs/acre and .1 lbs/acre, respectively (Table 7).

The highest total biomass for all species combined in project-affected stream reaches was on the Middle Yuba River at Milton Diversion Dam Reach – Middle (161.2; Table 11). The next closest reach in total biomass was on the Bear River at Bear River Reach #2 (67.4 lbs/acre; Table 11) Conversely, the lowest total biomass for all fish species in project-affected reaches was on the Middle Yuba River at Milton Diversion Dam Reach – Lower (2.9 lbs/acre; Table 11).

The highest biomass for all species combined in the North Yuba River reference reaches was at North Yuba River – Middle (125.9 lbs/acre; Table 9). The North Yuba River – Upper exceeded the biomass of the Lower site and were 56.1 lbs/acre and 7.6 lbs/acre, respectively.

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Table 7. Estimates of fish abundance and biomass for Level II fish population monitoring sites, July–August 2008.

Stream	Site	Method[c]	Species Code	Ecozone[a]	Estimated Population	Estimated Weight (g)	Site Length (m)	Avg Site Width (m)	Fish/100 meters	Fish/mile	lbs/acre	kg/ha
Middle Yuba River	Jackson Meadows Dam Reach	EF/SN	Rainbow Trout	4+	55	2,899.2	136.1	14.5	40	650	13.1	14.7
	Jackson Meadows Dam Reach	EF/SN	Brown Trout	4+	67	817.1	136.1	14.5	49	792	3.7	4.1
	Jackson Meadows Dam Reach	EF/SN	Speckled Dace	4+	1	3.6	136.1	14.5	1	12	0	0
	Milton Diversion Dam Reach – Upper Site	EF/SN	Rainbow Trout	4+	65	3,493.6	60.8	4.6	107	1,720	111.3	124.7
	Milton Diversion Dam Reach – Upper Site	EF/SN	Brown Trout	4+	50	1,565.2	60.8	4.6	82	1,323	49.9	55.9
	Milton Diversion Dam Reach – Middle Site	EF/SN	Rainbow Trout	2-4	109	1,828.2	75.7	13.6	144	2,317	15.9	17.8
	Milton Diversion Dam Reach – Middle Site	EF/SN	Sacramento Sucker	2-4	10	113.4	75.7	13.6	13	213	1	1.1
	Milton Diversion Dam Reach – Lower	SN/QF	Rainbow Trout	0-2	33	357.3	141.7	10.5	23	375	2.1	2.4
	Milton Diversion Dam Reach – Lower	SN/QF	Sacramento Sucker	0-2	28	115.4	141.7	10.5	20	318	0.7	0.8
	Milton Diversion Dam Reach – Lower	SN/QF	Sacramento Pikeminnow	0-2	6	5.3	141.7	10.5	4	68	0	0
Canyon Creek	Bowman Spaulding Diversion Dam Reach – Upper	EF	Rainbow Trout	4+	128	2,074.6	93.6	6.9	137	2,201	28.7	32.2
	Bowman Spaulding Diversion Dam Reach – Upper	EF	Brown Trout	4+	53	1,234.8	93.6	6.9	57	912	17.1	19.1
	Bowman Spaulding Diversion Dam Reach – Lower	EF/SN	Rainbow Trout	2-4	202	3,280.4	126.6	7.2	160	2,568	32	35.9
Fordyce Creek	Fordyce Lake Dam Reach – Upper	EF/SN	Rainbow Trout	4+	24	553.7	127.7	11.7	19	302	3.3	3.7
	Fordyce Lake Dam Reach – Upper	EF/SN	Brown Trout	4+	3	470.4	127.7	11.7	2	38	2.8	3.1
	Fordyce Lake Dam Reach – Upper	EF/SN	California Roach	4+	2	6.7	127.7	11.7	2	25	0	0
	Fordyce Lake Dam Reach – Middle	EF/SN	Rainbow Trout	4+	44	1,387.3	128.3	14.2	34	552	6.8	7.6
	Fordyce Lake Dam Reach – Middle	EF/SN	Brown Trout	4+	2	338.6	128.3	14.2	2	25	1.7	1.9
	Fordyce Lake Dam Reach – Lower	EF/SN	Rainbow Trout	4+	69	1,344.9	178.6	15.8	39	622	4.2	4.8
	Fordyce Lake Dam Reach – Lower	EF/SN	Brown Trout	4+	10	397.6	178.6	15.8	6	90	1.3	1.4
South Yuba River[b]	South Yuba River – Upper	EF/SN	Rainbow Trout	4+	137	4,193.2	163.7	12.3	84	1,347	18.6	20.9
	South Yuba River – Middle	EF/SN	Sacramento Sucker	2-4	5	242.2	118.6	13.7	4	68	1.3	1.5
	South Yuba River – Middle	EF/SN	Rainbow Trout	2-4	163	4,410.2	118.6	13.7	137	2,212	24.3	27.2
	South Yuba River – Lower	SN/QF	Rainbow Trout	0-2	20	604.3	93	8.4	22	346	6.9	7.7
	South Yuba River – Lower	SN/QF	Sacramento Pikeminnow	0-2	82	986	93	8.4	88	1,420	11.2	12.6
	South Yuba River – Lower	SN/QF	Sacramento Sucker	0-2	2	33.8	93	8.4	2	35	0.4	0.4

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Table 7. (continued)

Stream	Site	Method[c]	Species Code	Ecozone[a]	Estimated Population	Estimated Weight (g)	Site Length (m)	Avg Site Width (m)	Fish/100 meters	Fish/mile	lbs/acre	kg/ha
Bear River	Bear River Reach #2 – Upper	EF	Rainbow Trout	4+	1	94.5	85.6	6.1	1	19	1.6	1.8
	Bear River Reach #2 – Upper	EF	Brown Trout	4+	172	3,864.2	85.6	6.1	201	3,232	65.8	73.8
	Bear River Reach #2 – Middle	EF	Rainbow Trout	4+	58	1,423.5	50	8.7	116	1,867	29.2	32.8
	Bear River Reach #2 – Middle	EF	Brown Trout	4+	16	870.4	50	8.7	32	515	17.9	20
	Bear River Reach #2 – Lower	EF	Rainbow Trout	2-4	70	1,529.0	79.2	6.4	88	1,422	26.8	30.1
	Bear River Reach #2 – Lower	EF	Brown Trout	2-4	16	780.2	79.2	6.4	20	325	13.7	15.4
	Drum Afterbay Dam Reach – Upper	EF	Brown Trout	2-4	1	310	73.8	7.9	1	22	4.7	5.3
	Drum Afterbay Dam Reach – Upper	EF/SN	Rainbow Trout	2-4	54	983.9	73.8	7.9	73	1,178	15	16.8
	Dutch Flat Afterbay Dam Reach – Upper	EF/SN	Rainbow Trout	2-4	82	1,653.2	178.3	6.5	46	740	12.7	14.2
	Dutch Flat Afterbay Dam Reach – Upper	EF/SN	Speckled Dace	2-4	5	13.8	178.3	6.5	3	45	0.1	0.1
	Dutch Flat Afterbay Dam Reach – Lower	EF	Rainbow Trout	2-4	13	354.2	149	6.9	9	140	3.1	3.4
	Dutch Flat Afterbay Dam Reach – Lower	EF	Speckled Dace	2-4	7	16.7	149	6.9	5	76	0.1	0.2
	Bear River Canal Diversion Dam Reach – Upper	EF	Rainbow Trout	0-2	3	30.2	52.4	22.7	6	92	0.2	0.3
	Bear River Canal Diversion Dam Reach – Upper	EF	Brown Trout	0-2	35	132.9	52.4	22.7	67	1,074	1	1.1
	Bear River Canal Diversion Dam Reach – Upper	EF	Sacramento Pikeminnow	0-2	5	47.6	52.4	22.7	10	153	0.4	0.4
	Bear River Canal Diversion Dam Reach – Upper	EF	Sacramento Sucker	0-2	12	103.5	52.4	22.7	23	368	0.8	0.9
	Bear River Canal Diversion Dam Reach – Lower	SN/QF	Rainbow Trout	0-2	6	513.2	127.9	12.5	5	76	3	3.2
	Bear River Canal Diversion Dam Reach – Lower	SN/QF	Brown Trout	0-2	2	342.5	127.9	12.5	2	25	1.9	2.1
	Bear River Canal Diversion Dam Reach – Lower	SN/QF	Sacramento Pikeminnow	0-2	1	2.7	127.9	12.5	1	13	0	0
	Bear River Canal Diversion Dam Reach – Lower	SN/QF	Sacramento Sucker	0-2	2	0.6	127.9	12.5	2	25	0	0

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Table 7. (continued)

Stream	Site	Method[c]	Species Code	Ecozone[a]	Estimated Population	Estimated Weight (g)	Site Length (m)	Avg Site Width (m)	Fish/100 meters	Fish/mile	lbs/acre	kg/ha
North Fork North Fork American River	Lake Valley Reservoir Dam Reach	EF	Rainbow Trout	4+	41	938.4	115.8	7.1	35	570	10.2	11.5
	Lake Valley Reservoir Dam Reach	EF	Brown Trout	4+	57	1,599.0	115.8	7.1	49	792	17.4	19.5
	Lake Valley Canal Diversion Dam Reach – Upper	EF	Rainbow Trout	4+	16	384.4	68.9	8.5	23	374	5.9	6.6
	Lake Valley Canal Diversion Dam Reach – Upper	EF	Brown Trout	4+	65	2,373.2	68.9	8.5	94	1,519	36.3	40.6
	Lake Valley Canal Diversion Dam Reach – Lower	EF/SN	Rainbow Trout	4+	65	1,586.5	97.9	6	66	1,068	24	26.9
	Lake Valley Canal Diversion Dam Reach – Lower	EF/SN	Brown Trout	4+	16	272.9	97.9	6	16	263	4.1	4.6
North Yuba River (Reference reach)	North Yuba River – Upper	EF	Rainbow Trout	4+	198	4,719.1	76.5	9.9	259	4,165	55.8	62.5
	North Yuba River – Upper	EF	Brown Trout	4+	1	27.2	76.5	9.9	1	21	0.3	0.4
	North Yuba River – Middle	EF	Rainbow Trout	4+	235	4,332.4	63.1	7.1	372	5,994	86.1	96.5
	North Yuba River – Middle	EF	Brown Trout	4+	9	2,002.2	63.1	7.1	14	230	39.8	44.6
	North Yuba River – Lower	SN/QF	Rainbow Trout	2-4	193	3,689.2	183.2	24.9	105	1,696	7.2	8.1
	North Yuba River – Lower	SN/QF	Sacramento Sucker	2-4	4	58.7	183.2	24.9	2	35	0.1	0.1
	North Yuba River – Lower	SN/QF	Sacramento Pikeminnow	2-4	269	111.8	183.2	24.9	147	2,363	0.2	0.2

[a] 0-2= 0-2,000 ft msl (foothill); 2-4= 2,000-4,000 ft msl (montane); 4+=4,000+ ft msl (montane/sub-alpine)
[b] Estimated Population is for each site
[c] EF=Quantitative electrofishing; SN/QF=A combination of quantitative snorkeling and supplemental electrofishing; EF/SN=A combination of quantitative electrofishing and supplemental snorkeling

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Table 8. Estimates of combined total trout abundance and biomass for Level II fish population monitoring sites, July–August 2008.

Site	Method	Ecozone	Sum of kg/ha	Sum of Estimated Population	Sum of lbs/acre	Sum of Fish/mile	Sum of Fish/100 meters	Sum of Avg Site Width (m)	Sum of Estimated Weight (g)
Jackson Meadows Dam Reach	EF+SN	4+	18.8	122	16.8	1442	89	29	3716.3
Milton Diversion Dam Reach – Upper Site	EF+SN	4+	180.6	115	161.2	3043	189	9.2	5058.8
Milton Diversion Dam Reach – Middle Site	EF+SN	2-4	17.8	109	15.9	2317	144	13.6	1828.2
Milton Diversion Dam Reach – Lower	SN/QF	0-2	2.4	33	2.1	375	23	10.5	357.3
Bowman Spaulding Diversion Dam Reach – Upper	EF	4+	51.3	181	45.8	3113	194	13.8	3309.4
Bowman Spaulding Diversion Dam Reach – Lower	EF+SN	2-4	35.9	202	32	2568	160	7.2	3280.4
Fordyce Lake Dam Reach – Upper	EF+SN	4+	6.8	27	6.1	340	21	23.4	1024.1
Fordyce Lake Dam Reach – Middle	EF+SN	4+	9.5	46	8.5	577	36	28.4	1725.9
Fordyce Lake Dam Reach – Lower	EF+SN	4+	6.2	79	5.5	712	45	31.6	1742.5
South Yuba River – Upper	EF+SN	4+	20.9	137	18.6	1347	84	12.3	4193.2
South Yuba River – Middle	EF+SN	2-4	27.2	163	24.3	2212	137	13.7	4410.2
South Yuba River – Lower	SN/QF	0-2	7.7	20	6.9	346	22	8.4	604.3
Bear River Reach #2 – Upper	EF	4+	75.6	173	67.4	3251	202	6.1	3958.7
Bear River Reach #2 – Middle	EF	4+	52.8	74	47.1	2382	148	17.4	2293.9
Bear River Reach #2 – Lower	EF	2-4	45.5	86	40.5	1747	108	12.8	2309.2
Drum Afterbay Dam Reach – Upper	EF	2-4	5.3	1	4.7	22	1	7.9	310
	EF+SN	2-4	16.8	54	15	1178	73	7.9	983.9
Dutch Flat Afterbay Dam Reach – Upper	EF+SN	2-4	14.2	82	12.7	740	46	6.5	1653.2
Dutch Flat Afterbay Dam Reach – Lower	EF	2-4	3.4	13	3.1	140	9	6.9	354.2
Bear River Canal Diversion Dam Reach – Lower	SN/QF	0	5.3	8	4.9	101	7	25	855.7
Bear River Canal Diversion Dam Reach – Upper	EF	0-2	1.4	38	1.2	1166	73	22.7	163.1
Lake Valley Reservoir Dam Reach	EF	4+	31	98	27.6	1362	84	14.2	2537.4
Lake Valley Canal Diversion Dam Reach – Upper	EF	4+	47.2	81	42.2	1893	117	17	2757.6
Lake Valley Canal Diversion Dam Reach – Lower	EF+SN	4+	31.5	81	28.1	1331	82	12	1859.4
North Yuba River – Upper	EF	4+	62.9	199	56.1	4186	260	19.8	4746.3
North Yuba River – Middle	EF	4+	141.1	244	125.9	6224	386	14.2	6334.6
North Yuba River – Lower	SN/QF	2-4	8.1	193	7.2	1696	105	24.9	3689.2

[a] 0-2= 0-2,000 ft msl (foothill); 2-4= 2,000-4,000 ft msl (montane); 4+=4,000+ ft msl (montane/sub-alpine)
[c] EF=Quantitative electrofishing; SN/QF=A combination of quantitative snorkeling and supplemental electrofishing; EF/SN=A combination of quantitative electrofishing and supplemental snorkeling

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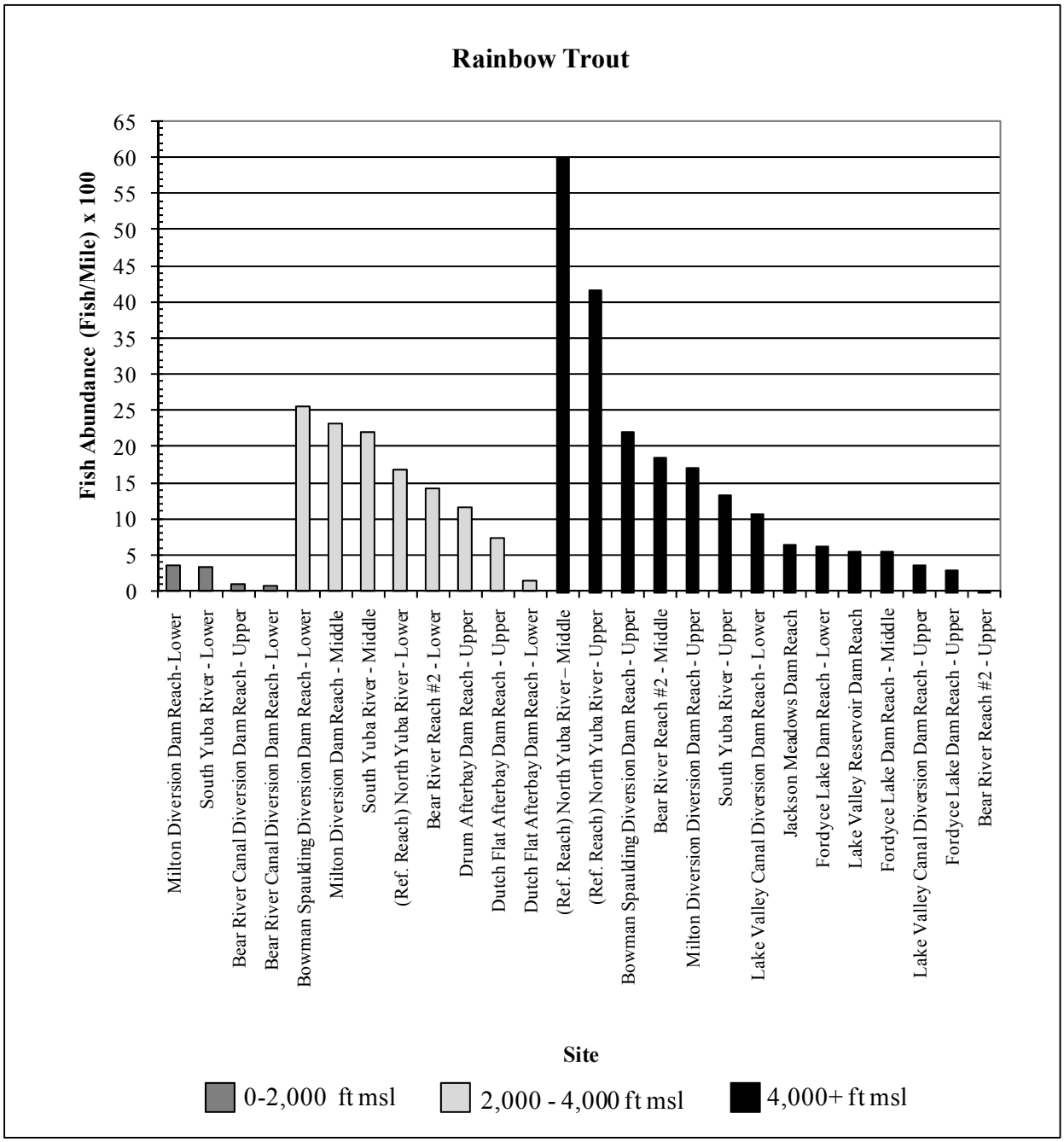

Figure 6. Estimated fish abundance (fish/mile) of rainbow trout at Level II fish population monitoring sites, July–August 2008.

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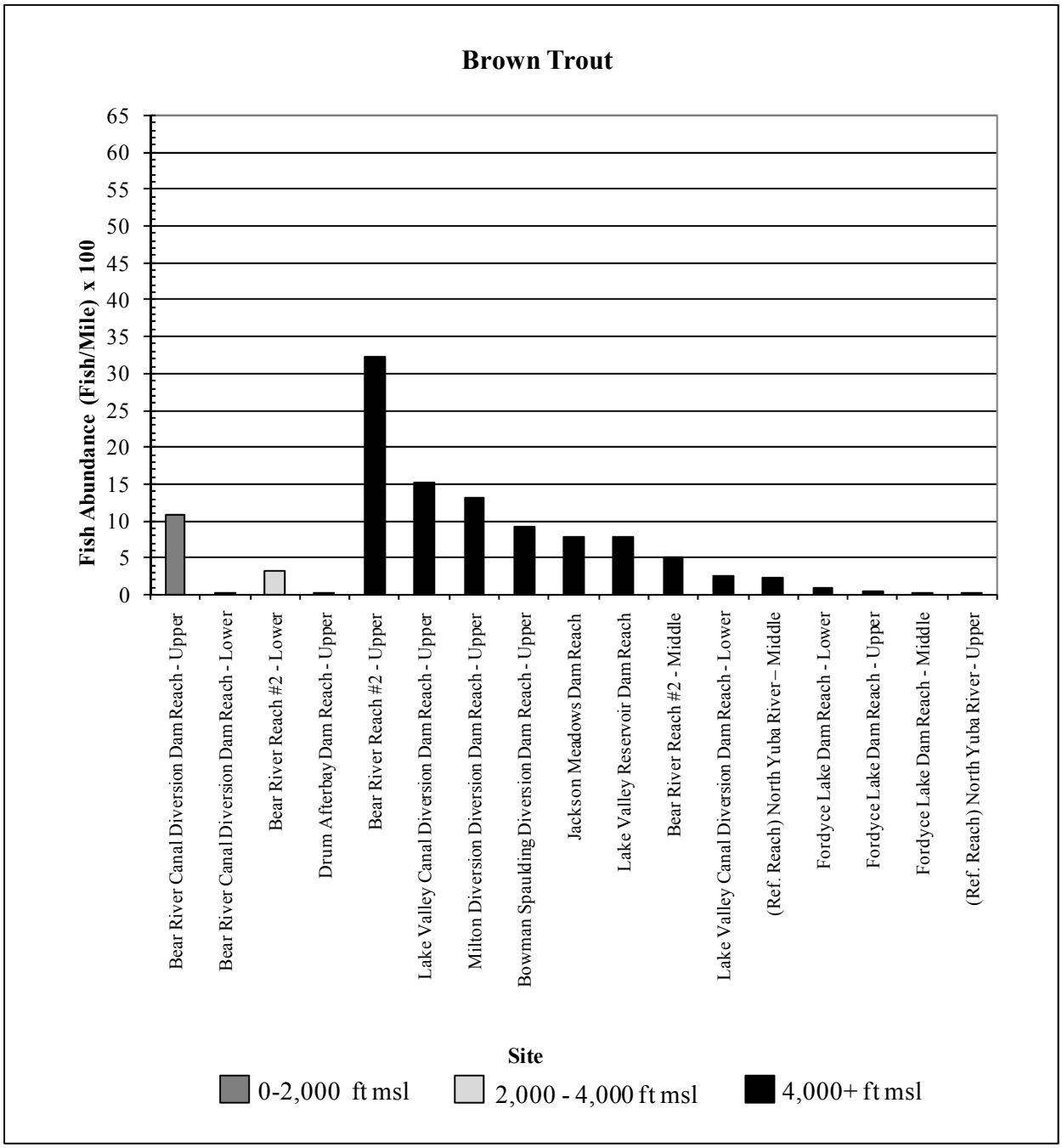

Figure 7. Estimated fish abundance (fish/mile) of brown trout at Level II fish population monitoring sites, July–August 2008.

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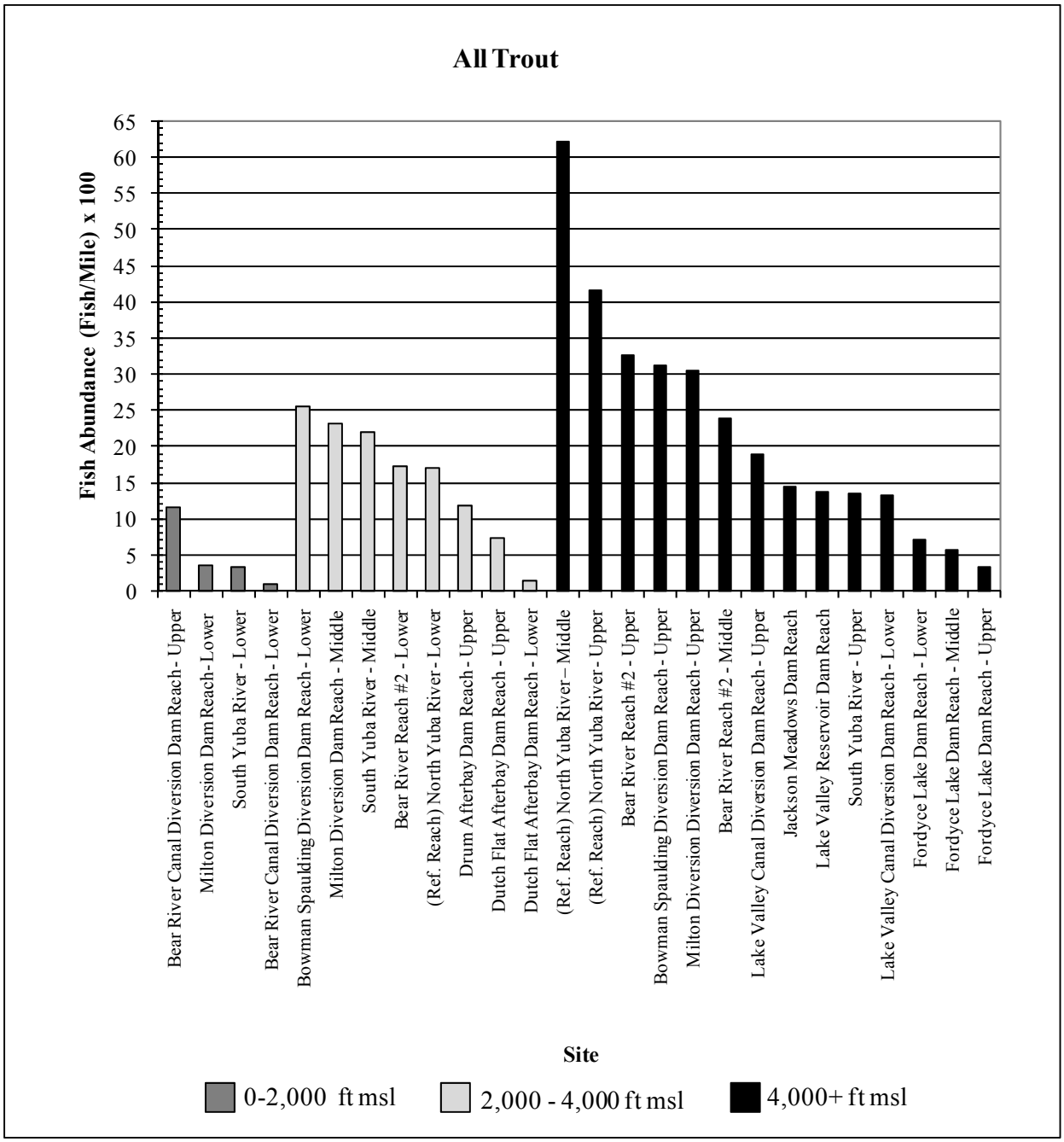

Figure 8. Estimated fish abundance (fish/mile) of all trout at Level II fish population monitoring sites, July–August 2008.

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Table 9. Comparison of minimum, maximum, and mean estimated fish abundances (fish/mile) for Level II fish population monitoring by ecozone, July–August 2008.

	Brown Trout			Rainbow Trout			All Trout		
	0-2,000 ft (foothill)	2,000-4,000 ft (montane)	4,000+ ft (montane/ sub-alpine)	0-2,000 ft (foothill)	2,000-4,000 ft (montane)	4,000+ ft (montane/ sub-alpine)	0-2,000 ft (foothill)	2,000-4,000 ft (montane)	4,000+ ft (montane/ sub-alpine)
N	4	2	13	4	8	14	4	8	14
min	25	22	21	76	140	19	101	162	40
max	1,074	325	3,232	375	2,568	5,994	1449	2893	9226
mean	550	173	750	222	1,534	1,532	772	1707	2282

[a] N=The number of sites in each ecozone sampled where the respective species were captured.

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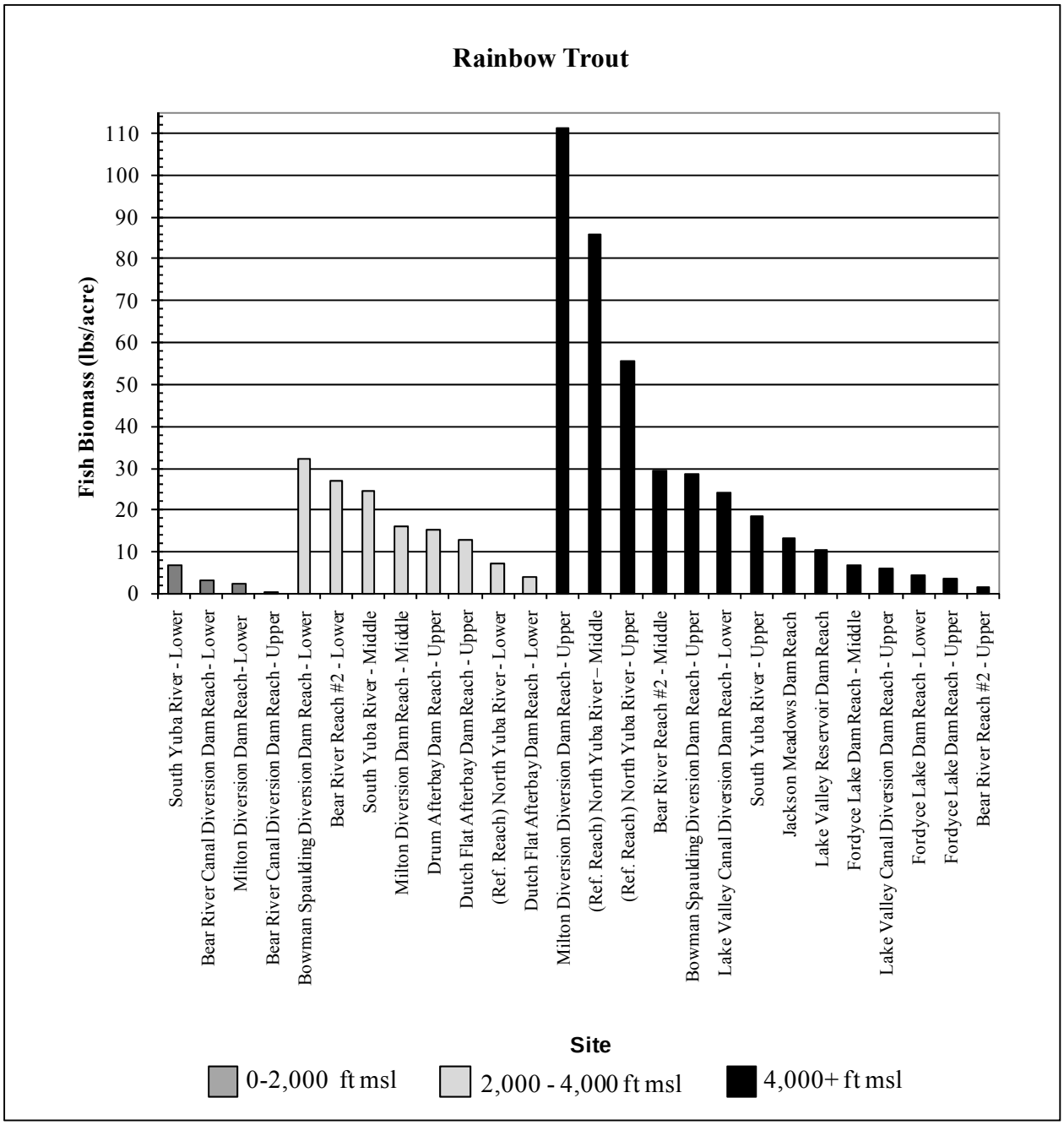

Figure 9. Estimated fish biomass (lbs/acre) of rainbow trout at Level II fish population monitoring sites, July–August 2008.

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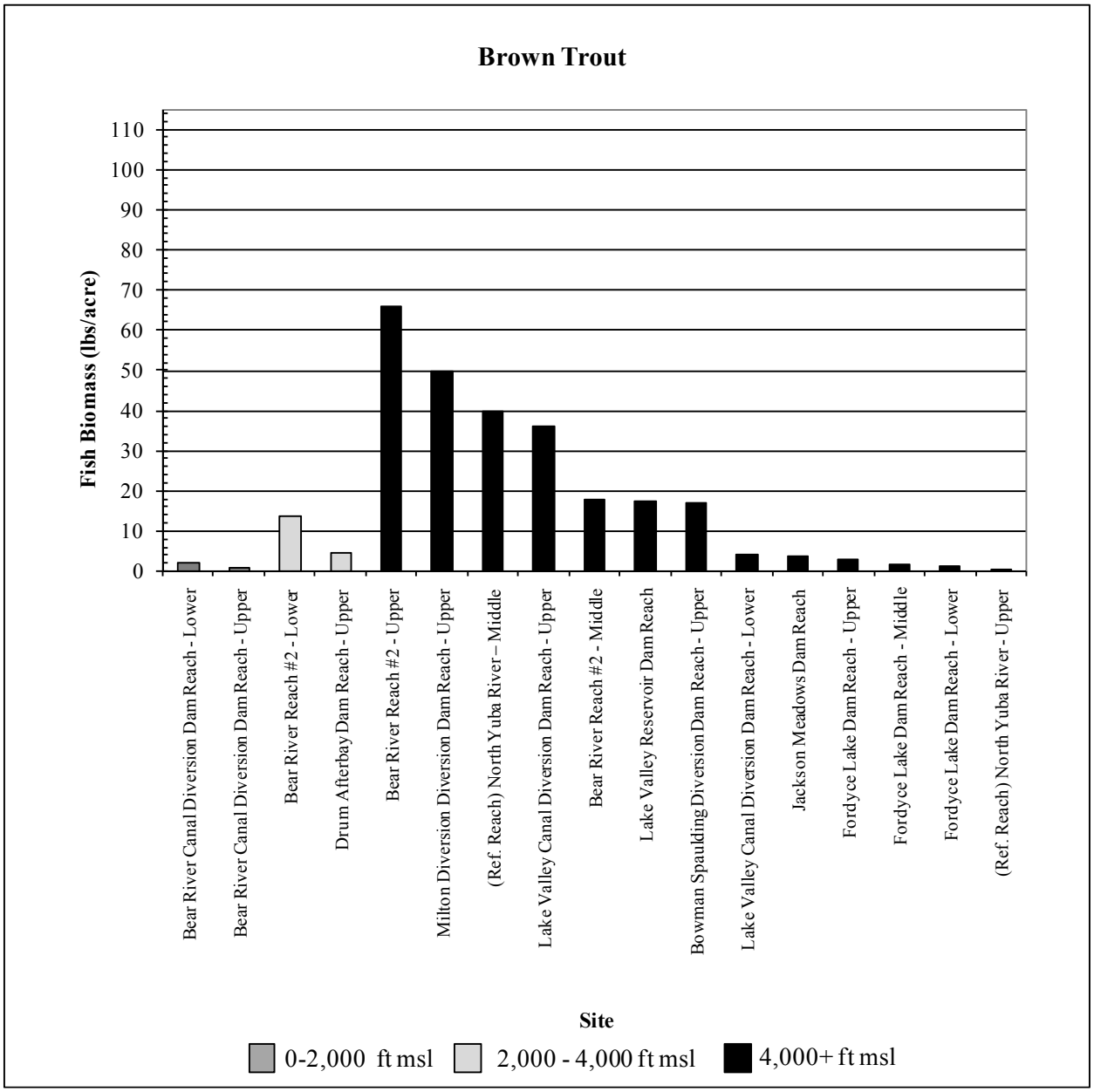

Figure 10. Estimated fish biomass (lbs/acre) of brown trout at Level II fish population monitoring sites, July–August 2008.

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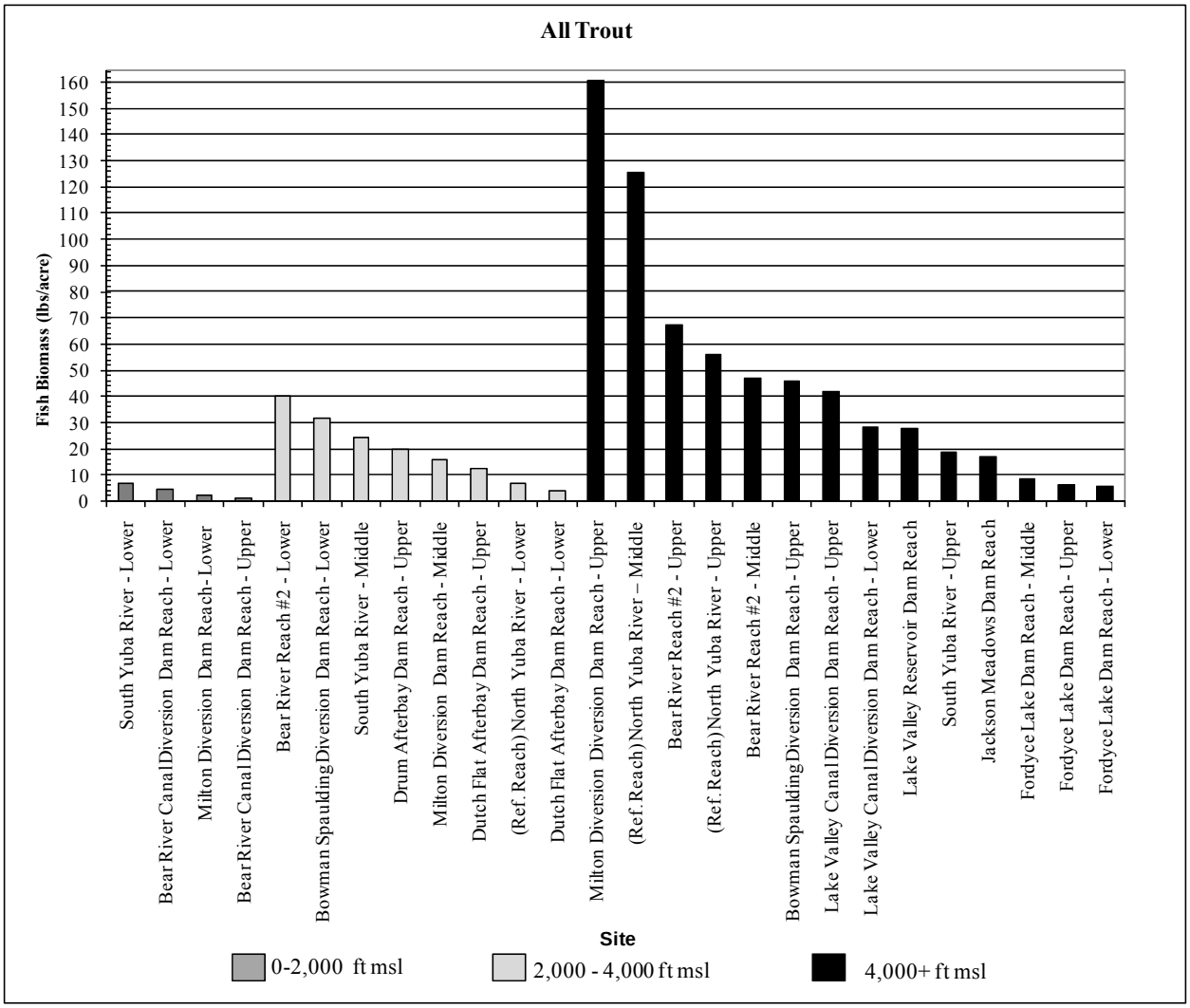

Figure 11. Estimated fish biomass (lbs/acre) of rainbow and brown trout at Level II fish population monitoring sites, July–August 2008.

Table 10. Comparison of minimum, maximum, and mean estimated fish biomass (pounds/acre) for Level II fish population monitoring by ecozone, July–August 2008.

	Brown Trout			Rainbow Trout			All Trout		
	0-2,000 ft (foothill)	2,000-4,000 ft (montane)	4,000+ ft (montane/ sub-alpine)	0-2,000 ft (foothill)	2,000-4,000 ft (montane)	4,000+ ft (montane/ sub-alpine)	0-2,000 ft (foothill)	2,000-4,000 ft (montane)	4,000+ ft (montane/ sub-alpine)
N [a]	2	2	13	4	8	14	4	8	14
min	1.0	4.7	0.3	0.2	4.7	0.3	1.2	4.7	0.3
max	1.9	13.7	65.8	6.9	13.7	65.8	6.9	13.7	65.8
mean	1.5	9.2	19.8	3.1	9.2	19.8	3.8	9.2	19.8

[a] N=The number of sites in each ecozone sampled where the respective species were captured.

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Table 11. Summary of fish population statistics for all fish combined by stream reach, July-August 2008.

Reach	Total No. of Fish	Total Weight (g)	Fish/ 100m	Weight (g)/100m	Fish/ mile	lbs/ acre	kg/ha
Jackson Meadows Dam Reach	123	3,719.9	90	2,733.3	1,454	16.8	18.8
Milton Diversion Dam Reach - Upper	115	5,058.8	189	8,319.4	3,044	161.2	180.6
Milton Diversion Dam Reach - Middle	119	1,941.6	157	2,564.4	2,529	16.9	18.9
Milton Diversion Dam Reach - Lower	67	478.0	47	337.3	761	2.9	3.2
Bowman-Spaulding Diversion Dam Reach - Upper	53	1,234.8	57	1,319.6	912	17.1	19.1
Bowman-Spaulding Diversion Dam Reach - Lower	160	2,536.7	126	2,003.5	2,034	24.7	27.7
Fordyce Lake Dam Reach - Upper	29	1,030.8	23	807.1	365	6.1	6.9
Fordyce Lake Dam Reach - Middle	46	1,725.9	36	1,345.0	577	8.4	9.5
Fordyce Lake Dam Reach - Lower	79	1,742.5	44	975.6	712	5.5	6.2
South Yuba below Spaulding Dam Reach- Upper	137	4,193.2	84	2,561.9	1,347	18.6	20.9
South Yuba below Spaulding Dam Reach- Middle	168	4,652.4	142	3,923.9	2,280	25.6	28.7
South Yuba below Spaulding Dam Reach- Lower	104	1,624.1	112	1,747.0	1,800	18.5	20.8
Bear River Reach #2 - Upper	173	3,958.7	202	4,622.0	3,251	67.4	75.6
Bear River Reach #2 - Middle	74	2,225.0	148	4,588.9	2,382	47.1	52.8
Bear River Reach #2 - Lower	86	2,309.2	109	2,913.9	1,746	40.5	45.4
Drum Afterbay Dam Reach - Upper	55	1,293.9	75	1,754.2	1,200	19.8	22.1
Dutch Flat Afterbay Dam Reach - Upper	87	1,667.0	49	936.4	794	12.8	14.3
Dutch Flat Afterbay Dam Reach - Lower	20	467.9	13	313.9	216	4	4.5
Bear River Canal Diversion Dam Reach - Upper	55	314.2	105	599.3	1,688	2.4	2.6
Bear River Canal Diversion Dam Reach - Lower	11	859.0	9	671.8	138	5	5.4
Lake Valley Reservoir Dam Reach	98	2,537.4	85	2,190.7	1,362	27.6	31
Lake Valley Canal Diversion Dam Reach - Upper	81	2,757.6	118	4,003.2	1,892	42.1	47.2
Lake Valley Canal Diversion Dam Reach - Lower	81	1,859.4	83	1,899.3	1,332	28.1	31.5
North Yuba River - Upper	199	4,746.3	260	6,203.9	4,186	56.1	62.9
North Yuba River - Middle	244	6,334.6	387	10,040.0	6,224	125.9	141.1
North Yuba River - Lower	466	3,859.7	254	2,107.0	4,094	7.6	8.5

Level I Qualitative Results

The following section describes a summary of results for all qualitative sampling occurring within the projects.

Methods, Physical Habitat, and Water Quality Data at Level I Sites

Sample methods, number of spot checks, physical measurements, and water quality data are presented in Table 12 below for each Level I monitoring site. A total of 1,965 spots were sampled in 44 surveyed reaches (see Figure 1). One additional reach below the Towle Canal Diversion Dam Reach was added and the Wise Powerhouse Overflow Reach was not sampled due to permitting requirements (see Section 6 for a detailed description of variances). The reach below the Towle Canal Diversion Dam Reach was added as a result of a decision made by the field lead that identified beneficial habitat in the reach while in the field and saw the opportunity

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to provide additional important data. The following five reaches were dry when accessed: Trap Creek Diversion Dam Reach, Upper Lindsey Lake Diversion Dam Reach, Texas Creek Diversion Dam Reach, Wilson Creek Diversion Dam Reach, and Rucker Creek Diversion Dam Reach. Map documentation for each of the sampled reaches is presented in Attachment 3-1F. Photo documentation for sampled stream reaches is presented in Attachment 3-1G.

Sampling within several of the Level I reaches posed challenges. Many of the small streams were heavily encroached by brush, limiting access to the wetted channel (see images in Attachment 3-1G). Small high gradient and boulder dominated reaches offered only small separate pools to sample, limiting available habitat. As a result, some reaches had a reduced number of available spot habitat. Further, smaller streams and low amounts of available habitat reduced the electrofishing time used in CPUE calculations. For example, in Sawmill Lake Dam Reach, Faucherie Lake Dam Reach, and Peak Lake Dam Reach, high flows in the moderately small channel limited the efficiency of the electrofisher and precluded effective snorkeling. Field surveyors sought out the desired habitat spots for each reach, but were not always able to meet desired numbers due to these issues. In all cases, effort was made to seek out all reasonably accessible and safe access areas to collectively document and characterize available habitat within a stream reach.

Species Composition and Relative Abundance

A total of 886 fish from seven families were captured in qualitative electrofishing and 416 fish from snorkeling surveys in 2008. Of the 15 total species captured between Level II and Level I sampling, 14 species were represented by Level I collection efforts. The 14 species captured or observed during Level I surveys in 2008 are listed in Table 13. During 2008, the species composition and relative abundance (Table 13; Figure 12) of the fish community in the project area(s), was numerically dominated by salmonids (n=754, 58.2%; Table 13). Rainbow trout was the most dominant species (n=438, 33.6%) within all salmonids and for all species collected and observed. Brook trout was the least common salmonid (n=65, 5%) and only found in Sterling and White Rock Lake Dam Reaches. The next most numerically abundant family was cyprinidae (36.4%). Sacramento pikeminnow were the most abundant cyprinid (n=403, 31%). The majority of Sacramento pikeminnow (n=381 or 94.5%) were observed in the lower South Yuba River, proximally above Purdon's Crossing (lowest sampled site on the South Yuba River at RM 4). The Catostomidae represented the third most dominant family (n=43, 3.3%) and was composed of one species, Sacramento Sucker. The remaining four families composed fewer than 3% of the total collected or observed species and were represented by: centrarchidae (n=15, 1.2%), cottidae (n=7, .5%), ictaluridae (n=5, .4%), and poeciliidae (n=4, .3%).

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Table 12. Summary of sampling method, physical habitat, and water quality data for Level I fish population monitoring sites, September to October 2008.

Stream	Location	Sample Information		Sample Area Characteristics					
		Method	# of Spots	Site Length (m)	Avg Width[a] (m)	Avg Depth[a] (m)	DO[a] (mg/l)	Conductivity (µS)[a]	Water Temp.[a] (°C)
Middle Yuba River	Jackson Meadows Dam Reach	E-Fish	62	100	6.7	0.46	23.6	10.3	7.1
Wilson Creek	Wilson Creek Diversion Dam Reach	Reach was dry							
South Fork Deer Creek	Deer Creek Powerhouse Reach	E-Fish	25	59	17.4	0.3	8.7	26.2	15.2
Jackson Creek	Jackson Lake Dam Reach	E-Fish	89	269	.9 - 1.8	.09 - 1.31	7.9 - 9.0	11.7 - 26.4	10.5 - 13.1
Canyon Creek	French Lake Dam Reach	E-Fish	67	177	7.2	0.24	8.8	5.2	9.2
	Faucherie Lake Dam Reach	E-Fish	45	204	14.9	0.76	8.5	5.1	11.2
	Sawmill Lake Dam Reach	E-Fish	20	192	14.3	0.91	7.7	6.4	12.7
		Snorkel	N/A	192	14.3	0.91	7.7	N/A	12.7
Texas Creek	Upper Rock Lake Dam Reach	E-Fish	25	252	1.5	0.09	7.1	6.6	15.8
	Lower Rock Lake Dam Reach	E-Fish	77	107	.9 - 6.7	.24 - .27	8.7 - 9.0	88.5 - 98.5	11.5 - 11.6
	Texas Creek Diversion Dam Reach	Reach was dry							
Unnamed Tributary	Culbertson Lake Dam Reach	E-Fish	28	189	3	0.06	6.8	38.3	18
Lindsey Creek	Upper Lindsey Lake Dam Reach	Reach was dry							
	Middle Lindsey Lake Dam Reach	E-Fish	20	313	1.8	0.09	7.8	101.6	13.8
	Lower Lindsey Lake Dam Reach	E-Fish	20	130	3.7	0.3	7.6	69.1	13.9
Clear Creek	Clear Creek Diversion Dam Reach	E-Fish	55	195	3	0.24	7.6	29.4	12.5
Lake Creek	Feeley Lake Dam Reach	E-Fish	15	63	0.9	0.09	6.5	34.4	18
	Carr Lake Dam Reach #1	E-Fish	35	113	3	0.18	7.6	38.7	14.9
Fall Creek	Carr Lake Dam Reach #2	E-Fish	65	231	5.5	0.18	8.4	40.9	13.1
	Fall Creek Diversion Dam Reach	E-Fish	40	259	2.1	0.3	8.2	43.7	15.4
Trap Creek	Trap Creek Diversion Dam Reach	Reach was dry							
Rucker Creek	Blue Lake Dam Reach	E-Fish	30	158	1.8	0.18	7	13	19.6
	Rucker Lake Dam Reach	E-Fish	53	114	3	0.18	6.7	20.2	20.2
	Rucker Creek Diversion Dam Reach	Reach was dry							
Unnamed Tributary	Fuller Lake Dam Reach	E-Fish	50	280	4.6	0.09	7.8	36.3	14.5
Unnamed Tributary	Meadow Lake Dam Reach	E-Fish	54	190	5.5	0.18	7.4	16	13.8
White Rock Creek	White Rock Lake Dam Reach	E-Fish	65	114	1.5	0.3	7.7	10.5	10.2
Bloody Creek	Lake Sterling Dam Reach	E-Fish	20	73	3.7	0.2	7.3	14.9	16.7
Tributary to South Yuba River	Kidd Lake Dam Reach	E-Fish	20	91	1.2	0.03	3.8	11	19.4
Cascade Creek	Lower Peak Lake Dam Reach	E-Fish	75	283	3.7	0.46	7.2	6	16.9

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Table 12. (continued)

Stream	Location	Sample Information		Sample Area Characteristics					
		Method	# of Spots	Site Length (m)	Avg Width[a] (m)	Avg Depth[a] (m)	DO[a] (mg/l)	Conductivity (µS)[a]	Water Temp.[a] (°C)
South Yuba River	Upper South Yuba #1	E-Fish	55	229	6.1	0.3	7.2	65	12.9
	Upper South Yuba #2	E-Fish	130	418	9.1-47.3	.30 - .61	7.0 - 9.7	15.8 - 32.5	7.7 - 17.3
	South Yuba River (Spaulding to Englebright)	E-Fish	35	91	6.1	0.24	9.3	35	9.9
		Snorkel	N/A	373	15.2	1.07	9.3	N/A	20.1
Bear River	Bear River Reach #1	E-Fish	50	114	5.2	0.37	9.2	95.2	15.2
	Chicago Park Powerhouse Reach	E-Fish	55	232	7.6	0.61	8.3	55.8	15.7
	Bear River Canal Diversion Dam Reach	E-Fish	65	148	18.3	0.46	9.1	31.8	17.7
Little Bear River	Alta Powerhouse Reach	E-Fish	50	194	2.1 - 2.4	.06 - .15	7.0 - 9.9	29.6 - 34.5	10.2 - 16.4
NF of NF American River	Lake Valley Canal Diversion Dam Reach	E-Fish	120	377	7.6	0.46	9.4	71.3	14.6
Sixmile Creek	Kelly Lake Dam Reach	E-Fish	35	264	1.5	0.09	7.5	30.1	18.1
Canyon Creek (NF American Tributary)	Canyon Creek above Towle Diversion Dam	E-Fish	26	76	1.2	0.12	7.7	125.9	13.2
	Canyon Creek below Towle Diversion Dam[b]	E-Fish	52	131	5.2	0.24	42	55.8	10.2
	Towle Canal Diversion Dam Reach	E-Fish	82	91	3.7	0.09	7.9	25.4	16.5
Mormon Ravine	Mormon Ravine Reach	E-Fish	52	124	53.4	0.3	8.5	83.8	14.5
Rock Creek	Rock Creek Dam Reach	E-Fish	113	358	3.7	.37 - .53	7.6 - 8.3	31.6 - 51.7	16.4 - 19.8
Dry Creek	Halsey Afterbay Dam Reach	E-Fish	15	61	1.5	0.15	0.8	143.8	17.9

[a] Ranges of data address more than one distinct location sampled in a reach.
[b] An added site not required in the study plan.

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Fish abundance by sampled reach is presented in Table 14. On Fall Creek at Carr Lake Dam Reach #2, a total of 82 collected fish represented the greatest number of fish sampled at the highest rate (CPUE = 11.3 fish/minute; Table 14). The next highest catch rate occurred on Canyon Creek below Towle Canal Diversion Dam Reach, an added site not included in the study plan (62 collected, CPUE 10.5 fish/minute; Table 12). A total 13 of the 44 sampled stream reaches did not have any fish collected from them (5 with dry stream channels) and were represented by: Wilson Creek Diversion Dam Reach (dry), Deer Creek Powerhouse Reach, Texas Creek Diversion Dam Reach (dry), Upper Lindsey Lake Dam Reach (dry), Middle Lindsey Lake Dam Reach, Feeley Lake Dam Reach, Trap Creek Diversion Dam Reach (dry), Blue Lake Dam Reach, Rucker Creek Diversion Dam Reach (dry), Meadow Lake Dam Reach, Kidd Lake Dam Reach, Lower Peak Lake Dam Reach, and Halsey Afterbay Dam Reach.

Average fork length for rainbow trout ranged from 65mm on Canyon Creek at Faucherie Lake Dam Reach (n=2; Table 15) to 151 mm on the Middle Yuba River at Jackson Meadows Dam Reach (n=2; Table 15). Brown trout were generally longer than rainbow trout and ranged in fork length from 78mm on the South Yuba River at Upper South Yuba Reach #1 (n=5; Table 15) to 231mm on Canyon Creek at Faucherie Lake Dam Reach (n=2; one fish at 385mm was captured; Table 15). Brook trout were only collected in three reaches and ranged in average fork length from 115mm on Rucker Creek at Rucker Lake Dam Reach (n=60; Table 15) to 141mm on both the Middle Yuba River at Jackson Lake Dam Reach (n=3; Table 15) and Bloody Creek at Lake Sterling Dam Reach (n=2; Table 15).

Table 13. Overall fish species composition at Level I fish population monitoring sites, September to October, 2008.

Family	Common Name	Native (N) Introduced (I)	Captured (Electrofishing)	Observed (Snorkeling)	Composition
Salmonidae	Rainbow Trout	N	432	6	33.6%
	Brown Trout	I	251		19.6%
	Brook Trout	I	65		5.0%
Cyprinidae	Sacramento Pikeminnow	N	22	381	31.0%
	Speckled Dace	N	37		2.80%
	Lahontan Redside	N	23		1.8%
	California Roach	N	7		0.5%
	Unknown Minnow	N/A	4		0.3%
Catostomus	Sacramento Sucker	N	14	29	3.3%
Centrarchidae	Green Sunfish	I	14		1.1%
	Pumpkinseed	I	1		0.1%
Cottidae	Riffle Sculpin	N	7		0.5%
Ictaluridae	Brown Bullhead	I	5		0.4%
Poeciliidae	Mosquitofish	I	4		0.3%
Total			886	416	100%

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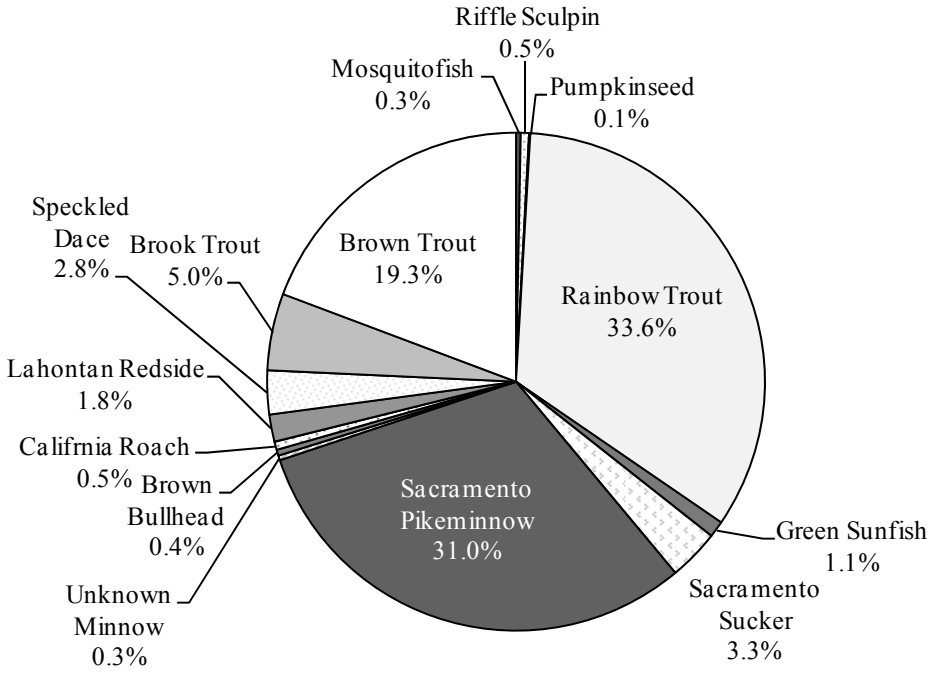

Figure 12. Relative abundance of fish species captured and observed at Level I fish population monitoring sites, September to October, 2008.

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Table 14. Summary of timing, reach characteristics, total catch and rate of catch for fish collected during electrofishing and snorkel surveys at Level I fish population monitoring sites, in September and October, 2008.

Stream	Reach Name	Month Surveyed	Estimated Flow (cfs)	Avg. Elevation (ft.)	Gradient (%)	Common Name														Total	Catch/min.
						Rainbow Trout	Brown Trout	Brook Trout	California Roach	Sacramento Pikeminnow	Lahontan Redside	Speckled Dace	Sacramento Sucker	Riffle Sculpin	Green Sunfish	Pumpkinseed	Brown Bullhead	Unknown Minnow	Mosquitofish		
Middle Yuba River	Jackson Meadows Dam Reach	September	55	5,845	3.6	2	12													14	2
Wilson Creek	Wilson Creek Diversion Dam Reach	September	0	5,665	3.6	Reach was dry															
South Fork Deer Creek	Deer Creek Powerhouse Reach	September	50	3,360	3															0	0
Jackson Creek	Jackson Lake Dam Reach	September	0.5	6,082	6.9	67	7	3												77	8.9
Canyon Creek	French Lake Dam Reach	October	5	6,403	7.3	11														11	0.8
	Faucherie Lake Dam Reach	October	30	5,998	3.3	2	2													4	0.7
	Sawmill Lake Dam Reach [b]	October	30	5,710	6.9	6	4													10	n/a
Texas Creek	Upper Rock Lake Dam Reach	September	0.25	6,666	13	3														3	0.7
	Lower Rock Lake Dam Reach	September	3	5,560	10.6	10	60													70	7.4
Texas Creek	Texas Creek Diversion Dam Reach	September	0	5,020	24.2	Reach was dry															
Unnamed Tributary	Culbertson Lake Dam Reach	September	0.25	6,420	5.3	2														2	0.4
Lindsey Creek	Upper Lindsey Lake Dam Reach	September	0	6,468	11	Reach was dry															
	Middle Lindsey Lake Dam Reach	September	0.5	6,336	12.9															0	0
	Lower Lindsey Lake Dam Reach	September	1	5,940	7.1		39													39	8
Clear Creek	Clear Creek Diversion Dam Reach	September	2	5,280	3.7	21	11													32	2.8
Lake Creek	Feeley Lake Dam Reach	September	0.2	6,694	4.7															0	0
	Carr Lake Dam Reach #1	September	1	6,112	10	35	20													55	10
Fall Creek	Carr Lake Dam Reach #2	September	0.75	5,420	3.2	73	9													82	11.3
	Fall Creek Diversion Dam Reach	September	<1	4,260	20.9	21	6													27	3.6
Trap Creek	Trap Creek Diversion Dam Reach	September	Reach was dry																		

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Table 14. (continued)

Stream	Reach Name	Month Surveyed	Estimated Flow (cfs)	Avg. Elevation (ft.)	Gradient (%)	Common Name														Total	Catch/min.
						Rainbow Trout	Brown Trout	Brook Trout	California Roach	Sacramento Pikeminnow	Lahontan Redside	Speckled Dace	Sacramento Sucker	Riffle Sculpin	Green Sunfish	Pumpkinseed	Brown Bullhead	Unknown Minnow	Mosquitofish		
Rucker Creek	Blue Lake Dam Reach	September	0.5	5,691	9.5																
	Rucker Lake Dam Reach	September	1	5,371	2.8		6								4					10	1
Rucker Creek	Rucker Creek Diversion Dam Reach	September	0	4,480	26.1	Reach was dry															
Unnamed Tributary	Fuller Lake Dam Reach	September	0.2	4,960	14.5	2														2	0.5
Unnamed Tributary	Meadow Lake Dam Reach	September	17	6,845	11.9															0	0
White Rock Creek	White Rock Lake Dam Reach #1	September	<0.5	7,360	6.5	2		60												62	9.3
Bloody Creek	Lake Sterling Dam Reach	September	1	6,695	31.3			2										4		6	0.9
Tributary to South Yuba River	Kidd Lake Dam Reach	September	0.3	6,340	16.6															0	0
Tributary to South Yuba River	Lower Peak Lake Dam Reach	September	15	6,300	9.6															0	0
South Yuba River	Upper South Yuba River #1	September	<0.5	6,056	<1.0		5				6	32	1				5			49	4.1
	Upper South Yuba River #2	September, October	5, 2	5,540	1.6		19				17	5	2							43	1.2
South Yuba River	South Yuba River #1	September	5	4,580	5.9	5	7													12	1.5
	South Yuba River #6[b]	September	30	1,965	N/A	4				384			30							418	n/a
Bear River	Bear River Reach #1	September	2	4,700	13.1	47														47	5.2
Bear River	Chicago Park Powerhouse Reach	September	60	2,200	1.2		1													1	0.1
Bear River	Bear River Canal Diversion Dam Reach	September	100-120	1,780	0.7					22			5							27	3.6
Little Bear River	Alta Powerhouse Reach	September, October	0.25,1	3,140	8.3	6														6	1
Sixmile Creek	Kelly Lake Dam Reach	September	0.2	5,820	4.4	7									10					17	2.8
Canyon Creek	Canyon Creek above Towle Diversion Dam Reach	September	0.1	4,250	3.9	10														10	3.6

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Table 14. (continued)

Stream	Reach Name	Month Surveyed	Estimated Flow (cfs)	Avg. Elevation (ft.)	Gradient (%)	Common Name														Total	Catch/min.
						Rainbow Trout			California Roach	Sacramento Pikeminnow	Lahontan Redside	Speckled Dace	Sacramento Sucker	Riffle Sculpin	Green Sunfish	Pumpkinseed	Brown Bullhead	Unknown Minnow	Mosquitofish		
Canyon Creek (cont.)	Canyon Creek below Towle Canal Diversion Dam Reach[a]	October	2	3,840	3.7	60	2													62	10.5
	Towle Canal Diversion Dam Reach	September	1	3,840	3.7		41													41	6.4
Mormon Ravine	Mormon Ravine Reach	October	<1	520	6.7	26								7						33	6.8
Rock Creek	Rock Creek Dam Reach	September, October	50, 1	1,310	2.4	4										1			4	9	1.2
Dry Creek	Halsey Afterbay Dam Reach	September	0.5	1,450	1.6															0	0

[a] An added site not required in the study plan
[b] Reach was snorkeled and electrofished

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Table 15. Summary of fish composition, length, catch by reach for Level I fish population sampling in September and October, 2008.

Stream	Location	Species	Length (mm)			By Species			By Reach	
			Average	Min	Max	Count	% Comp.	Catch/Min	Count	Catch/Min
Middle Yuba River	Jackson Meadows Dam Reach	Brown Trout	91	42	156	12	86%	1.7	14	2
		Rainbow Trout	151	142	160	2	14%	0.3		
Wilson Creek	Wilson Creek Diversion Dam Reach	Reach was dry								
South Fork Deer Creek	Deer Creek Powerhouse Reach	None Collected[a]	0	0	0	0	0%	0	0	0
Jackson Creek	Jackson Lake Dam Reach	Brook Trout	141	112	161	3	4%	0.3	77	8.9
		Brown Trout	115	50	153	7	9%	0.8		
		Rainbow Trout	70	36	205	67	87%	7.8		
Canyon Creek	French Lake Dam Reach	Rainbow Trout	108	58	190	11	100%	0.8	11	0.8
	Faucherie Lake Dam Reach	Brown Trout	231	76	385	2	50%	0.3	4	0.7
		Rainbow Trout	65	63	67	2	50%	0.3		
	Sawmill Lake Dam Reach[b]	Brown Trout	107	79	138	6	50%	n/a	10	n/a
		Rainbow Trout	49	13	65	4	50%	n/a		
Texas Creek	Upper Rock Lake Dam Reach	Rainbow Trout	73	71	75	3	100%	0.7	3	0.7
	Lower Rock Lake Dam Reach	Brown Trout	99	50	160	60	86%	6.4	70	7.4
		Rainbow Trout	124	80	185	10	14%	1.1		
	Texas Creek Diversion Dam Reach	Reach was dry								
Unnamed Tributary	Culbertson Lake Dam Reach	Rainbow Trout	118	110	125	2	100%	0.4	2	0.4
Lindsey Creek	Upper Lindsey Lake Dam Reach	Reach was dry								
	Middle Lindsey Lake Dam Reach	None Collected[a]	0	0	0	0	0%	0	0	0
	Lower Lindsey Lake Dam Reach	Brown Trout	125	57	226	39	100%	8	39	8
Clear Creek	Clear Creek Diversion Dam Reach	Brown Trout	127	42	204	11	34%	1	32	2.8
		Rainbow Trout	121	84	182	21	66%	1.8		
Lake Creek	Feeley Lake Dam Reach	None Collected[a]	0	0	0	0	0%	0	0	0
	Carr Lake Dam Reach #1	Brown Trout	119	41	211	20	36%	3.6	55	10
		Rainbow Trout	114	42	194	35	64%	6.4		
Fall Creek	Carr Lake Dam Reach #2	Brown Trout	122	63	263	9	11%	1.2	82	11.3
		Rainbow Trout	92	39	180	73	89%	10.1		
	Fall Creek Diversion Dam Reach	Brown Trout	143	115	185	6	22%	0.8	27	3.6
		Rainbow Trout	120	75	183	21	78%	2.8		
Trap Creek	Trap Creek Diversion Dam Reach	Reach was dry								
Rucker Creek	Blue Lake Dam Reach	None Collected[a]	0	0	0	0	0%	0	0	0
	Rucker Lake Dam Reach	Brown Trout	113	71	155	6	60%	0.6	10	1
		Green Sunfish	115	77	146	4	40%	0.4		
	Rucker Creek Diversion Dam Reach	Reach was dry								
Unnamed Tributary	Fuller Lake Dam Reach	Rainbow Trout	137	85	189	2	100%	0.5	2	0.5
Unnamed Tributary	Meadow Lake Dam Reach	None Collected[a]	0	0	0	0	0%	0	0	0

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Table 15. (continued)

Stream	Location	Species	Length (mm)			By Species			By Reach	
			Average	Min	Max	Count	% Comp.	Catch/Min	Count	Catch/Min
White Rock Creek	White Rock Lake Dam Reach	Brook Trout	115	50	169	60	97%	9	62	9.3
		Rainbow Trout	106	85	127	2	3%	0.3		
Bloody Creek	Lake Sterling Dam Reach	Brook Trout	141	135	147	2	33%	0.3	6	0.9
		Unknown Minnow	84	76	98	4	67%	0.6		
Tributary to South Yuba River	Kidd Lake Dam Reach	None Collected[a]	0	0	0	0	0%	0	0	0
Cascade Creek	Lower Peak Lake Dam Reach	None Collected[a]	0	0	0	0	0%	0	0	0
South Yuba River	Upper South Yuba Reach #1	Brown Bullhead	134	111	170	5	10%	0.4	49	4.1
		Brown Trout	132	59	305	5	10%	0.4		
		Lahontan Redside	46	23	72	6	12%	0.5		
		Speckle Dace	50	23	75	32	65%	2.7		
		Sacramento Sucker	72	72	72	1	2%	0.1		
	Upper South Yuba Reach #2	Brown Trout	126	66	312	19	44%	0.5	43	1.2
		Lahontan Redside	69	56	81	17	40%	0.5		
		Speckle Dace	57	30	74	5	12%	0.1		
		Sacramento Sucker	119	76	162	2	5%	0.1		
	South Yuba River#1	Brown Trout	78	39	131	7	58%	0.9	12	1.5
		Rainbow Trout	94	79	113	5	42%	0.6		
	South Yuba River #6[b]	Rainbow Trout	140	127	177	4	1	n/a	n/a	n/a
		Sacramento Pikeminnow	92	25	228	381	92	n/a	n/a	n/a
		Sacramento Sucker	178	127	228	29	7	n/a	n/a	n/a
Bear River	Bear River Reach #1	Rainbow Trout	105	48	164	47	100%	5.2	47	5.2
	Chicago Park Powerhouse Reach	Brown Trout	104	104	104	1	100%	0.1	1	0.1
	Bear River Canal Diversion Dam Reach	Sacramento Pikeminnow	77	42	110	22	81%	2.9	27	3.6
		Sacramento Sucker	87	80	98	5	19%	0.7		
Little Bear River	Alta Powerhouse Reach	Rainbow Trout	99	63	162	6	100%	1	6	1
NF of NF American River	Lake Valley Canal Diversion Dam Reach	California Roach	51	33	67	7	28%	0.6	25	2.2
		Rainbow Trout	94	61	133	12	48%	1		
		Sacramento Sucker	74	36	122	6	24%	0.5		

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Table 15. Summary of fish composition, length, catch by reach for Level I fish population sampling in September and October, 2008 (cont.).

Stream	Location	Species	Length (mm)			By Species			By Reach	
			Average	Min	Max	Count	% Comp.	Catch/Min	Count	Catch/Min
Sixmile Creek	Kelly Lake Dam Reach	Green Sunfish	111	69	132	10	59%	1.6	17	2.8
		Rainbow Trout	90	57	164	7	41%	1.1		
Canyon Creek (NF American Tributary)	Canyon Creek Above Towle Diversion Dam	Rainbow Trout	125	48	198	10	100%	3.6	10	3.6
	Canyon Creek Below Towle Diversion Dam[c]	Brown Trout	165	163	166	2	3%	0.3	62	10.5
		Rainbow Trout	84	51	160	60	97%	10.1		
	Towle Canal Diversion Dam Reach	Brown Trout	116	52	255	41	100%	6.4	41	6.4
Mormon Ravine	Mormon Ravine Reach	Rainbow Trout	127	74	175	26	79%	5.4	33	6.8
		Riffle Sculpin	63	44	105	7	21%	1.4		
Rock Creek	Rock Creek Dam Reach	Mosquitofish	24	17	31	4	44%	0.3	9	0.72
		Rainbow Trout	118	79	212	4	44%	0.3		
		Pumpkinseed	100	100	100	1	11%	0.1		
Dry Creek	Halsey Afterbay Dam Reach	None Collected[a]	0	0	0	0	0%	0	0	0

[a] The stream was not dry, was surveyed with an electrofisher and did not result in any collected fishes.
[b] Reach was snorkeled and electrofished
[c] An added site not required in the study plan

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Tributaries to the Bowman Spaulding Conduit

Interest in stream fish abundance and composition specific to feeder tributaries of the Bowman Spaulding conduit was identified by relicensing participants. These tributaries include Texas Creek, Clear Creek, Fall Creek, Trap Creek, and Rucker Creek (listed from upstream to downstream relative to the canal). The following description addresses Project reaches sampled above and below the conduit within the listed streams.

Texas Creek

There were two reaches on Texas Creek that reside upstream and downstream of the Bowman-Spaulding conduit. These reaches included the lower Rock Lake Dam Reach (upstream) and the Texas Creek Diversion Dam Reach (downstream).

The lower Rock Lake Dam Reach lies above the Bowman-Spaulding conduit on Texas Creek. Two samples were taken within the reach. Lower Rock Lake Dam Reach begins at the confluence of Texas Creek and Lindsey Creek (RM 1.1) and extends 3.6 miles upstream to the base of Lower Rock Lake Dam (RM 4.7). The reach has an average elevation of 6,011 feet and average channel gradient of 4.8%. The first sample location was near Loney Meadows. Here the Licensee sampled 52 spots over 200 feet of stream. At the second location in Texas Creek below Bowman Lake road, the Licensee sampled 25 potential fish habitat spots in 150 feet of stream length starting approximately 0.28 miles upstream of the Lindsey Creek confluence. At Loney Meadows, 56 fish (80%) were collected and 14 fish (20%) were sampled at Bowman Lake Road. Brown and rainbow trout were captured at both locations. Brown trout fork length averaged 99mm (range: 50 to 160mm) and represented 86% of the total catch (CPUE 7.4 fish/minute; Table 14). Brown trout also composed 92% of the Loney Meadows area sample. Rainbow trout fork length averaged 124mm (range: 80 to 185mm; Table 15) and represented 90% of the Bowman Lake Road sample (CPUE 1.1 fish/minute; Table 14).

The Texas Creek Diversion Dam Reach (.6 miles long) is downstream of the Bowman Spaulding conduit. The reach starts at Texas Creek's confluence with Canyon Creek (RM 0.0) and extends to the Bowman-Spaulding Conduit (RM 0.6). The reach has an average elevation of 5,020 feet and a channel gradient of 24.2%. The Licensee was unable to sample potential fish habitat spots along this section of Texas Creek for species composition and size distribution as the accessible areas of the reach were dry.

Clear Creek

Clear Creek Diversion Dam Reach was the only reach sampled within Clear Creek. The Clear Creek Diversion Dam Reach (.9 miles long) lies downstream of the Bowman Spaulding conduit. The reach begins at Clear Creek's confluence with Fall Creek (RM 0.0) and extends upstream to the Bowman-Spaulding Conduit and Clear Creek Diversion Dam (RM 0.9). The primary source of water for the reach below the conduit was leakage coming from the conduit. Clear Creek above the conduit was also accessed and found to be dry.

Clear Creek below the conduit has an average elevation of 5,280 feet and a channel gradient of 3.7%. The Licensee sampled 55 potential fish habitat spots along a 640 foot section of stream starting approximately 0.12 miles downstream of the Bowman-Spaulding Conduit. A total of 32

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fish, representing rainbow (34%) and brown trout (66%) were collected at 2.8 fish/minute (Table 14). Brown trout fork length averaged 127mm (range: 42 – 204mm; Table 15) and rainbow trout averaged 121 (range: 84 – 182mm; Table 15).

Fall Creek

There were two reaches on Fall Creek that reside upstream and downstream of the conduit. These reaches included the Carr Lake Dam Reach #2 (upstream) and the Fall Creek Diversion Dam Reach (downstream).

Carr Lake Dam Reach #2 is approximately 1.3 miles long and extends from the Bowman–Spaulding conduit (RM 2.0) to the confluence with Lake Creek (RM 3.3). The reach has an average elevation of 5,420 feet and a channel gradient of 3.2%. The Licensee sampled 65 potential fish habitat spots along a 757 foot section of stream, starting approximately 0.2 miles downstream of Bowman Lake Road. The majority of the collected fish were rainbow trout (89%) with an average length of 91.5mm (range: 39mm to 189mm; Table 15). Brown trout (11%) made up the remainder of the sample with an average length of 122mm (range: 63mm to 263mm; Table 15). There was one large brown trout (263mm), which skewed the average length. Removal of the outlier individual brown trout adjusts the average to 104mm. The total CPUE for the reach was 11.3 fish/minute with rainbow trout representing the highest collection rate (10.1 fish/minute; Table 14).

The Fall Creek Diversion Dam Reach (2 miles long) extends from Fall Creek's confluence with the South Yuba River (RM 0.0, elevation 3,200 ft.) to the Bowman-Spaulding Conduit (RM 2.0, elevation 5,320 ft.). The reach has an average elevation of 4,260 feet and a channel gradient of 20.9%. The Licensee sampled 40 potential fish habitat spots along an 850 foot section of stream starting approximately 1.72 miles upstream of the South Yuba River confluence. A total of 27 fish representing rainbow trout (22%) and brown trout (78%) were captured. CPUE for the reach was 3.6 fish/minute (Table 14) with brown trout providing the highest rate by species of 2.8 fish/minute. The average fork length of the rainbow trout was 120mm (range: 75mm to 183mm; Table 15), while the brown trout averaged 143mm (range: 115mm to 185mm; Table 15).

Trap Creek

Trap Creek Diversion Dam Reach was the only reach sampled within Trap Creek. The Trap Creek Diversion Dam Reach (1.2 miles long) lies below the Bowman-Spaulding conduit and extends from Trap Creek's confluence with Fall Creek (RM 0.0) to the Bowman-Spaulding conduit (RM 1.2). The reach has an average elevation of 4,480 feet and a channel gradient of 27.6%. The Licensee was unable to sample potential fish habitat spots along this section of Trap Creek for species composition and size distribution as the entire reach was dry. Trap Creek upstream of the conduit was accessed and also found to be dry.

Rucker Creek

There were two reaches on Rucker Creek that reside upstream and downstream of the conduit. These reaches included the Rucker Lake Dam Reach (upstream) and the Rucker Creek Diversion Dam Reach (downstream).

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Rucker Lake Dam Reach (0.4 miles long) lies upstream of the Bowman-Spaulding conduit and extends from the Bowman-Spaulding conduit (RM 1.2) to Rucker Lake Dam (RM 1.6). The reach has an average elevation of 5,371 feet and a channel gradient of 2.8%. The Licensee sampled 53 potential fish habitat spots along a 375 foot section of stream, starting approximately 600 feet downstream of Bowman Lake Road. A total of 10 fish were captured with a CPUE of 1 fish/minute for the site. Brown trout made up the dominant species (60%) and were collected at .6 fish/minute (Table 14). Average fork length for brown trout was 113mm (range: 71mm to 155mm; Table 15). Green sunfish length averaged 115mm (range: 77mm to 146mm; Table 15). Fish were distinctly separated by habitats with brown trout being found in riffle habitats and green sunfish in the largest pool in the site.

The Rucker Creek Diversion Dam Reach (1.2 miles) lies below the Bowman-Spaulding conduit and extends from Rucker Creek's confluence with the South Yuba River (RM 0.0) to the Bowman-Spaulding Conduit (RM 1.2). The reach has an average elevation of 4,480 feet and a channel gradient of 26.1%. The Licensee was unable to sample potential fish habitat spots within Rucker Creek Diversion Dam Reach below the Bowman Spaulding Conduit for species composition and size distribution as the entire reach was dry.

Incidental Observations and CNDDB Reports

The only ongoing Relicensing study that noted significant incidental observations of fish was the Fish Passage Study.

- In Pass Creek, a tributary to Jackson Meadows Reservoir, approximately 300 brook trout ranging from 2 to 5 inches in size were observed in a shallow pool within the margin of the normal maximum water surface elevation.
- In the Middle Yuba River, a tributary to Jackson Meadows Reservoir, approximately 230 brook trout, ranging in size from 2 to 5 inches, were observed in three shallow pools within the normal maximum water surface elevation of the reservoir approximately 1000 feet above the pool level at the time of survey (6,001 feet msl).
- In Jackson Creek, a tributary to Bowman Lake, about 300 kokanee were observed from approximately 500 feet above the pool level at the time of survey (5,512 feet msl) to well upstream of the normal maximum water surface elevation, many of which were actively spawning and digging redds.

Since special-status fishes were not observed during the Stream Fish Population Study, no California Natural Diversity Database (CNDDB) reports were made.

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4.0 Discussion

This technical memo provides a results summary for all Level II and Level I sampling activities. A detailed discussion will be provided after the second year of Level II[2] sampling concludes within the final report, in 2009. Therefore, discussion was not provided addressing all project-affected reaches; however, the study plan stipulates that after the first year of sampling the relicensing participants will have the option to upgrade up to five Level I qualitative sites to Level II quantitative sites. The following discussion addresses the Level I findings in light of this option.

The purpose of Level II quantitative sampling is to document fish population characteristics (*i.e.,* abundance, biomass, age, etc.) for selected stream reaches. This information is useful to assess streams where the potential for diverse and relatively significant fish populations can be supported. Of the sampled reaches, only five streams had a catch rate over 8 fish/minute with more than one species present. These streams were represented by: Jackson Lake Dam Reach (CPUE=8.9; Table 15), White Rock Lake Dam Reach (CPUE=9.3; Table 15), Carr Lake Dam Reach #1 (CPUE=10.0; Table 15), Canyon Creek Below Towle Diversion Dam Reach (added site not in the study plan; CPUE=10.5; Table 15), and Carr Lake Dam Reach #2 (CPUE=11.3; Table 15).

5.0 Study Proposal Consultation

Licensees engaged in the following consultation activities that were required during the 2008 fish population study year:

- Consulted with NMFS in regards to sampling in the Wise Powerhouse Reach and are obtaining a 4(d) Research Collection Permit. The collection permit is approved and expected to be valid by mid to late March 2009. Field sampling for the Level I site at the Wise Powerhouse Reach is planned for late March 2009.
- Invited the Relicensing Participants into the field to comment on the selected Level I and Level II sampling sites prior to conducting field activities.

6.0 Variances from Study Proposal

In 2008, six variances from the study proposal occurred:

- During the site selection period, the Drum Afterbay Dam Reach – Lower site was deemed inaccessible for sampling. Upon consultation with Relicensing Participants present on the site selection event, an additional North Yuba River site was added in exchange for removing the Drum Afterbay Dam Reach – Lower site.

[2] A repeat of Level I qualitative sampling will not occur, as indicated in the study plan.

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- Block nets were not set at the upstream and downstream ends of the Bear River Canal Diversion Dam Reach – Lower site because depths and velocities were not conducive to the use of block nets. Observers took extreme care to prevent pushing fish in or out of the snorkeling survey reach.
- The Milton Diversion Dam Reach – Lower site was snorkeled rather than electrofished for the following reasons: 1) because of what appeared to be poor water quality, there were already a number of moribund fish and amphibians throughout the reach and there was concern about fish health; 2) approximately one fourth of the study site was too deep to electrofish along the right bank; and 3) an alternative representative site location was not readily located in the immediate vicinity.
- Sampling did not occur on the Wise Powerhouse Overflow Reach due to the potential for ESA protected steelhead to occur. Currently, the Licensees are undertaking consultation with NOAA to obtain a 4(d) research collection permit to sample in the Wise Powerhouse Overflow Reach. It is expected that the permit will be obtained in early 2009 and allow for sampling shortly thereafter. An appending submission will be made upon conclusion of sampling, analyzing and reporting the data.
- Sampling in Canyon Creek above Towle was not attempted due to unsafe conditions for either snorkeling or electrofishing. The reach above the Drum Forebay input into Canyon Creek was sampled and represents the information presented in the qualitative survey summary. An additional sample below the Towle Canal Diversion Dam Reach was also added to supplement collected information.
- Weight measurements during qualitative sampling in the South Yuba River – Lower site were not collected. This was a result of the site being primarily snorkeled. Electrofishing was inefficient and resulted in collection of less than five fish (three pikeminnow and one sucker) being collected after significant effort.

7.0 Schedule

This study is on schedule.

The Stream Fish Population Study Proposal states:

> After year 1, Level I site data would be reviewed by CDFG, FS, BLM, NOAA, and SWRCB in consultation with the licensees. One year of Level II data will be collected on up to five Level I sites if these five agencies reach consensus on the need for additional data based on relative composition.

8.0 Attachments to this Technical Memorandum

This section includes the following attachments on CD:

Attachment 3-1A Poorman Creek Temperature Refuge Assessment (Word File)

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Attachment 3-1B	Level II Fish Population Monitoring Site Locations, Physical Dimensions, And Aquatic Habitat Data (Word File)
Attachment 3-1C	Fish Population and Biomass Estimates for Level II Fish Population Monitoring Sites Including Fish Size and Condition
Attachment 3-1D	Length-frequency Distributions of Trout Species Summarized by Ecozone and Stream, Including Age and Scale Data (Word File)
Attachment 3-1E	Length-Weight Relations for Fish Captured at Level II Fish Population Monitoring Sites (Word File)
Attachment 3-1F	Sampled Reach Maps for Level II and Level I Methodologies and Focus Study (Word File)
Attachment 3-1G	Photo Documentation for Level II Quantitative Sampled River Reaches (Word File)
Attachment 3-1H	Summary Checklist of Collected Data (Word File)

9.0 References

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

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

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

Hayes, D.B., J.R. Bense, T.J. Kwak, and B.E. Thompson. 2007. Abundance, biomass, and production. In Analysis and Interpretation of Freshwater Fisheries Data, edited by C.S. Guy and M.L. Brown. Bethesda, Maryland: American Fisheries Society.

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

McCain, M., D. Fuller, L. Decker, and K. Overton. 1990. Stream habitat classification and inventory procedures for northern California. In In FHC Currents. No.1. Arcata, California: U.S. Department of Agriculture. Forest Service, Pacific Southwest Region.

MacDonald, P.M. 1987. Analysis of length-frequency distributions. In The Age and Growth of Fish, edited by R.C. Summerfelt and G.E. Hall. Ames, Iowa: Iowa State University Press.

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Meador, M. R., T.F. Cuffney, and M. E. Gurtz. 1993. Methods for sampling fish communities as part of the national water-quality assessment program. U.S. Geological Survey open file report 93-104, Raleigh, North Carolina.

O'Neal, J.S. 2007. Snorkel Surveys. Pages 325-340 in Salmonid Field Protocols Handbook – Techniques for Assessing Status and Trends in Salmon and Trout Populations. American Fisheries Society, Bethesda, Maryland and State of the Salmon, Portland, Oregon.

Reynolds, J. B. 1996. Electrofishing. Pages 83-120 in B. R. Murphy and D. W. Willis, editors. Fisheries techniques, 2nd edition. American Fisheries Society, Bethesda, Maryland.

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

Snedecor, G.W., and W.G. Cochran. 1980. Statistical methods. 7th Edition. Ames, Iowa: Iowa State University Press.

Stangl, M. J. 2001. An electrofishing raft for sampling intermediate-size waters with restricted boat access. North American Journal of fisheries Management 21:679-682.

Temple, G. M. and Todd N. Pearsons. 2007. Electrofishing: Backpack and Drift Boat. Pages 95-132 in Salmonid Field Protocols Handbook – Techniques for Assessing Status and Trends in Salmon and Trout Populations. American Fisheries Society, Bethesda, Maryland and State of the Salmon, Portland, Oregon.

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

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

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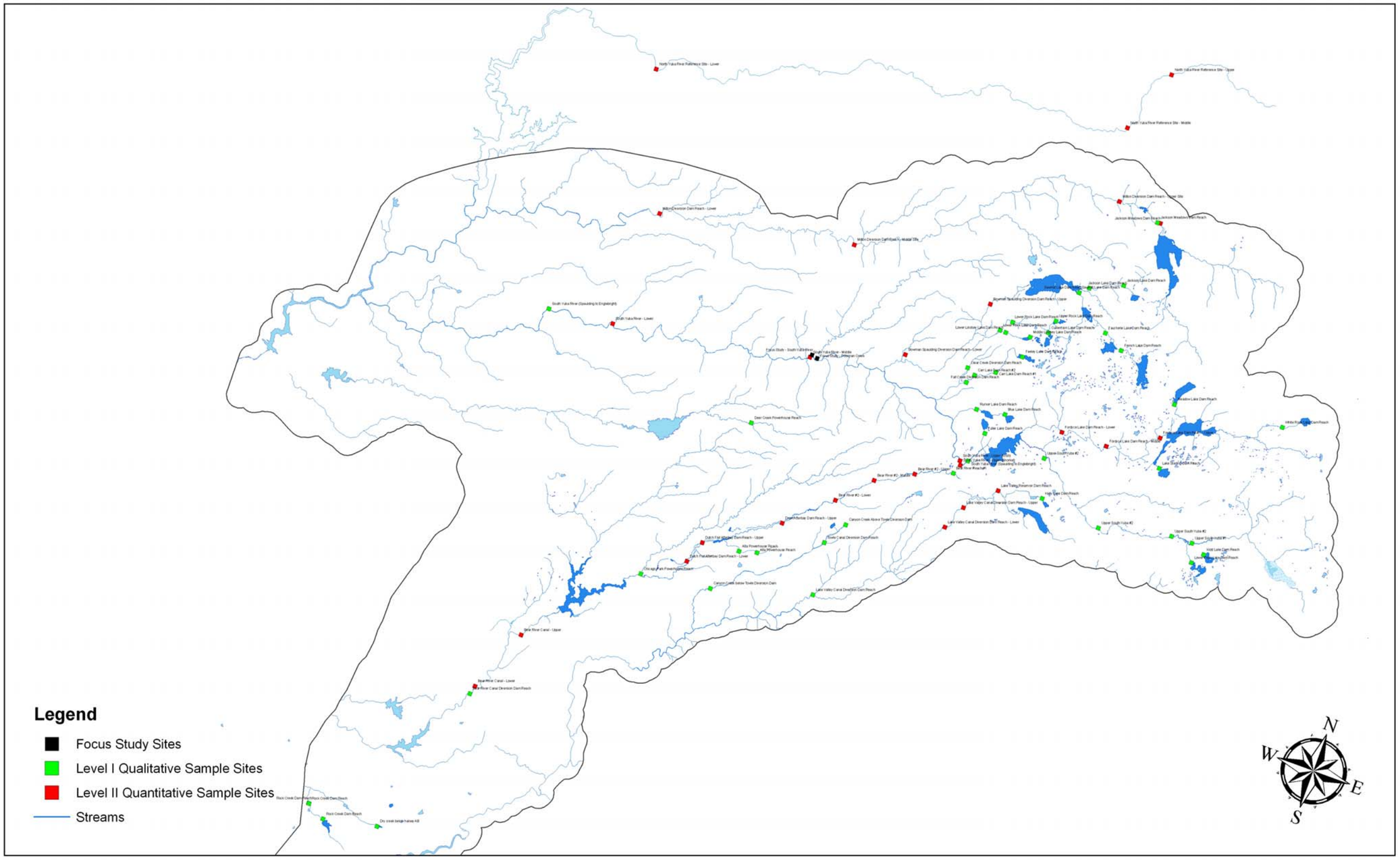

Figure 1. Map depicting sampling locations for the Focus Study and Level I and Level II methodologies.

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