TABLE OF CONTENTS

List of Tables

List of Figures

List of Maps

List of Appendices

6.0 FISH AND AQUATIC RESOURCES

This section describes the fish and aquatic resources in Middle Fork American River Watershed (Watershed), including in the reservoirs and streams associated with the Middle Fork American River Project (MFP or Project). The content requirements for this section are specified in Title 18 of the Code of Federal Regulations (CFR) Chapter I § 5.6 (d)(3)(iv).

6.1 INFORMATION SOURCES

The information presented in this section was developed by acquiring, compiling, and reviewing data available in various resource agency files, websites and through personal communications with resource agency staff, as follows.

- California Department of Fish and Game (CDFG) Region II files for Placer and El Dorado counties, and the water bodies of interest;
- CDFG Region II Senior Hatchery Supervisor;
- CDFG Website (www.dfg.ca.gov);
- CDFG Natural Diversity Database (CNDDB);
- CDFG California Wildlife Website (www.dfg.ca.gov/bdb/html/cawildlife.html);
- Tahoe National Forest (TNF), Foresthill Ranger District, files for the water bodies of interest;
- Eldorado National Forest (ENF), Georgetown Ranger District, files provided by Jann Williams, Fisheries Biologist;
- State Water Resources Control Board;
- Central Valley Regional Water Quality Control Board;
- University of California MELVYL Library Catalog; and
- General Internet searches.

In addition, previously published reports were retrieved and reviewed. Pertinent data was incorporated into this section and referenced as appropriate.

6.2 RECENT STUDIES

During 2005 and 2006, PCWA implemented a number of early studies to collect Project-specific information that could be used to (1) enhance the description of environmental resource in the Pre-Application Document (PAD); and (2) inform the development of comprehensive technical study plans. These studies focused on the following topics: channel geomorphology, riparian habitat, aquatic habitat, hydrology and water temperature. Study plans for each of these studies were developed in collaboration with the resource agencies and are included in Supporting Document G (SD-G). The study results are presented in a number of study reports, which are also included in

SD-G, for reference. The following three study reports contain information pertinent to this section:

- 2005 Water Temperature Study Report (PCWA 2006)
- 2006 Water Temperature Study Report (PCWA 2007a)
- 2006 Physical Habitat Characterization Study Report (PCWA 2007b)

The 2006 Physical Habitat Characterization Study Report provides information on the types and distribution of aquatic habitat in the stream and river reaches associated with the MFP. Similarly, the 2005 and 2006 Water Temperature Study reports provide water temperature information. Both of these studies are referenced throughout this section and should be referred to for additional information on study methods and results.

During the spring of 2007, PCWA initiated a special-status amphibian and aquatic reptile study (PCWA 2007c), which continued through the summer of 2007. A report documenting the results of this effort is currently under development. Qualitative observations from the spring portion of the study are discussed in this section.

6.3 OVERVIEW OF EXISTING CONDITIONS

The following provides an overview of the fish communities, benthic macroinvertebrates, aquatic mollusks, amphibians, and aquatic reptiles that occur in the Watershed. This subsection also provides detailed information on special-status aquatic species known or potentially occurring in the Watershed. For reference, the Middle Fork American River Watershed boundary, Project facilities, and associated river reaches are shown on Figure 6-1.

6.3.1 Fish Community

The Sacramento-San Joaquin drainage, which includes the American River and tributaries that drain the west slope of the Sierra Nevada, historically contained the richest native fish fauna of the Sierra Nevada, with 22 taxa (Moyle, et al. 1996). Fourteen of these native fishes (including 4 runs of Chinook salmon) historically may have occurred in the streams associated with the MFP. Table 6-1 lists these native fish, their potential to occur in the Middle Fork American River Watershed (Watershed) and their current management status.

Three native anadromous species (winter steelhead, Pacific lamprey, and Chinook salmon) that historically migrated into the Watershed are currently excluded from the region by Nimbus and Folsom dams on the lower American River. Both steelhead and Chinook salmon reportedly ascended the Middle Fork American River past the Rubicon River confluence, and the Rubicon River as far as the Pilot Creek confluence, which is approximately 5 miles upstream of the Middle Fork American River confluence (Yoshiyama, et al. 1996). There are no catadromous or other migratory species present in the Watershed. In addition, the Watershed does not include essential fish habitat as defined under the Magnuson-Stevens Fishery Conservation and Management Act.

Fish stocking and non-native fish introductions have modified the fish distribution and species composition in the Watershed. Twelve non-native species have been stocked or established populations by means other than intentional stocking in the reservoir and streams associated with the MFP. Rainbow trout/steelhead have been stocked outside of their historical, natural distribution (Table 6-2). As early as the 1800s, trout were stocked in an effort to establish populations where none previously existed (Knapp 1996). As a result, the status of native rainbow trout (which would have descended from steelhead that residualized upstream of Folsom Dam) in MFP streams is difficult to determine due to extensive genetic introgression with introduced hatchery rainbow trout (Knapp 1996). Historical fish stocking records obtained from CDFG Region II files are summarized in the tables presented in Appendix 6-A.

A limited amount of fish sampling (electrofishing, snorkeling, gillnetting, and angling) has been conducted in the reservoirs and streams associated with the MFP by CDFG, the US Department of Agriculture, Forest Service (USDA-FS), and others. A summary of the fish sampling data is presented in Table 6-3. Reported quantitative fish population (fish per mile) or standing crop estimates (pounds per acre) are included by reach in Table 6-3 along with the approximate river mile of the sampling location and the length of the sampling reach. Qualitative data are also included in Table 6-3. For reference purposes, historic fish sampling data in Sierra streams indicated that the average trout standing crop was 41 pounds per acre or approximately 224 adult trout (fish over 6 inches) per mile (Gerstung 1973).

The assemblages of fish species known to occur, or with a reasonable potential to occur, in streams and reservoirs associated with the MFP are presented in Table 6-4. The known occurrences and distributions of trout in the Watershed are well established relative to those of other fish species, such as hardhead. Historical electrofishing sampling results in the Watershed commonly present trout-biased data (indicating only the trout captured). It is possible that other species are present in the Watershed. The presence of fish in particular stream reaches (e.g., Table 6-4), therefore, may change as additional information is obtained and reviewed. A reach-by-reach description of current information on fish and fish habitat is presented in Section 6.4.

6.3.2 Benthic Macroinvertebrates and Aquatic Mollusks

Benthic macroinvertebrates inhabit the sediment or live on the bottom substrates of rivers and streams. For reasons such as variations in elevation, climate patterns, geology, substrate, streamflow, and riparian vegetation, it is not possible to describe a typical western Sierra Nevada aquatic invertebrate assemblage (Erman 1996). Generally, however, the aquatic invertebrate fauna of the Sierra Nevada is numerous, diverse, and includes many endemic species (Erman 1996). The status or health of benthic macroinvertebrate communities is typically measured and compared using various metrics (species richness, diversity, abundance, pollution tolerance of individuals, etc.) that are combined or used individually as numerical indices. In this report, species richness, Shannon Diversity Index, Hilsenhoff Biotic Index (HBI), EPT index, and the California Tolerance Level are presented.

Limited quantitative macroinvertebrate data were obtained for the streams associated with the MFP. Despite numerous resource agency datasheets indicating that aquatic macroinvertebrate sampling has occurred along the streams and rivers associated with the MFP, only four studies provide data summaries of macroinvertebrate assemblages collected (JSA 2002, 2003, and 2005; USDA-FS 2005). Macroinvertebrate information from these studies are summarized in this report.

Little information exists regarding aquatic mollusks in the Watershed. Western pearlshell mussels (*Magaritifera falcata*) or shells have been observed at two locations during early field surveys, at the confluences of Otter Creek and North Fork of the Middle Fork American River with the Middle Fork American River. There are several Forest Service sensitive mollusk species that could also potentially occur in the Watershed. More information on these species is provided below.

6.3.3 Amphibians and Aquatic Reptiles

Based on the CDFG species range maps (CDFG 2007b) there are at least 10 amphibian and aquatic reptile species present or potentially present in the vicinity of the MFP. Foothill yellow-legged frogs (*Rana boylii*), red-legged frogs (*Rana aurora*), pacific tree frogs (*Hyla regilla*), western toad (*Bufo boreas*), bullfrogs (*Rana catesbeiana*), California newts (*Taricha torosa*), northwestern pond turtle (*Emys marmorata*), western aquatic garter snake (*Thamnophis couchii*), Mount lyell salamander (*Hydromantes platycephalus*), and Ensatiina (*Ensatina eschscholtzi*). Other species may also be present.

Based on qualitative results from current field surveys, California newts (*Taricha torosa*) and foothill yellow-legged frogs (FYLF) are relatively abundant in different portions of the streams and rivers associated with the MFP. California newts are most abundant in the small creeks: Duncan Creek, North Fork Long Canyon Creek, South Fork Long Canyon Creek, Long Canyon Creek. Foothill yellow-legged frogs are present in the Rubicon River and Middle Fork American rivers upstream of their confluence with Ralston Afterbay. FYLF are also present in several tributaries to the Middle Fork American River downstream of Ralston Afterbay (Otter Creek, Gas Canyon Creek, Todd Creek, and North Fork of the Middle Fork American River), but rare on the Middle Fork American River downstream of Ralston Afterbay.

Western toads and Pacific tree frogs have been observed along with their tadpoles in the streams and rivers associated with the MFP. Western aquatic garter snakes have also been observed. There are species accounts of federally threatened California red-legged frog and special-status northwestern pond turtle Watershed. During field surveys conducted in 2007, one pond turtle was observed in Otter Creek. The salamander species have not been observed during recent field work. Bullfrogs are assumed present, but based on the lack of sightings in most areas they may be in low abundance. The exception to this may be the Horseshoe Bar area. This is an old river bend that generally has become isolated from the river due to a tunnel (Middle Fork tunnel) diverting flow through bedrock past the river bend (the tunnel is not part of the MFP and Horseshoe Bend is isolated from the MFP). The old river bend is now ponds

and wetland. Jones & Stokes (2002) identified a large population of bullfrogs in the wetland.

6.3.4 Special-Status Aquatic Species

For the purposes of this report, special-status aquatic species are defined as aquatic species granted status by federal and state agencies. Federally listed species granted status by the U.S. Fish and Wildlife Service (USFWS) under the Endangered Species Act (ESA) include threatened (FT), endangered (FE), proposed threatened and endangered (FPT, FPE), candidate (FC) or listed species proposed for delisting (FPD).

State-listed aquatic species, which are granted status by the CDFG under the California Endangered Species Act (CESA), include threatened (ST), endangered (SE), California Fully Protected Species (CFP), and California Species of Special Concern (CSC).

USDA-FS maintains lists of Forest Service Sensitive (FSS) species and National Forest Management Indicatory Species (MIS) for each forest (USDA-FS 1998). FSS species are those species identified by a Regional Forester as having current or predicted downward trends in population numbers or density, or current or predicted downward trends in habitat quality that would reduce the species' current distribution.

Three special-status fish species are known to occur or potentially occur in the streams and rivers associated with the MFP. The special-status fish species include hardhead (FSS, CSC); brown trout (MIS); and rainbow trout (MIS). Four special-status amphibians or aquatic reptiles are either known or have the potential to occur in the vicinity of the MFP. Three special-status mollusks have been identified as having some remote potential for occurring in the Watershed. No ESA or CESA listed threatened or endangered fish or aquatic invertebrates are known to occur in the Watershed. Brief descriptions of the life histories and habitat requirements of the fish species are presented in Appendix 6-B.

Table 6-5 summarizes pertinent information regarding special-status amphibians, aquatic reptiles, and mollusks that are known to occur or have the potential to occur in the vicinity of the MFP, including their status and habitat requirements. Those species that are unlikely to occur, or for which no appropriate habitat is present, are not discussed further in this document. Appendix 6-C contains life history information for special-status amphibian, aquatic reptile, or mollusk species. Map 6-2 shows occurrences of these species in the Watershed.

There are four special-status amphibians or aquatic reptiles that either occur or potentially occur in the vicinity of the MFP (Table 6-5 and Map 6-2). Foothill yellow-legged frog (FSS, CSC) occur in some of the streams and rivers associated with the MFP. California red-legged frog (FT, CSC) have been found in two pond locations in the Watershed. One of the sites is a multiple pond location near Michigan Bluff in the North Fork of the Middle Fork American River Watershed that contains on the order of 50 individuals (Amy Fesnock, Pers. Comm.). The other is an isolated, possibly aberrant, pond on Ralston Ridge that contained one individual (as well as one individual

FYLF and western pond turtle) (LSA Inc. 2001, LSA Inc. 2004). Northwestern Pond turtles (CSC, FSS) have been found in the isolated ponds and wetland at Horseshoe Bar adjacent to the Middle Fork American River (JSA 2002) and one individual was observed during Spring 2007 field work in Otter Creek. One sighting has been recorded by the Forest Service in the Little Wallace Creek area. The Mount Lyell salamander also potentially occurs in the Watershed, but there are no known sightings.

Some of the Forest Service regionally (Pacific Southwest Region) sensitive aquatic mollusk species are listed in Table 6-5. While there are no known records of the these species in the Watershed, based on discussions with Forest Service biologists, the following species warrant consideration as having some remote potential for occurring in the Watershed: Great Basin rams-horn (snail) (*Helisoma newberryi*), California floater (*Anodonta californiensis*), scalloped juga (snail) (*Juga (Calibasis) acutifilosa*). This is based on the fact that the Sierra Nevada Province has been poorly surveyed for mollusks so reliable conclusions about what is or is not in the region or in the streams and rivers associated with the MFP are not presently possible (Joseph Furnish, Pers. Comm.).

6.4 DESCRIPTION OF THE FISH, MACROINVERTEBRATE, AND OTHER AQUATIC SPECIES COMMUNITIES BY REACH

The following describes the fish, macroinvertebrate and special-status aquatic species communities present in the streams and rivers associated with the MFP, organized by river reach. Information about water temperature and habitat is also summarized. The community information was developed mainly by reviewing data contained in resource agency files and in published literature and qualitative observations during 2006 spring 2007 field studies. The temperature and habitat information is based mainly on data documented in PCWA's 2006 Physical Habitat Characterization Report (PCWA 2007b) and 2005 and 2006 Water Temperature Study reports (PCWA 2006, PCWA 2007a).

6.4.1 Middle Fork American River

Middle Fork American River above French Meadows Reservoir

The tributaries to French Meadows Reservoir generally are steep, narrow channels composed of primarily bedrock, boulders, and cobbles (TNF 2002). The primary tributary, the Middle Fork American River, had a maximum observed water temperature of 76°F, and a maximum daily average temperature of 69°F during 2005 and 2006. The Middle Fork American River likely provides the only potential stream spawning habitat for the rainbow and brown trout that reside in French Meadows Reservoir.

Qualitative electrofishing surveys were conducted in the Middle Fork American River above French Meadows Reservoir in August 1986. Several areas were electrofished, with both brown trout and rainbow trout collected; brown trout were more numerous. The brown trout ranged in size from young-of-year to 13.5 inches, and the rainbow trout from young-of-year to 5 inches (Table 6-3).

Qualitative snorkel surveys performed in 1990 by TNF fisheries biologists, as part of the Middle Fork American River Trout Habitat Enhancement Project, indicate that rainbow trout, brown trout, and brook trout reside in the reach of the Middle Fork American River upstream of French Meadows Reservoir. The observed trout ranged in size from 2 to 13 inches fork length, and 2 inch brown trout were the most abundant species/size class observed.

No special-status amphibians, aquatic reptile, or mollusks have been recorded in this river reach.

French Meadows Reservoir

French Meadows Reservoir is relatively deep with a maximum depth of approximately 214 feet. Water clarity is generally high with visible depths (photic zone) of approximately 20-30 feet (secchi depth). The littoral habitat (shallow water photic zone) does not contain aquatic vegetation because the water surface varies seasonally with storage of water and subsequent release of stored water. Substrates in the reservoir are a mix of fine to coarse sand, cobbles, boulders, and bedrock.

French Meadows Reservoir is a coldwater reservoir that becomes thermally stratified during the summer. Summer water temperatures remain cold throughout the majority of the Reservoir's depth (e.g., <45°F at the bottom of the reservoir in the hypolimnion to >70°F at the surface), providing suitable habitat for trout. A more detailed summary of the observed water temperature characteristics of French Meadows Reservoir is presented in the 2005 and 2006 Water Temperature Study reports (PCWA 2006, PCWA 2007a).

French Meadows Reservoir contains rainbow and brown trout. Although no stocking records were located, French Meadows Reservoir reportedly contains smallmouth bass, sunfish, and catfish (CDFG 2002). Fish stocking records for the Middle Fork American River around and upstream of the present day reservoir date back to the 1930s and indicate that brown trout, rainbow trout, brook trout, and steelhead all were planted. Reservoir stocking records were obtained for 1968 – 1971 and 2001 – 2005 (Appendix 6-A), although it is likely that French Meadows Reservoir has been stocked annually since the completion of French Meadows Dam. During the last five years, rainbow trout, Eagle Lake rainbow trout, and brown trout have been stocked in French Meadows Reservoir (Appendix 6-A).

Little information was found describing the trout populations (e.g., standing crop, biomass, age structure, or growth) residing in French Meadows Reservoir. Creel survey data from 1966 indicate that, although numerous, the rainbow trout caught were generally small (typically less than 10 inches). Results from subsequent creel surveys conducted between 1968 and 1971 indicate that annual angler hours ranged from 386 to 1,995 and that catch per hour varied from 0.23 to .45 fish. The majority of trout caught were rainbows. For creel surveys on three dates in 1985, catch rates varied from 0.25 to 0.59 fish per angler hour for brown trout and rainbow trout combined.

Rainbow trout caught ranged from 9.5 to 13 inches, and brown trout ranged from 9.5 to 16 inches.

Gill net catch data was obtained from 1975, 1982, and 1985 (see Table 6-3). Rainbow trout caught in 1975 ranged from 7.5 to 11 inches in length, and brown trout ranged from 10 to 13 inches in length. In 1982, the rainbow trout ranged from 9.5 to 13 inches, and the brown trout ranged from 7 to 19 inches. The rainbow and brown trout captured in 1985 were between 6 and 7 inches in length.

No special-status amphibians, aquatic reptile, or mollusks have been recorded in French Meadows Reservoir.

Middle Fork American River from French Meadows Reservoir to Middle Fork Interbay

Water released into the Middle Fork American River from French Meadows Reservoir is generally cold because it is released from a low-level outlet. During 2005 and 2006, immediately downstream of French Meadows Reservoir, the maximum observed water temperature was 59°F, and the maximum daily average temperature was 57°F (PCWA 2006, PCWA 2007a). Water temperature data collected during 2005 and 2006 indicated that thermal warming during the summer and inflows from Duncan Creek increase the temperature as much as approximately 20°F from French Meadows Reservoir downstream to immediately upstream of Middle Fork Interbay (approximately 10 river miles). The observed instantaneous maximum water temperature during 2005 and 2006 just upstream of Middle Fork Interbay was 74°F and the maximum daily average was 70°F. A more detailed summary of the water temperature characteristics of the Middle Fork American River between French Meadows Dam and Middle Fork Interbay is presented in the 2005 and 2006 Water Temperature Study reports (PCWA 2006, PCWA 2007a).

Rainbow trout, brown trout, hardhead, Sacramento sucker, and Sacramento pikeminnow reportedly occupy this reach of the Middle Fork American River (TNF 2003; ENF 1977) (Table 6-4). Fish stocking records indicate that the Middle Fork American River (throughout the Watershed) was stocked with as many as 60,000 rainbow trout almost annually from 1926 to 1953 (Appendix 6-A). Between 20,000 and 90,000 brown trout were stocked for 9 out of 10 years from 1930 to 1939. Brook trout and steelhead also were stocked on one occasion each near present day French Meadows Reservoir. More recent stocking records were not located.

No information (e.g., standing crop, biomass, age structure, or growth) was obtained regarding the populations of rainbow trout, brown trout, and hardhead residing in the Middle Fork American River between French Meadows Dam and Middle Fork Interbay.

Aquatic habitat classification results from the 2006 Aquatic Habitat Characterization Study for this reach are provided in Table 6-6. Slow water pool habitat, as classified following Hawkins et al. (1993), accounts for approximately 57% of this reach. Fast water turbulent habitat was the next largest habitat type at approximately 27%. The

most common occurring habitat types as classified following McCain et al. (1990) were mid-channel pools, step pools, and high gradient riffles, which accounted for 28%, 20%, and 17 % of the habitat, respectively.

No special-status amphibians, aquatic reptile, or mollusks have been recorded in this river reach, nor were any observed during spring 2007 field surveys.

Middle Fork Interbay

Middle Fork Interbay has a maximum depth of approximately 64 feet. Water clarity is generally high with visible depths (photic zone) of approximately 20-30 feet (secchi depths). The littoral habitat (shallow water photic zone) does not contain aquatic vegetation because the water surface varies due to powerhouse inflows/outflows and annual lowering for powerhouse maintenance. The shoreline is steep and the substrate coarse (e.g., bedrock) and there is little area available for establishment of aquatic vegetation. Substrates in the reservoir are a mix of fine to coarse sand, cobbles, boulders, and bedrock.

Water in the Middle Fork Interbay is typically cold because most of the water during the warmer months is routed from Hell Hole Reservoir through the Middle Fork Powerhouse and into Middle Fork Interbay. Somewhat limited data obtained from 2005 indicated that the maximum observed water temperature was 54°F, and the maximum daily average water temperature was 50°F (PCWA 2006).

Specific information regarding the fish and macroinvertebrates inhabiting Middle Fork Interbay were not located. Because fish can freely move between the reservoir and the river upstream, the fish assemblage in the reservoir is likely similar to that of the Middle Fork American River upstream. However, due to the influences of power operations, the water temperature regime in Middle Fork Interbay during the warmer months of the year is typically cooler than that immediately upstream in the Middle Fork American River.

No special-status amphibians, aquatic reptile, or mollusks observations were located from Middle Fork Interbay.

Middle Fork American River from Middle Fork Interbay to Ralston Afterbay

Water released into the Middle Fork American River from Middle Fork Interbay is generally cold (PCWA 2006, PCWA 2007a). Water temperature data collected in 2005 and 2006 indicated that the maximum and maximum daily average water temperature below Middle Fork Interbay were approximately 59°F and 57°F, respectively. During 2005 and 2006, the maximum observed water temperature at the downstream end of the reach (immediately upstream of Ralston Afterbay) was 74°F, and the maximum daily average water temperature was approximately 71°F (PCWA 2006, PCWA 2007a).

Rainbow trout, brown trout, hardhead, Sacramento sucker, and Sacramento pikeminnow reportedly occupy this reach of the Middle Fork American River (TNF 2003;

ENF 1977). Very little information (e.g., standing crop, biomass, age structure, or growth) was obtained regarding the populations of rainbow trout, brown trout, and hardhead. One CDFG memorandum (CDFG 1966) states that trout biomass in the Middle Fork American River downstream of Brushy Canyon Creek confluence was 20 pounds per acre (estimated using electrofishing) while the trout biomass in the river upstream of Brushy Canyon Creek confluence was 50 pounds per acre (estimated visually).

Aquatic habitat classification results from the 2006 Aquatic Habitat Characterization Study for this reach are provided in Table 6-6. Fast water habitat with a relatively even mix of non-turbulent (e.g., runs) and turbulent habitat (e.g., riffles) (using Hawkins classification system) accounts for approximately 60% of this reach. The most common occurring habitat types using the McCain classification system were mid-channel pools, high gradient riffles, and step runs, which accounted for 29%, 20%, and 14% of the habitat, respectfully.

A reach of river upstream of Ralston Afterbay was sampled for benthic macroinvertebrates in 2001, 2002, and 2004 as part of the Ralston Sediment Management Project (JSA 2002, 2003, 2005). Three riffles were sampled in June, August, and October 2001, 2002, and in August and October 2004. Figure 6-1 presents the benthic macroinvertebrate density results. Figure 6-2 presents the EPT index results. Figure 6-3 presents the taxa richness results. Figure 6-4 presents the California Tolerance Level results.

Based on field observations in 2006 and 2007, FYLF are known to occur from Ralston Afterbay upstream three miles. No sampling has been conducted further upstream in the reach near Middle Fork Interbay Dam. FYLF densities in the section of river known to be occupied are qualitatively lower than those in the nearby Rubicon River (see below). No other special-status amphibians, reptiles, or mollusks have been observed in this reach of river.

Ralston Afterbay

Ralston Afterbay has a maximum depth of approximately 78 feet. Water clarity is generally high with visible depths (photic zone) of approximately 20-30 feet (secchi depths). The littoral habitat (shallow water photic zone) does not contain aquatic vegetation because the water surface varies due to powerhouse inflows/outflows and annual lowering for powerhouse maintenance. Substrates in the reservoir are a mix of fine to coarse sand, cobbles, boulders, and bedrock.

Ralston Afterbay receives water inputs from three sources: (1) the Rubicon River; (2) the Middle Fork American River; and (3) the Ralston Powerhouse. Input from the Rubicon and Middle Fork American rivers is much warmer than that from the Ralston Powerhouse, which provides the bulk of the water during the warmer months of the year. Thus, Ralston Afterbay is typically cool (i.e., less than 53°F in the hypolimnion during 2005 and 2006). Water temperature profiling conducted during 2005 and 2006 indicated that the surface layer of Ralston Afterbay was subject to some thermal

warming (maximum surface temperature recorded was approximately 65°F in 2005 and 56°F in 2006) (PCWA 2006, PCWA 2007a).

No data on fish composition in the Ralston Afterbay were identified during the information search; however, the fish community in Ralston Afterbay likely is representative of the species found upstream in the Middle Fork American and Rubicon rivers. Therefore, brown trout, rainbow trout, hardhead, Sacramento sucker, and Sacramento pikeminnow are expected to reside in Ralston Afterbay.

No special-status amphibians, aquatic reptile, or mollusks were recorded in Ralston Afterbay.

Middle Fork American River – Ralston Afterbay Dam/Oxbow Powerhouse to the North Fork American River Confluence

Water released from Oxbow Powerhouse and Ralston Dam is typically cool. During 2005 and 2006, the maximum observed water temperature of the Oxbow Powerhouse release was 64°F, and the maximum daily average temperature observed was approximately 63°F. Typically the temperature was cooler (mid to low 50°F range) during the summer. Observed water temperatures during 2005 and 2006 in this reach increased downstream due to inflow from the North Fork of the Middle Fork American River and thermal warming. Water temperature data collected during 2005 in the Middle Fork American River downstream near the confluence with the North Fork American River (approximately 23 river miles down river from Ralston Dam) indicated that the summer maximum water temperature was 70°F, and the maximum daily average temperature was approximately 67°F (PCWA 2006, PCWA 2007a).

An indication of the fish assemblage in the Middle Fork American River downstream of Ralston Dam was provided when a large pool at the base of the dam was dewatered to construct a low-level outlet guard valve in 1999. The following species were collected: rainbow trout, brown trout, suckers, speckled dace, sculpin, hardhead, and pikeminnow. Of these, sucker and sculpin were the most abundant.

USFWS surveys in 1989 documented brown trout, rainbow trout, Sacramento hitch, Sacramento sucker, Sacramento pikeminnow, and riffle sculpin (USBR 1992). CDFG (1979) reports that Sacramento blackfish have been observed in the Middle Fork American River. Information regarding the populations (e.g., abundance or biomass estimates) of rainbow trout, brown trout, and hardhead residing in the Middle Fork American River downstream of Ralston Dam was not located.

Aquatic habitat classification results from the 2005 and 2006 Aquatic Habitat Characterization Study for this reach are provided in Table 6-6. The Middle Fork American River from Ralston Dam to the North Fork American River confluence is dominated by slow water pool habitats 55% (Hawkins classification system). The most common occurring habitat types using the McCain classification system consists of mid-channel pools, runs, and low gradient riffles, 46%, 18%, and 9%, respectively.

Four reaches in the Middle Fork American River downstream of Ralston Afterbay were sampled for benthic macroinvertebrates in 2001, 2002, and 2004 as part of the Ralston Sediment Management Project (JSA 2002, 2003, 2005). Three riffles were sampled in June, August, and October 2001, 2002, and in August and October 2004. Figure 6-1 presents the benthic macroinvertebrate density results. Figure 6-2 presents the EPT index results. Figure 6-3 presents the taxa richness results. Figure 6-4 presents the California Tolerance Level results.

FYLF were observed in four tributary streams to the Middle Fork American River during field work in 2006 and spring 2007; Gas Canyon Creek, Todd Creek, Otter Creek, and North Fork of the Middle Fork American River. A few observations were recorded in the Middle Fork American River, but only in the vicinity of the tributaries. Two western pond turtles were observed in the isolated ponds and wetlands in the Horseshoe Bar area by Jones & Stokes (2002). One pond turtle was observed in Otter Creek during spring 2007 field surveys. No other special-status amphibian, aquatic reptile, or mollusk species were recorded in this reach.

6.4.2 North Fork American River

North Fork American River – Middle Fork American River Confluence to the Folsom Reservoir High Water Mark

Temperature monitoring in 2005 and 2006 indicated that water temperature in the North Fork American River upstream of the Middle Fork American River confluence were very warm during the summer (with a maximum observed water temperature of approximately 85°F, and a maximum daily average of 83°F). Observations during the summer months indicated that the Middle Fork American River (with a maximum observed water temperature of 70°F, and maximum daily average water temperature of 67°F) contributed substantially cooler water to the North Fork American River. Downstream of the Middle Fork American River confluence, the observed water temperatures in the North Fork American River had an instantaneous maximum of 73°F, and a maximum daily average of 68°F (PCWA 2006, PCWA 2007a).

The North Fork American River downstream of the Middle Fork confluence supports both warmwater and coldwater fish assemblages. Warmwater species observed in this reach include smallmouth bass, brown bullhead, and green sunfish. Other species documented include Sacramento hitch, Sacramento sucker, and riffle sculpin (USBR 2002 – Pump Station). In a letter to PCWA regarding the American River Pump Station Project, CDFG states, "*The American River upstream of Folsom Lake maintains a self-sustaining coldwater fishery including rainbow trout, brown trout, and a variety of non-game coldwater species. Adequate spawning, rearing, and holding habitat exists in the system to maintain viable populations of these resident fish. Spawning salmonids use the project area from upstream and downstream locations and provide recruitment to the American River, as well as Folsom Reservoir*" (CDFG Unpublished Memo). A survey datasheet from 1938 indicates that hardhead were observed near the Middle Fork American River confluence.

Habitat mapping was not conducted in the North Fork American River, but the habitat is similar to that in the lower Middle Fork American River.

No special-status amphibians, aquatic reptile, or mollusks records were located from the North Fork American River.

6.4.3 Rubicon River

Rubicon River and Five Lakes Creek Upstream of Hell Hole Reservoir

Two main tributaries, Five Lakes Creek and the Rubicon River, flow into Hell Hole Reservoir. During 2005 and 2006, the maximum observed water temperature in Five Lakes Creek observed was 68°F, and the maximum daily average temperature was 66°F. During 2005 and 2006, in the Rubicon River upstream of Hell Hole Reservoir, the maximum observed water temperature was 73°F, and the maximum daily average temperature was approximately 68°F.

Rainbow trout spawners were observed in Five Lakes Creek in 1971 when CDFG observed six spawned out trout had been caught by anglers. It has been reported that a large waterfall in Five Lakes Creek approximately ¾ miles upstream of Hell Hole Reservoir is a complete migration barrier. The Rubicon River reportedly is accessible during the spring (when rainbow trout would be spawning) when the reservoir is full. During the fall, an approximately 15-foot waterfall (depending on reservoir elevation) is present where the Rubicon River enters Hell Hole Reservoir at the upstream end.

Mesohabitat has not been mapped to date in this reach of river and no special-status amphibians, aquatic reptile, or mollusks records were obtained from upstream of Hell Hole Reservoir.

Hell Hole Reservoir

Hell Hole Reservoir is a deep reservoir with a maximum depth of approximately 378 feet. Water clarity is generally high with visible depths (photic zone) of approximately 20-30 feet (secchi depths). The littoral habitat (shallow water photic zone) does not contain aquatic vegetation because the water surface varies seasonally with storage of water and subsequent release of stored water. Substrates in the reservoir are a mix of fine to coarse sand, cobbles, boulders, and bedrock.

Hell Hole Reservoir is a coldwater reservoir that becomes thermally stratified during the summer. Summer water temperatures remain cold throughout the majority of the reservoir's depth, providing habitat for trout. During the summer of 2005 and 2006 the hypolimnion was less than about 55°F and the surface temperature was as high as about 70°F (note that the summer thermocline was relatively gradual) (PCWA 2006, PCWA 2007a).

Hell Hole Reservoir has been stocked extensively in the past with a variety of salmonid species including rainbow trout (including Eagle Lake strain), brown trout, brook trout,

cutthroat trout (and cutthroat-rainbow hybrids), lake trout, kokanee, and coho salmon. Recent management includes the stocking of brown trout, rainbow trout and kokanee (Appendix 6-A). Although official records of recent rainbow plants were not located, the USDA-FS reports that the reservoir is stocked annually with catchable rainbows, (ENF 2006). The lake trout, originally stocked in the 1970s, apparently are self-sustaining in Hell Hole Reservoir and are occasionally observed during gill net and angler surveys.

Periodic gill net sampling conducted in Hell Hole Reservoir also indicates the presence of tui chub and suckers (presumably Sacramento suckers). There was an apparent proliferation of tui chub shortly after Hell Hole Reservoir was completed. In 1966, no tui chub were captured during a 12-hour gill net soak. Four tui chub were captured during a 24-hour gill net soak in 1967 (see Table 6-3). Four years later during 1971, 539 tui chub were captured during 81 hours of gill netting. The rates of sucker catches during those samples were similar.

Gill net and angler surveys provide some information on the size of the trout in Hell Hole Reservoir. Six of seven brown trout captured in a gill net in 1974 were greater than 20 inches in length, whereas the 2 rainbow trout captured were 7.5 and 8.8 inches in length. In September 1975, the four brown trout captured by gill nets were all greater than 20 inches in length, while the one rainbow trout was 8.2 inches in length. During an April creel survey in 1985, 86 brown trout were observed ranging from 9.5 to 21.8 inches in length. The 14 rainbow trout observed during that survey ranged from 10 to 15.5 inches in length. The overall trout catch per hour was 0.15 fish for 107 anglers.

No special-status amphibians, aquatic reptile, or mollusks records were obtained from Hell Hole Reservoir.

Rubicon River from Hell Hole Dam to Ralston Afterbay

Temperature monitoring during 2005 and 2006 indicated that the temperature of the water released into the Rubicon River from Hell Hole Reservoir was cold (<50°F), but progressively warms in a downstream direction. During the summer, inflow of warmer water from the South Fork Rubicon River and Long Canyon Creek and presumably thermal warming along the length of the reach cause the warming trend (Pilot Creek adds cooler water). Water temperatures observed during 2005 and 2006 in the lower Rubicon River (immediately upstream of Ralston Afterbay and approximately 30 river miles from Hell Hole Dam) were warm with a maximum of near 81°F and a maximum daily average of 77.5°F. Daily average temperatures in the lowest reach of the Rubicon River during summer 2005 and 2006 exceeded 70°F for a relatively long period of time during the summer (e.g., 1 month or more) (PCWA 2006, PCWA 2007a).

The Rubicon River is a CDFG-designated Wild Trout Stream that contains populations of rainbow trout and brown trout. Other species documented to occur in the Rubicon River include Sacramento sucker, speckled dace, riffle sculpin, Sacramento pikeminnow and hardhead (CDFG 1979). Records obtained indicated that the Rubicon River was

extensively stocked from 1928 through 1953 (Appendix 6-A). Predominantly rainbow trout and brown trout were stocked, although brook trout and steelhead also were stocked in the Rubicon River. Post-1953 Rubicon River stocking records were not located and, as under its current designation as a Wild Trout Stream, the Rubicon River is no longer stocked with trout.

Several electrofishing surveys have been conducted in the Rubicon River (see Table 6-3). Surveys near Ellicott Bridge in 1974 - 1975 collected 128 rainbow trout and 36 brown trout, most of which were less than 6 inches in length. A 1978 survey upstream of Hales Crossing estimated a population of 545 trout per mile (rainbow = 475; brown = 70). Of the 545 fish per mile estimated in the area, trout equal to or greater than 6 inches were estimated to account for 159 fish per mile. The total biomass of trout estimated in the area was 33 pounds per acre (rainbow = 30; brown = 3). This same survey downstream of Hales Crossing estimated a population of 3,397 trout per mile (rainbow = 3,221; brown = 176). Of which fish equal to or greater than 6 inches accounted for 493 fish per mile. The total biomass of trout estimated was 48 pounds per acre (rainbow trout = 41; brown = 7) (CDFG 1979).

CDFG (1979) also provides population estimates for trout greater than 6 inches in length for six reaches, which cover the length of the Rubicon River. These estimates ranged from 50 to 900 trout per mile. It is not clear in the report (1979) what sampling methods were used to obtain these estimates.

Electrofishing surveys in 1993 estimated a total trout biomass of 64.4 pounds per acre (rainbow = 24.6; brown = 39.8) and a population of 7,058 trout per mile (rainbow = 4,675; brown = 2,383) at a site immediately upstream of the South Fork Rubicon River. The same survey found an estimated total trout biomass of 52.2 pounds per acre (rainbow = 13.9; brown = 38.3) and a population of 4,140 trout per mile (rainbow = 1,260; brown = 2,880) at a site approximately 1 mile upstream of the South Fork Rubicon River.

A similar 1994 survey near Ellicott Bridge estimated a trout biomass of 44.1 pounds per acre (rainbow = 12.6; brown = 31.5) and a population of 3,026 trout per mile (rainbow = 1,547; brown = 1,479). A 2001 snorkel survey near the Long Canyon Creek confluence estimated the following numbers of fish per mile: rainbow trout - 1,239; brown trout - 17; Sacramento sucker - 562; Sacramento pikeminnow – 953, and sculpin - 11.

CDFG (1979, p 11) provides some indication of trout growth in the Rubicon River:

> *"The growth rate of rainbow trout in the Rubicon River is slow relative to the growth rates observed in more fertile, non-granitic basin streams such as Hat Creek and the Pit River. It is comparable to those observed in other streams of the west slope of the Sierra Nevada…Rainbow trout in the Rubicon River require at least six growing seasons (Age V+) to attain 12 inches in length...[B]rown trout in the Rubicon River are often of good size…they frequently live 6 to 8 years and thus reach a much larger size."*

Angler survey boxes are maintained at two locations on the Rubicon River. Angler reported trout catch per hour ranged from about 0.60 to 2.1 during 1990 through 2004. The majority of anglers reporting were practicing catch-and-release, and fishing pressure appears to be relatively light overall.

Aquatic habitat classification results from the 2005 and 2006 Aquatic Habitat Characterization Study (PCWA 2007b) for this reach are provided in Table 6-6. Fast water habitat, as classified using the Hawkins classification system, comprise about 59% of the total habitat (23% non-turbulent runs and 36% turbulent riffles). Slow water pools, as classified by Hawkins, comprise about 39% of the habitat. The dominant McCain habitat types were mid-channel pools, high gradient riffles, and runs, 28%, 21%, and 14%, respectively. The river for several miles downstream of Hell Hole Dam has been aggraded substantially by sediment from the 1964 Hell Hole Dam failure. About 7,350 feet, of the channel length immediately below the dam exhibited no surface flow (all flow was subsurface).

A reach of the Rubicon River upstream of Ralston Afterbay was sampled for benthic macroinvertebrates in 2001, 2002, and 2004 as part of the Ralston Sediment Management Project (JSA 2001, 2002 and 2005). Three riffles were sampled in June, August, and October 2001, 2002, and in August and October 2004. Figure 6-1 presents the benthic macroinvertebrate density results. Figure 6-2 presents the EPT index results. Figure 6-3 presents the taxa richness results. Figure 6-4 presents the California Tolerance Level results.

FYLF are common throughout the lower half of the Rubicon River (2006 and spring 2007 surveys). FYLF have been observed as far upstream above Ralston Afterbay as Ellicott Bridge (21 miles upstream), and are particularly abundant in the lower portion of the river. No other special-status amphibian, aquatic reptile, or mollusks were identified in this reach.

6.4.4 Duncan Creek

Temperature monitoring upstream and downstream of the Duncan Creek Diversion Dam during 2005 and 2006 indicated that the maximum observed water temperature was approximately 74°F, and the maximum daily average water temperature was approximately 68°F during the warmest summer days. Water temperatures appear to cool quickly with the onset of cooler weather conditions during the fall (PCWA 2006, PCWA 2007a). In the summer there appears to be a slight increase in temperature immediately downstream of the Duncan Creek Diversion pool, perhaps due to thermal warming at the diversion pool. Conversely, Duncan Creek appears to cool further downstream (e.g., near the confluence with the Middle Fork American River), perhaps due to cool water inflows.

Stocking records for Duncan Creek identified that almost 300,000 rainbow trout were planted between 1930 and 1953. Brown trout, brook trout, and steelhead also were planted but in smaller numbers. Appendix 6-A details the Duncan Creek fish stocking history.

Forest Service survey datasheets from 1976 indicate that rainbow trout and brook trout were the primary species in Duncan Creek. More recent fish survey information was not located.

The following excerpt from Tahoe National Forest's Middle Fork American River Watershed Assessment (TNF 2003) provides some general information regarding the aquatic habitat in Duncan Creek:

> *"[Duncan Creek] is predominantly a boulder and large cobble substrate [sic] and is moderately entrenched and confined. Gradients are generally greater than 4%. Side slopes are moderately to very steep. Although the channel is relatively stable, the system periodically transports large amounts of bedload as evidenced by recent cobble and gravel deposition."*

Aquatic habitat classification results from the 2006 Aquatic Habitat Characterization Study (PCWA 2007b) for Duncan Creek are provided in Table 6-7. In spite of the steep gradient, Duncan Creek consists of a large amount of slow water pool habitat, 52% (Hawkins classification system). The most common occurring habitat types using the McCain classification system are mid-channel pools, high gradient riffles, and step pools, 29%, 24%, and 13%, respectively.

The USDA-FS (2005) prepared an aquatic invertebrate report for samples collected at the same two locations in Duncan Creek during 2002 and 2003. A number of metrics and/or ecological summaries were reported for each sampling locations, including taxa richness, abundance, EPT, Shannon Diversity Index, and HBI. Table 6-8 presents a few of the results from the 2002 and 2003 aquatic invertebrate sampling.

No special-status amphibians, aquatic reptile or mollusks records were observed or recorded in Duncan Creek (e.g., habitat mapping).

6.4.5 Long Canyon Creek

North Fork Long Canyon Creek

Water temperatures in North Fork Long Canyon Creek below the diversion dam during 2005 and 2006 were as high as 73°F and the maximum observed daily average temperature was approximately 68°F. The maximum observed water temperature upstream of the dam was slightly lower, 70°F. By early September 2005 and 2006, daily average water temperatures had dropped below 60°F (PCWA 2006, PCWA 2007a).

Rainbow trout have been documented in North Fork Long Canyon Creek. Electrofishing surveys were conducted at two sites (a riffle and a pool) downstream of the North Fork Diversion Dam by CDFG in 1968. The biomass of trout in the riffle was 64 pounds per acre (population estimate 1,840 fish per mile) (Table 6-3). The biomass of trout in the run was 115 pound per acre (population estimates of 2,480 fish per mile) No other fish species were noted.

Aquatic habitat classification results from the 2006 Aquatic Habitat Characterization Study (PCWA 2007b) for North Fork Long Canyon Creek are provided in Table 6-7. North Fork Long Canyon Creek consists of a 58% fast water habitat (43% turbulent riffle and 15% non-turbulent run) (Hawkins classification system). The most common occurring habitat types using the McCain classification system are mid-channel/step pools, high gradient riffles, and low gradient riffles, 37%, 24%, and 18%, respectively.

No special-status amphibians, aquatic reptile, or mollusks records were located from North Fork Long Canyon Creek and no observations were made during field surveys (e.g., habitat mapping).

South Fork Long Canyon Creek

Observed water temperatures in South Fork Long Canyon Creek during 2005 and 2006 were cooler than in North Fork Long Canyon Creek. The maximum observed water temperature in South Fork Long Canyon Creek upstream and downstream of the dam during 2005 and 2007 was approximately 64°F and 70°F, respectively. The maximum daily average water temperature upstream and downstream of the dam was 59°F and 60°F, respectively. By early September, daily average water temperatures had decreased to approximately 57°F or less (PCWA 2006, PCWA 2007a).

Past fish surveys on South Fork Long Canyon Creek indicate that rainbow trout are present. Scattered populations of rainbows are noted throughout the reach upstream of South Fork Diversion Dam, including observations of fry, fingerlings and sexually mature adults. Many fish passage barriers such as bedrock waterfalls were also observed.

Electrofishing results for South Fork Long Canyon downstream (Site 1) and upstream (Sites 2 and 3) were presented in an Environmental Assessment prepared by Eldorado National Forest, Georgetown Ranger District (1979) (see Table 6-3). For the three sites sampled, trout biomasses of 41.7 (Site 1), 142 (Site 2), and 54.6 (Site 3) pounds per acre were estimated. Adult fish per mile estimates for the three sites were 106 (Site 1), 766 (Site 2), and 276 (Site 3).

Aquatic habitat classification results from the 2006 Aquatic Habitat Characterization Study (PCWA 2007b) for South Fork Long Canyon Creek are provided in Table 6-7. South Fork Long Canyon Creek consists of a 61% fast water habitat (34% turbulent riffle and 27% non-turbulent run) (Hawkins classification system). The most common occurring habitat types using the McCain classification system are mid-channel pools, step runs, and low gradient riffles, 20%, 17%, and 17%, respectively.

No special-status amphibians, aquatic reptile or mollusks were recorded in South Fork Long Canyon Creek and no observations were made during field surveys (e.g., habitat mapping).

Long Canyon Creek

Water temperature monitoring results from mainstem Long Canyon Creek in 2005 and 2006 indicated that the maximum water temperature observed immediately downstream of the confluence of the North and South Forks of Long Canyon Creek was as high as 72°F for a very short period of time in the summer, and maximum daily average water temperature was approximately 66°F during the summer. The maximum observed water temperature in Long Canyon Creek immediately upstream from the confluence with the Rubicon River was 78°F, and the maximum daily average water temperature was 75°F (PCWA 2006, PCWA2007a).

Results from an electrofishing survey conducted in Long Canyon Creek in 1984 indicate that rainbow trout were the only fish species captured during two visits (see Table 6-3). The September survey resulted in a total trout biomass estimate of 59 pounds per acre, and an adult biomass estimate of 23 pounds per acre. Fish per mile estimates were 4,505 for all trout (adults and fry), and 387 for adult trout (Enviro Hydro 1984).

Surveys from Wallace Canyon Creek, a major tributary to Long Canyon Creek, document moderate numbers of brown trout throughout Wallace Canyon Creek and three of its tributaries. A population of brook trout also was documented in Little Wallace Canyon Creek in 1992 (Unidentified Document).

Aquatic habitat classification results from the 2006 Aquatic Habitat Characterization Study (PCWA 2007b) for Long Canyon Creek are provided in Table 6-7. Long Canyon Creek consists of a 57% fast water habitat (39% turbulent riffle and 18% non-turbulent run) (Hawkins classification system). The most common occurring habitat types using the McCain classification system are step pools, low gradient riffles, and mid-channel pools, 20%, 19%, and 18%, respectively.

No special-status amphibians, aquatic reptile, or mollusks were recorded from upper Long Canyon Creek and no observations were made during field surveys (e.g., habitat mapping, FYLF surveys). At the mouth of Long Canyon Creek near the confluence with the Rubicon River, FYLF were observed during the summer 2006. Based on spring 2007 FYLF surveys it did not appear that breeding occurred in Long Canyon Creek, but rather in the Rubicon River.

6.5 REFERENCES

California Department of Fish and Game (CDFG). Various unpublished documents.

CDFG. 1979. Rubicon River Wild Trout Management Plan. Inland Fisheries Branch. July 1979.

CDFG. 2002. Fishing California's Sacramento Valley – Central Sierra Region. October 2002.

CDFG. 2006. Brown Trout. Available at http://www.dfg.ca.gov/fishing/assets/document. Accessed on March 30, 2006.

CDFG. 2007a. California Natural Diversity Data Base (CNDDB). RareFind 3, Version 3.1.0 (March 3, 2007). Sacramento, California.

CDFG. 2007b. California Wildlife. California Department of Fish and Game Biogeographic Data Branch. http://www.dfg.ca.gov/bdb/html/cawildlife.html

Eldorado National Forest (ENF). 1977. Final Environmental Statement, Volcanoville Planning Unit, Land Management Plan. U.S. Forest Service, Eldorado National Forest.

ENF. 1979. Environmental Assessment, South Fork Long Canyon Creek. Georgetown Ranger District, Eldorado National Forest.

ENF. 2006. Recreational Activities: Fishing – Hell Hole Reservoir. Available at http://www.fs.fed.us/r5/eldorado/recreation/fishing/hellhole/ Accessed on June 16, 2006.

Enviro Hydro. 1984. Instream Beneficial Use Assessment (IBUA), Appendices. Water Right Application No. 7722 for Long Canyon Creek, Placer County, CA.

Erman, N.A. 1996. Status of Aquatic Invertebrates. *In* Sierra Nevada Ecosystem Project: Final Report to Congress, vol. II, Assessments and scientific basis for management options. Davis: University of California, Centers for Water and Wildland Resources, 1996.

Gerstung, E.R. 1973. Fish population and yield estimates from California trout streams. Cal-Neva Wildlife 1973:9–19.

Hawkins, C.P., and 10 coauthors. 1993. A hierarchical approach to classifying stream habitat features. Fisheries 18(6): 3-12.

Jones & Stokes, and Associates (JSA). 2002. Water quality and aquatic resources monitoring program for the Ralston Afterbay Sediment Management Project—2001 annual report. April. Sacramento, CA. Prepared for Placer County Water Agency, Foresthill, CA.

JSA. 2002b. Ralston Afterbay Sediment Management Project - Amphibian Population Monitoring: 2002 Survey Results. Sacramento, California.

JSA. 2003. Water quality and aquatic resources monitoring program for the Ralston Afterbay Sediment Management Project—2002 annual report. April. (J&S 02-234). Sacramento, CA. Prepared for Placer County Water Agency, Foresthill, CA.

JSA. 2005. Water quality and aquatic resources monitoring program for the Ralston Afterbay Sediment Management Project—2004 annual report. April. (J&S 02234.02). Sacramento, CA. Prepared for Placer County Water Agency, Foresthill, CA.

Knapp, R.A. 1996. Non-native Trout in Natural Lakes of the Sierra Nevada: An Analysis of Their Distribution and Impacts on Native Aquatic Biota. *In* Sierra Nevada Ecosystem Project: Final Report to Congress, vol. III, Assessments and scientific basis for management options. Davis: University of California, Centers for Water and Wildland Resources, 1996.

LSA Associates, Inc. 2001. Middle Fork – Goldhill Transmission Separation Project. Pacific Gas and Electric Company, Technical and Ecological Services, San Ramon, CA.

LSA Associates, Inc. 2004. California Red-Legged Frog Surveys Report: Ralston Ridge Pond. Pacific Gas and Electric Company, Technical and Ecological Services, San Ramon, CA.

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

Moyle, P.B., R.M. Yoshiyama, and R.A. Knapp. 1996. Status of Fish and Fisheries. *In* Sierra Nevada Ecosystem Project: Final Report to Congress, vol. II, Assessments and scientific basis for management options. Davis: University of California, Centers for Water and Wildland Resources, 1996.

Placer County Water Agency (PCWA). 2006. 2005 Water Temperature Study Report Middle Fork American River Project (FERC Project No. 2079).

PCWA. 2007a. 2006 Water Temperature Study Report. Middle Fork American River Project (FERC Project No. 2079).

PCWA. 2007b. 2006 Physical Habitat Characterization Study Report. Middle Fork American River Project (FERC Project No. 2079).

PCWA. 2007c. Special-Status Amphibian—Aquatic Mollusk Technical Study Plan. June 2007.

Raleigh, R.F., L.D. Zuckerman, and P.C. Nelson. 1986. Habitat Suitability Index Models and Instream Flow Suitability Curves: Brown Trout. U.S. Fish Wild. Serv. Biol. Rep. 82(10.124).

Tahoe National Forest (TNF). 2002. Final Environmental Impact Statement, Red Star Restoration Project. U.S. Forest Service, Pacific Southwest Region, Tahoe National Forest, Foresthill Ranger District. November 2002.

TNF. 2003. Middle Fork American River Watershed Assessment. U.S. Forest Service, Pacific Southwest Region, Tahoe National Forest, Foresthill Ranger District.

Unidentified Author. Wallace Canyon Creek Watershed.

U.S. Bureau of Reclamation (USBR). 1992. Auburn State Recreation Area Interim Resource Management Plan. September 1992.

USBR and Placer County Water Agency (USBR and PCWA). 2002. American River Pump Station Project. Final Environmental Impact Statement/Environmental Impact Report. SCH# 1999062089.

USDA-FS. 1998. Regional Forester's List of Sensitive Plant and Animal Species for Region 5 (USDA-FS June 8, 1998, appended March 6, 2001). Accessed from http://www.fs.fed.us/r5/projects/sensitive-species/.

USDA-FS. 2005. Aquatic Invertebrate Report for samples collected by the Tahoe National Forest, Foresthill Ranger District summer 2002 and 2003. Prepared by Mark Vinson, U.S.D.I Bureau of Land Management, National Aquatic Monitoring Center, Department of Aquatic, Watershed, & Earth Resources, Utah State University, Logan, Utah.

USDA-FS. 2007, May. E-mail correspondence with Joseph Furnish, Regional Aquatic Ecologist, Pacific Southwest Region.

U.S. Fish and Wildlife Service (USFWS). 1995. Working Paper on Restoration Needs: Habitat Restoration Actions to Double Natural Production of Anadromous Fish in the Central Valley of California. Volume 2. Stockton, CA: U.S. Fish and Wildlife Service.

USFWS. 2007, April. E-mail correspondence with Amy Fesnock, Forest and Foothills Ecosystems Endangered Species Division. Sacramento, CA.

Yoshiyama, R. M., E. R. Gerstung, F. W. Fisher, and P. B. Moyle. 1996 Historical and present distribution of Chinook salmon in the Central Valley drainage of California. Sierra Nevada Ecosystem Project: Final Report to Congress, vol. III. Davis, CA: University of California, Center for Water and Wildland Resources.

TABLES

Table 6-1. Fish Native to the Middle Fork American River Watershed.[1]

Name	Habitat	Presence	Management Status[2]
Lampreys, *Petromyzontide*			
Pacific lamprey, *Lampetra tridentata*	Anadromous, foothills, lowlands	Extirpated (Nimbus/Folsom)	
Salmon, *Salmonidae*			
Chinook salmon, *Oncorhynchus tshawytscha*			
Chinook salmon, Spring-run	Anadromous, foothills, lowlands	Extirpated (Nimbus/Folsom)	ST, FT
Chinook salmon, Winter-run	Anadromous, foothills, lowlands	Extirpated (Nimbus/Folsom)	SE, FE
Chinook salmon, Fall-run	Anadromous, lowlands	Extirpated (Nimbus/Folsom)	CSC, FSS
Chinook salmon, Late fall-run	Anadromous, foothills, lowlands	Extirpated (Nimbus/Folsom)	CSC, FSS
Trout, *Salmonidae*			
Resident rainbow trout, *O. mykiss irideus*	Foothills, High elevations	Present	MIS
Winter steelhead, *O. mykiss irideus*	Anadromous, foothills, lowlands	Extirpated (Nimbus/Folsom)	FT
Minnows, *Cyprinidae*			
Sacramento hitch, *Lavinia exilicauda excilicauda*	Lowlands, foothills	Present	
Sacramento roach, *Lavinia symmetricus symmetricus*	Foothills	Presence not documented	CSC
Sacramento blackfish, *Orthodon microlepidotus*	Lowlands	Present	
Hardhead, *Mylopharodon conocephalus*	Lowlands, foothills	Present	CSC, FSS
Sacramento pikeminnow, *Ptychocheilus grandis*	Lowlands, foothills	Present	
Sacramento speckled dace, *Rhinichthys osculus ssp.*	Lowlands, foothills	Present	

Table 6-1. Fish Native to the Middle Fork American River Watershed (continued).[1]

Name	Habitat	Presence	Management Status[2]
Suckers, *Catostomidae*			
Sacramento sucker, *Catostomous occidentalis*	Lowlands, foothills, high elevations	Present	
Surf Perches, *Embiotocidae*			
Sacramento tule perch, *Hysterocarpus t. traski*	Lowlands, foothills	Presence not documented	
Sculpins, *Cottidae*			
Prickly sculpin, *Cottus asper*	Lowlands, foothills	Present	
Riffle Sculpin, *Cottus gulosus*	Foothills, high elevations	Present	

[1]Table adapted from Moyle et al. 1996
[2]Status

FT = Federal Threatened
FE = Federal Endangered
ST = State Threatened
SE = State Endangered
MIS = USFS Management Indicator Species
CSC = CDFG Species of Special Concern
FSS = USFS Sensitive Species
FSC = USFWS Species of Concern

Table 6-2. Non-Native (Including Natives Outside of Historical Range) Fish that have been Introduced to the Middle Fork and North Fork American River Watersheds.

Name	Habitat	Location and Comments
Kokanee, *Oncorhynchus nerka*	Reservoir	Hell Hole Reservoir; Continues to be stocked annually.
Coho salmon, *O. kistuch*	Reservoir	Hell Hole Reservoir; stocked on one occasion in 1974 on an experimental basis.
Rainbow trout, *O. mykiss irideus*	Reservoir; riverine	Throughout the Middle Fork American River Watershed; Historically and annually stocked with non-endemic strains
Steelhead, *O. mykiss irideus*	Riverine	Stocked on at least one occasion in the Middle Fork American River in 1930, the Rubicon River and Duncan Creek in 1937
Cutthroat trout, *O. clarki*	Reservoir; riverine	Cutthroat trout and cutthroat-rainbow hybrids were stocked extensively in Hell Hole Reservoir from 1973 through 1976.
Brown trout, *Salmo trutta*	Reservoir; riverine	Throughout the Middle Fork American River Watershed; Stocked in French Meadows and Hell Hole Reservoirs
Brook trout, *Salvelinus fontinalis*	Reservoir; riverine	Stocked on at least one occasion in the Middle Fork American River in 1933, the Rubicon River in 1928 and 1936, and in Duncan Creek in 1934
Lake trout, *Salvelinus namaycush*	Reservoir	Self-sustaining population in Hell Hole Reservoir
Smallmouth bass, *Micropterus salmoides*	Reservoir; riverine	North Fork American River; Stocked on at least two occasions in 1951
Brown bullhead, *Ameiurus nebulosus*	Reservoir; riverine	North Fork American River
Green sunfish, *Lepomis cyanellus*	Reservoir; riverine	North Fork American River
Tui chub, *Gila bicolor*	Reservoir; riverine	Hell Hole Reservoir

Table 6-3. Summary of Fish Sampling that has Occurred In the Middle Fork American River Watershed.

Reservoir/ River	Location (~River Mile)	Date	Sampling Method	Sampling Area	# Passes	Species	Population Estimate (for sample reach)	Density (fish/mile)	Biomass (lbs/acre)	Minimum Length (mm)	Maximum Length (mm)	Notes
Rubicon River												
	21.5	1974-75	Electrofish			RBT	128[b]			38	241	Lengths approximate
	21.5	1974-75	Electrofish			BRN	36[b]			64	419	Lengths approximate
	25	1978	Electrofish	300 ft.		RBT		475	30			Upstream of Hales Crossing
	25	1978	Electrofish	300 ft.		BRN		70	3			Upstream of Hales Crossing
	25	1978	Electrofish	300 ft.		RBT		3,221	41			Downstream of Hales Crossing
	25	1978	Electrofish	300 ft.		BRN		176	7			Downstream of Hales Crossing
	22.7	10/14/1993	Electrofish	288 ft		RBT	255 ± 26	4,675	24.6	54	242	Immediately upstream of South Fork Rubicon confluence
	22.7	10/14/1993	Electrofish	288 ft		BRN	130 ± 13.8	2,383	39.8	70	527	Immediately upstream of South Fork Rubicon confluence
	22.7	10/14/1993	Electrofish	288 ft		Sculpin						Immediately upstream of South Fork Rubicon confluence
	23.7	10/13/1993	Electrofish	264 ft		RBT	63 ± 12	1,260	13.9	60	236	Site 1 mile upstream of South Fork Rubicon River confluence
	23.7	10/13/1993	Electrofish	264 ft		BRN	144 ± 9.8	2,880	38.3	65	287	Site 1 mile upstream of South Fork Rubicon River confluence
	23.7	10/13/1993	Electrofish	264 ft		Sculpin	8 ± 1	160	0.5	51	105	Sculpin not identified to species
	21.6	9/20/1994	Electrofish	232 ft		RBT	68	1,547	12.6	62	242	Near Ellicott Bridge
	21.6	9/20/1994	Electrofish	232 ft		BRN	65	1,479	31.5	73	527	Near Ellicott Bridge
	21.6	9/20/1994	Electrofish	232 ft		SS	1				47	Near Ellicott Bridge

Table 6-3. Summary of Fish Sampling that has Occurred In Middle Fork Project-Associated Waters (continued).

Reservoir/ River	Location (~River Mile)	Date	Sampling Method	Sampling Area	# Passes	Species	Population Estimate	Density (#/mile)	Biomass (lbs./acre)	Minimum Length (mm)	Maximum Length (mm)	Notes
Rubicon River (continued)												
	3.8	7/12/2001	Snorkel	959 ft.		RBT		1,239				
	3.8	7/12/2001	Snorkel	959 ft.		BRN		17				
	3.8	7/12/2001	Snorkel	959 ft.		SS		562				
	3.8	7/12/2001	Snorkel	959 ft.		SP		953				
	3.8	7/12/2001	Snorkel	959 ft.		Sculpin		11				
Long Canyon Creek												
	8.5	Feb-84	Electrofish	300 ft.	3	RBT	22[b]			75	180	High flows prevented popn estimation
	8.5	Sep-84	Electrofish	259 ft.	3	RBT	221± 4	4,505	59			Adults and fry
	8.5	Sep-84	Electrofish	259 ft.	3	RBT	19± 0	387	23			Adults only
Middle Fork American River												
	52	8/14/1986	Electrofish	250 ft		RBT	4[b]					Qualitative survey
	52	8/14/1986	Electrofish	250 ft		BRN	40[b]					Qualitative survey
SF Long Canyon												
	2.1	Aug-79	Electrofish			trout[a]	87 ± 5.2	106	41.7			Downstream of South Fork Diversion
	3.7	Aug-79	Electrofish			trout[a]	73 ± 3.8	766	142			Upstream of South Fork Diversion
	4.5	Aug-79	Electrofish			trout[a]	54 ±7.7	276	54.6			Upstream of South Fork Diversion
NF Long Canyon												
	2.5	5/28/1968	Electrofish	riffle	2	trout[a]	--	1,840	64			Downstream of North Fork Diversion
	2.5	5/28/1968	Electrofish	pool	2	trout[a]	--	2,480	115			Downstream of North Fork Diversion

Table 6-3. Summary of Fish Sampling that has Occurred In Middle Fork Project-Associated Waters (continued).

Reservoir/ River	Location (~River Mile)	Date	Sampling Method	Sampling Area	# Passes	Species	Population Estimate	Density (#/mile)	Biomass (lbs./acre)	Minimum Length (mm)	Maximum Length (mm)	Notes
Hell Hole Reservoir												
		5/24/1966	Gill Net			RBT	10[b]			157	318	12 hour set; one net
		5/24/1966	Gill Net			BRN	2[b]			356	394	12 hour set; one net
		5/24/1966	Gill Net			SKR	13[b]			170	272	12 hour set; one net
		9/7/1967	Gill Net			RBT	2[b]			165	185	12 hour set; two nets
		9/7/1967	Gill Net			BRN	1[b]			212		12 hour set; two nets
		9/7/1967	Gill Net			SKR	88[b]			127	279	12 hour set; two nets
		9/7/1967	Gill Net			TC	4[b]			96	152	12 hour set; two nets
		6/16/1971	Gill Net			RBT	5[b]			20	390	81 hour set; six nets
		6/16/1971	Gill Net			BRN	19[b]					81 hour set; six nets
		6/16/1971	Gill Net			SKR	228[b]					81 hour set; six nets
		6/16/1971	Gill Net			TC	539[b]					81 hour set; six nets
		11/7/1974	Gill Net			RBT	2[b]			191	224	14 hour set; two nets; across from boat ramp on east side
		11/7/1974	Gill Net			BRN	7[b]			251	597	14 hour set; two nets; across from boat ramp on east side
		11/7/1974	Gill Net			SKR	62[b]					14 hour set; two nets; across from boat ramp on east side
		11/7/1974	Gill Net			TC	20[b]					14 hour set; two nets; across from boat ramp on east side

Table 6-3. Summary of Fish Sampling that has Occurred In Middle Fork Project-Associated Waters (continued).

Reservoir/ River	Location (~River Mile)	Date	Sampling Method	Sampling Area	# Passes	Species	Population Estimate	Density (#/mile)	Biomass (lbs./acre)	Minimum Length (mm)	Maximum Length (mm)	Notes
Hell Hole Reservoir (continued)												
		9/15/1975	Gill Net			RBT	1[b]			208		11 hour set; two nets; west shore near power house and east shore
		9/15/1975	Gill Net			BRN	4[b]			508	610	11 hour set; two nets; west shore near power house and east shore
		9/15/1975	Gill Net			SKR	1[b]			356		11 hour set; two nets; west shore near power house and east shore
		1/25/1978	Gill Net			RBTxCT	2[b]			280	338	16.75 hour set; cove on south shore
		1/25/1978	Gill Net			BRN	4[b]			245	330	16.75 hour set; cove on south shore
		1/25/1978	Gill Net			SKR	38[b]					16.75 hour set; cove on south shore
		1/25/1978	Gill Net			TC	267[b]					16.75 hour set; cove on south shore
		1/25/1978	Gill Net			RBTxCT	1[b]			328		14 hour set; upper end of lake
		1/25/1978	Gill Net			BRN	6[b]			234	623	14 hour set; upper end of lake
		1/25/1978	Gill Net			SKR	3[b]			116	354	14 hour set; upper end of lake
		1/25/1978	Gill Net			TC	134[b]			92	274	14 hour set; upper end of lake
		6/16/1983	Gill Net			BRN	9[b]					54 hour set; three nets; near boat camps
		6/16/1983	Gill Net			SKR	219[b]					54 hour set; three nets; near boat camps
		6/16/1983	Gill Net			TC	104[b]					54 hour set; three nets; near boat camps

Table 6-3. Summary of Fish Sampling that has Occurred In Middle Fork Project-Associated Waters (continued).

Reservoir/ River	Location (~River Mile)	Date	Sampling Method	Sampling Area	# Passes	Species	Population Estimate	Density (#/mile)	Biomass (lbs./acre)	Minimum Length (mm)	Maximum Length (mm)	Notes
French Meadows Reservoir												
		9/16/1975	Gill Net			RBT	5[b]			190.5	279	11 hour set; two nets; west of boat ramp near first cove
		9/16/1975	Gill Net			BRN	9[b]			254	330	11 hour set; two nets; west of boat ramp near first cove
		5/24/1982	Gill Net			RBT	2[b]			254	360	14 hour set; two nets; off islands at upper end of lake
			Gill Net			BRN	3[b]			256	360	14 hour set; two nets; off islands at upper end of lake
		6/2/1982	Gill Net			RBT	5[b]			241	328	15 hour set; 5 nets
		6/2/1982	Gill Net			BRN	51[b]			178	505	15 hour set; 5 nets
		8/21/1985	Gill Net			RBT	12[b]			154	174	12 hour set; Middle Fork Arm
		8/21/1985	Gill Net			BRN	2[b]			152	180	12 hour set; Middle Fork Arm

[a] Species not specified

[b] Actual count - not an estimate

Species: RBT=Rainbow trout, BRN=Brown trout, BRK=Brook trout, CT=Cutthroat trout, SR=Sacramento roach, SH=Sacramento hitch, SB=Sacramento blackfish, HH=Hardhead, SP=Sacramento pikeminnow, SD=Speckled dace, SS=Sacramento Sucker, TP=Tule perch, SC=Prickly/Riffle Sculpin, KS=Kokanee salmon, LT=Lake trout, SMB=Smallmouth bass, BB=Brown bullhead, GS=Green sunfish, TC=Tui chub, CF=Catfish (species undefined)

Table 6-4. Known (●) and Suspected (○) Native and Introduced Fish Species Distribution in the Middle Fork American River Watershed.

Reach	RBT	BRN	BRK	CT	SR	SH	SB	HH	SP	SD	SS	SC	KS	LT	SMB	BB	GS	TC	CF
Duncan Creek	●	○	●						○	●	●	●							
Middle Fork American River above French Meadows	●	●	●						○	●	○	○							
French Meadows Reservoir	●	●							●	●	●	○			●		●		●
Middle Fork American River from French Meadows – Interbay	●	●						●	●		●								
Interbay Reservoir	●	●						○	●	●	●	●							
Middle Fork American River from Interbay – Ralston	●	●						●	●		●								
Middle Fork American River from Ralston – NF American	●	●				○	●	●	●	●	●	●							
NF American from Middle Fork American River – Folsom Reservoir	●	●			○	●	●	○	○	●	●	●			●	●	●		
Rubicon River above Hell Hole	●	●	○	○				○	●	●	●	●							
Hell Hole Reservoir	●	●	○	○				●	●	●	●	○	●	●				●	
Rubicon R from Hell Hole – Ralston	●	●	○	○				●	●	●	●	●							
North Fork Long Canyon Creek	●							○	○	●	●	●							
South Fork Long Canyon Creek	●							○	○	●	●	●							
Long Canyon Creek	●	○	○						○	●	●	●							

Species: RBT=Rainbow trout, BRN=Brown trout, BRK=Brook trout, CT=Cutthroat trout, SR=Sacramento roach, SH=Sacramento hitch, SB=Sacramento blackfish, HH=Hardhead, SP=Sacramento pikeminnow, SD=Speckled dace, SS=Sacramento Sucker, TP=Tule perch, SC=Prickly/Riffle Sculpin, KS=Kokanee salmon, LT=Lake trout, SMB=Smallmouth bass, BB=Brown bullhead, GS=Green sunfish, TC=Tui chub, CF=Catfish (species undefined)

Table 6-5. Summary of Special-status Amphibians, Aquatic Reptiles, Mollusks Known to Occur or Potentially Occurring in the Vicinity of the Middle Fork American River Project (MFP).

Scientific Name	Common Name	Federal Status	State Status	Other List	Habitat	Occurrence Notes
Special-Status Aquatic Species Known to Occur in the Vicinity of the MFP						
Rana boylii	foothill yellow-legged frog	—	CSC	FSS[3]	Breeds in rocky streams with cool, clear water in a variety of habitats, including valley and foothill oak woodland, riparian forest, ponderosa pine, mixed conifer, coastal scrub, mixed chaparral, and wet meadows; occurs at elevations ranging from 0 to 6,000 feet.	Known to occur in the vicinity of the MFP. Downstream of Ralston Afterbay, FYLF occur at the confluences of four tributaries with the Middle Fork American River (Gas Canyon Creek, Todd Creek, Otter Creek, and the North Fork of the Middle Fork American River). Above Ralston Afterbay, FYLF are found in the Rubicon River as far upstream as Ellicott Bridge and in the Middle Fork American River an unknown distance upstream.
Special-Status Aquatic Species Potentially Occurring in the Vicinity of the MFP						
Rana aurora draytonii	California red-legged frog	FT	CSC	—	Breeds in quiet streams and permanent, deep, cool ponds with overhanging and emergent vegetation below 4,000 feet elevation. Known to occur adjacent to breeding habitats in riparian areas and heavily vegetated streamside shorelines, and non-native grasslands. Sierran streams historically supported populations of red-legged frog; however, these populations have been eliminated.	May occur in appropriate habitat. The MFP is within the known geographic and elevational range of this species. The closest records for this species are ~ 1.5 miles east of the Ralston Powerhouse and ~ 2.5 miles NE of Ralston Afterbay Dam.
Hydromantes platycephalus	Mount Lyell salamander	—	CSC	—	High elevation rock outcrops associated with free surface water (permanent streams, waterfalls, and seeps); breeds beneath granite rocks or slabs covering moist granitic soil. Sierra to Tulare counties at elevations from 4,000 to 11,600 feet.	May occur in appropriate habitat. The MFP is within the known geographic and elevational range of this species.
Actinemys marmorata marmorata	northwestern pond turtle	—	CSC	FSS[3]	Perennial wetlands and slow moving creeks and ponds with overhanging vegetation up to 6,000 feet; suitable basking sites such as logs and rocks above the waterline.	May occur in appropriate habitat. The MFP is within the known geographic and elevational range of this species. Known to occur within the watershed on the Middle Fork American River just downstream of Ralston Afterbay Dam in the Horseshoe Bar area.
Special-Status Mollusk Species Potentially Occurring in the Vicinity of the MFP (based on the fact that Mollusks have been poorly surveyed in the Sierra Province and reliable conclusions about their distribution cannot be made).						
Helisoma newberryi	Great Basin rams-horn (snail)	—	—	FSS[2]	Larger lakes and slow rivers, including larger spring sources and spring fed creeks. In mountain streams and lakes south to Lake Tahoe; under stones (Storer et al. 2004).[2]	This is a relict species that is confined to large spring complexes on the periphery of the Great Basin. There are few remaining populations; one Lake Tahoe population is believed extant.
Anodonta californiensis	California Floater	—	—	FSS	Larger lakes and slow rivers. Generally on soft substrates (mud-sand). Low elevation species.	There are few remaining populations. The MFP is outside the known geographic range of this species.
Juga (Calibasis) acutifilosa	Scalloped Juga (snail)	—	—	FSS	Large river form, restricted to swift unpolluted, well-oxygenated areas with gravel boulder substrate, generally at low elevations.	There are few remaining populations. The MFP is outside the known geographic range of this species.
Special-Status Aquatic Species Unlikely to Occur in the Vicinity of the MFP						
Bufo canorus	Yosemite toad	FC	CSC	FSS[1]	Occurs in montane meadows and forest borders; breeds in shallow pools, at lake margins, or in pools of quiet streams at elevations ranging 6,400 to 11,300 feet.	Unlikely to occur. The MFP is outside the known elevational range of this species.
Rana pipiens	northern leopard frog	—	CSC	FSS[1]	Native range is east of the Sierra crest only. Found near permanent or semi-permanent water in a variety of habitats. Highly aquatic species. Shoreline cover, submerged and emergent aquatic vegetation are important habitat characteristics. Elevation range extends from sea level to 7000 feet.	Unlikely to occur. The MFP is outside the known geographic range of this species.
Rana muscosa	mountain yellow-legged frog	FC	CSC	FSS[3]	Occurs in the Sierras at elevations ranging from 4,500 to 12,000 feet; associated with streams, lakes, and ponds in montane riparian, lodgepole pine, subalpine conifer, and wet meadow habitats; breeds in shallow water in low gradient perennial streams and lakes.	Unlikely to occur. The MFP is outside the known geographic range of this species. (Pers. comm., Jann Williams USFS)

LEGEND:

Federal Status
FT = Federal Threatened
FE = Federal Endangered
FC = Federal Candidate
FD = Delisted Species
FSS1 = Forest Service Sensitive, Eldorado National Forest
FSS2 = Forest Service Sensitive, Tahoe National Forest
FSS3 = Forest Service Sensitive, Eldorado and Tahoe National Forests
FSS = Forest Service Sensitive, Pacific Southwest Region
MIS = Management Indicator Species

State Status
SR = California Rare
ST = California Threatened
SE = California Endangered
CFP = California Fully Protected
CSC = California Species of Special Concern

Table 6-6. Summary of Mesohabitat Types for the Middle Fork American River and Rubicon River.

Mesohabitat Type Classification			Percentage By Length of Habitat Types			
			Middle Fork American River			Rubicon River
McCain et al. 1990	Hawkins et al. 1993		French Meadows Reservoir to Middle Fork Interbay	Middle Fork Interbay to Ralston Afterbay	Ralston Afterbay to North Fork American River	Hell Hole Reservoir to Ralston Afterbay
Bedrock Sheet (BRS)	Fast Water	Turbulent	0.0%	0.0%	0.0%	0.0%
Cascade (CAS)			5.0%	5.7%	1.8%	9.2%
High Gradient Riffle (HGR)			17.1%	19.7%	3.5%	20.5%
Low Gradient Riffle (LGR)			4.8%	7.5%	9.0%	6.4%
Pocket Water (POW)		Non-Turbulent	1.3%	4.5%	0.2%	1.2%
Run (RUN)			7.6%	7.2%	18.2%	13.7%
Step Run (SRN)			4.4%	13.7%	6.9%	7.1%
Glide (GLD)			0.0%	1.6%	5.3%	1.3%
Trench Run (TRN)			2.5%	0.1%	0.1%	0.0%
Lateral Scour Pool (LSP)	Slow Water	Scour Pools	1.1%	2.0%	5.9%	7.9%
Corner Pool (CRP)			0.0%	0.0%	2.7%	0.0%
Mid Channel Pool (MCP)			27.8%	29.2%	46.1%	27.6%
Plunge Pool (PLP)			6.8%	0.3%	0.0%	0.2%
Step Pool (SPO)			19.7%	7.3%	0.3%	3.6%
Dammed Pool (DPL)		Dammed Pool	1.9%	1.3%	0.0%	1.4%

Table 6-7. Summary of Mesohabitat Types for the Duncan Creek, Long Canyon Creek, South Fork Long Canyon Creek and North Fork Long Canyon Creek.

Mesohabitat Type Classification			Percentage By Length of Habitat Types			
McCain et al. 1990	**Hawkins et al. 1993**		**Duncan Creek**	**Long Canyon Creek**	**South Fork Long Canyon**	**North Fork Long Canyon**
Bedrock Sheet (BRS)	Fast Water	Turbulent	0.0%	2.0%	1.9%	1.3%
Cascade (CAS)			3.0%	4.3%	0.8%	0.5%
High Gradient Riffle (HGR)			24.0%	13.6%	14.8%	23.9%
Low Gradient Riffle (LGR)			7.4%	18.7%	16.8%	17.5%
Pocket Water (POW)		Non-Turbulent	3.9%	2.5%	1.3%	0.7%
Trench Run (TRN)			2.4%	0.3%	0.7%	3.9%
Run (RUN)			2.5%	3.6%	7.6%	3.1%
Step Run (SRN)			5.1%	11.9%	17.3%	6.9%
Glide (GLD)			0.0%	0.0%	0.0%	0.0%
Lateral Scour Pool (LSP)	Slow Water	Scour Pool	7.8%	2.8%	5.6%	3.7%
Mid Channel Pool (MCP)			29.4%	18.4%	19.9%	15.9%
Plunge Pool (PLP)			1.4%	1.8%	1.6%	0.9%
Step Pool (SPO)			13.1%	19.7%	11.6%	21.1%
Dammed Pool (DPL)		Dammed Pool	0.0%	0.5%	0.1%	0.5%

Table 6-8. Results from Aquatic Invertebrate Sampling at Two Sites[1] in Duncan Creek in 2002 and 2003.

Location, Year	Number of Families Observed	Dominant Family	Total Taxa Richness	Shannon Diversity Index	Hilsenhoff Biotic Index
Duncan 1, 2002	21	Chironomidae	45	2.971	3.95
Duncan 1, 2003	24	Chironomidae	51	3.269	3.25
Duncan 2, 2002	16	Chironomidae	31	1.805	5.53
Duncan 2, 2003	26	Chironomidae	56	3.111	3.92

[1] The "Duncan 1" site is located downstream of the Duncan Diversion Dam near Bloody Ravine, and "Duncan 2" is located upstream of the Duncan Diversion Dam near the Little Duncan Creek confluence.

FIGURES

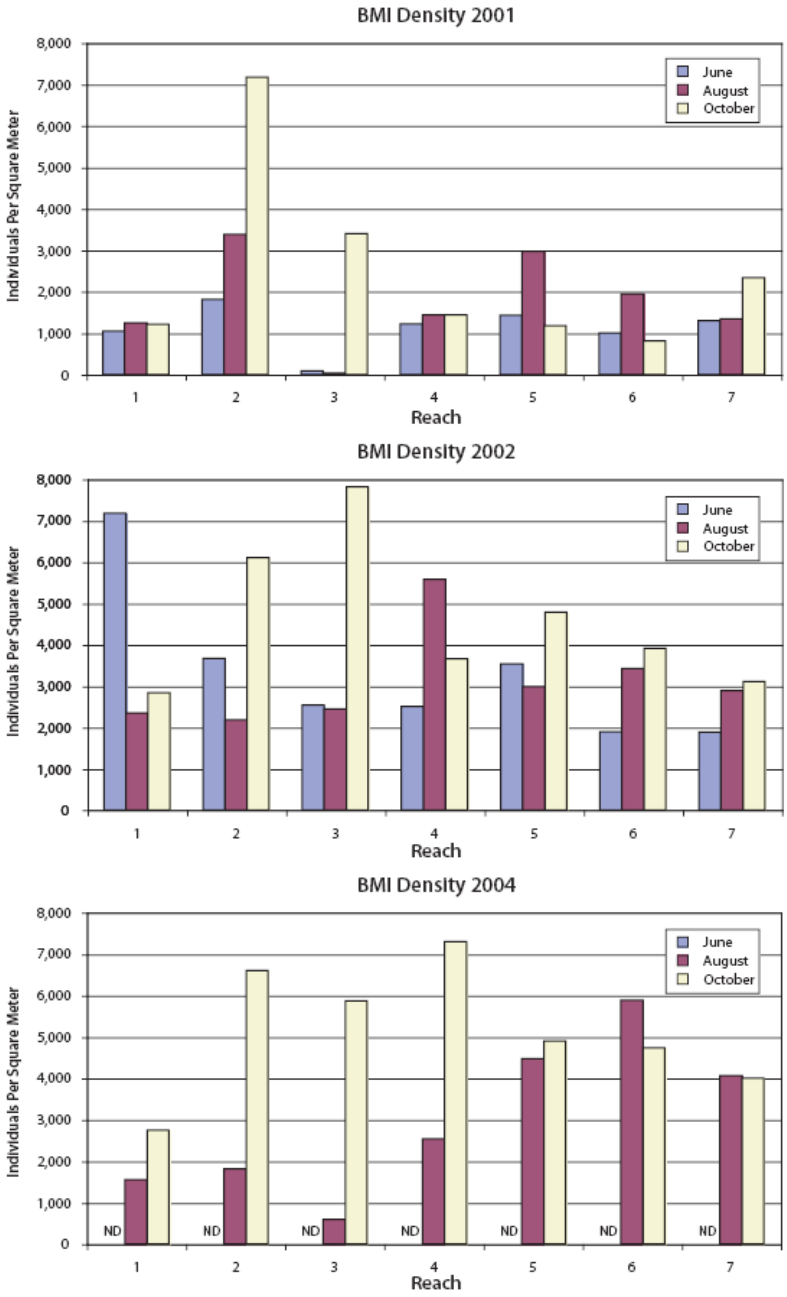

Figure 6-1. Benthic Macroinvertebrate Sampling Results from Five Reaches in the Middle Fork American River, One Reach in the North Fork of the Middle Fork American River, and One Reach in the Rubicon River (from JSA 2005)[1].

[1] Reaches 1, 2, 3, and 4 are located downstream of Ralston Dam, Reach 5 is located in the Middle Fork American River upstream of Ralston Afterbay, Reach 6 is located in the NF of the Middle Fork American River, and Reach 7 is located in the Rubicon River upstream of the Ralston Powerhouse.

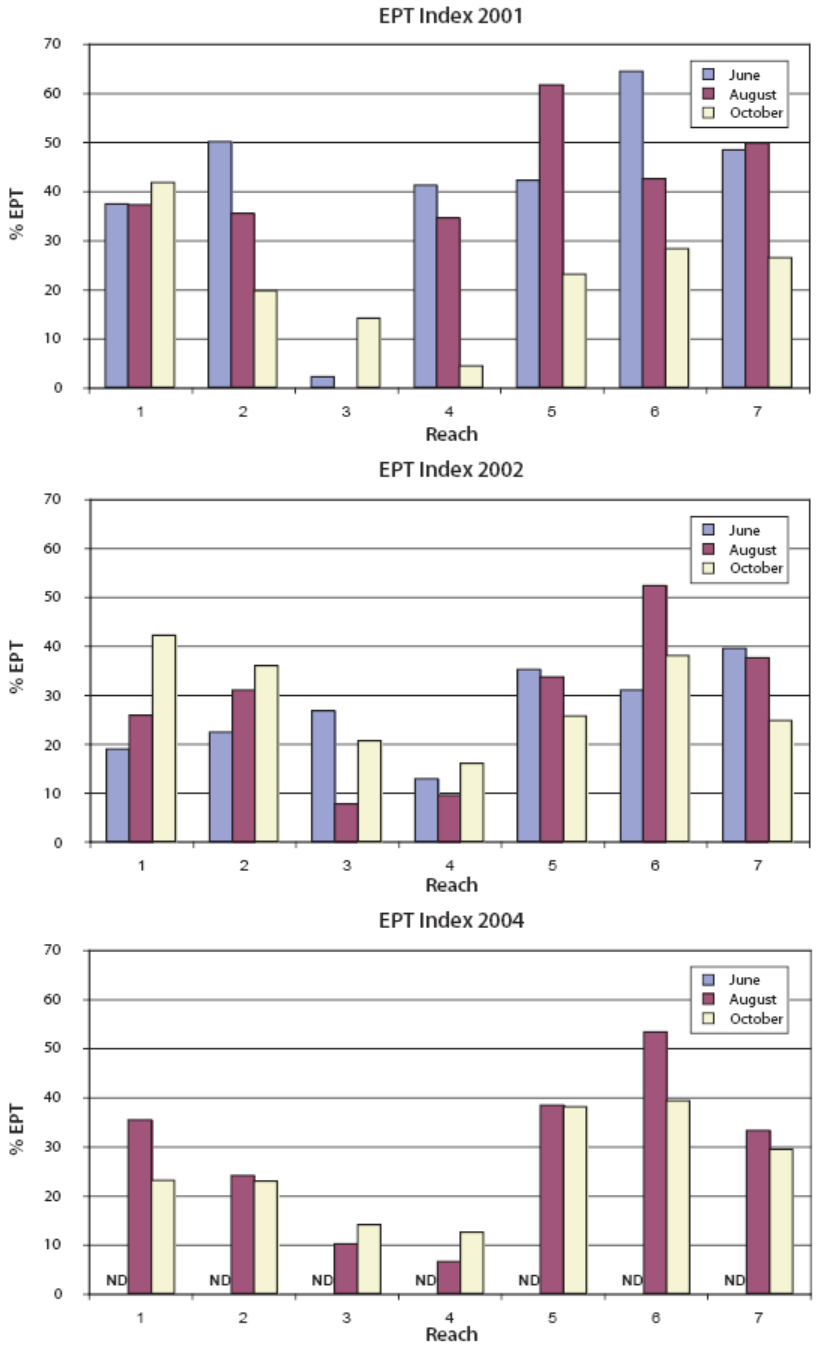

Figure 6-2. EPT Index Results from Five Reaches in the Middle Fork American River, One Reach in the North Fork of the Middle Fork American River, and One Reach in the Rubicon River (from JSA 2005)[1].

[1] Reaches 1, 2, 3, and 4 are located downstream of Ralston Dam, Reach 5 is located in the Middle Fork American River upstream of Ralston Afterbay, Reach 6 is located in the NF of the Middle Fork American River, and Reach 7 is located in the Rubicon River upstream of the Ralston Powerhouse.

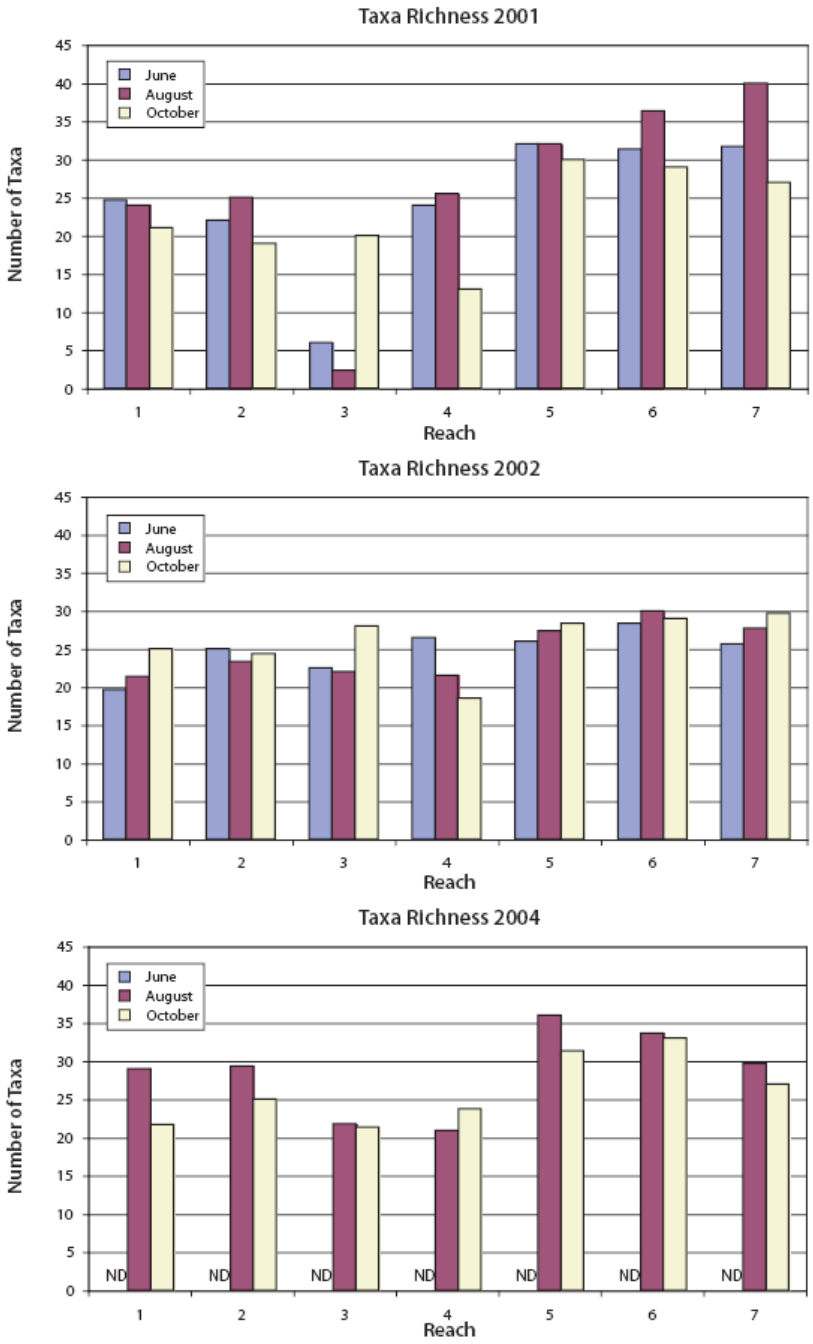

Figure 6-3. Taxa Richness Results from Five Reaches in the Middle Fork American River, One Reach in the North Fork of the Middle Fork American River, and One Reach in the Rubicon River (from JSA 2005)[1].

[1] Reaches 1, 2, 3, and 4 are located downstream of Ralston Dam, Reach 5 is located in the Middle Fork American River upstream of Ralston Afterbay, Reach 6 is located in the NF of the Middle Fork American River, and Reach 7 is located in the Rubicon River upstream of the Ralston Powerhouse.

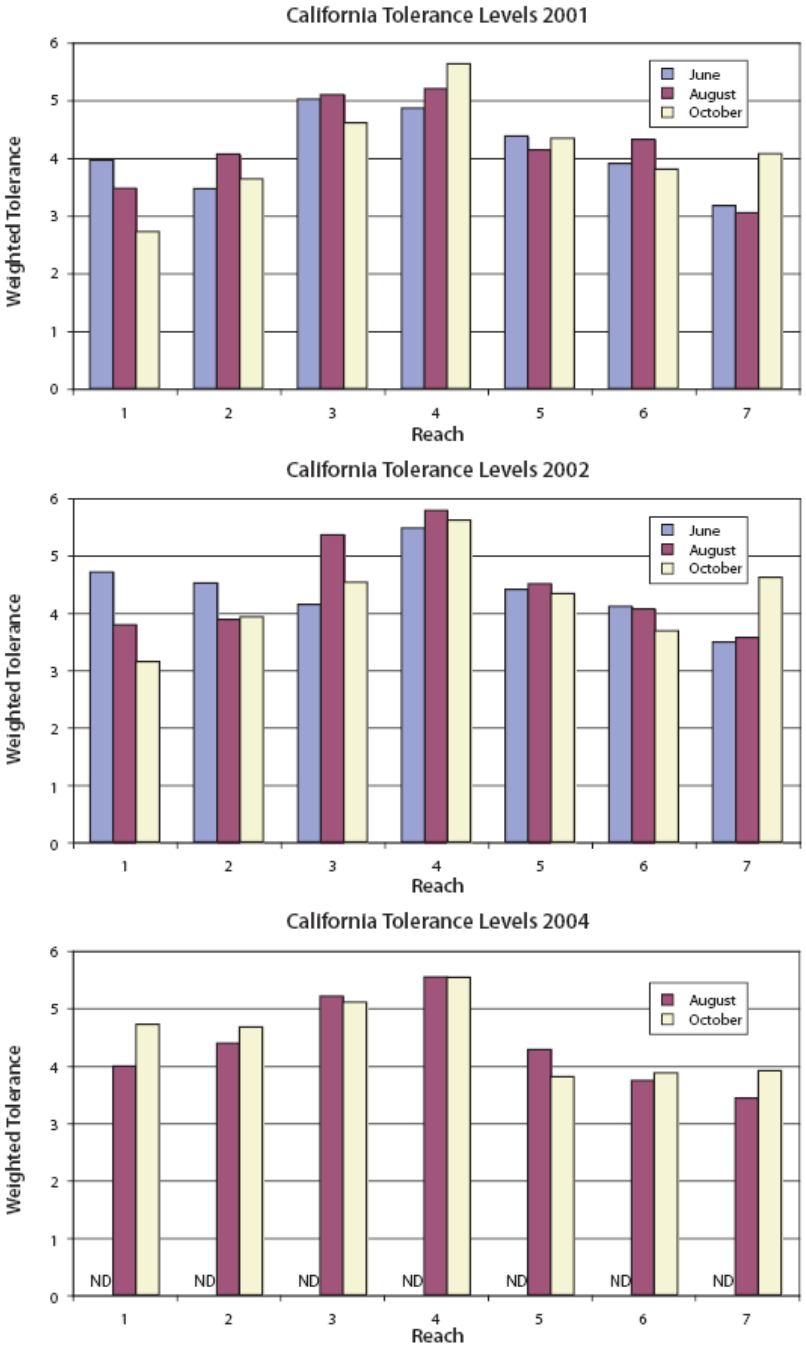

Figure 6-4. California Tolerance Level Results from Five Reaches in the Middle Fork American River, One Reach in the North Fork of the Middle Fork American River, and One Reach in the Rubicon River (from JSA 2005)[1].

[1] Reaches 1, 2, 3, and 4 are located downstream of Ralston Dam, Reach 5 is located in the Middle Fork American River upstream of Ralston Afterbay, Reach 6 is located in the NF of the Middle Fork American River, and Reach 7 is located in the Rubicon River upstream of the Ralston Powerhouse.

MAPS

APPENDIX 6-A

Historical Fish Stocking Records in the Middle Fork American River Watershed

Table 6-A-1. Historical Fish Stocking Records for the Middle Fork American River.

Year	Rainbow Trout	Brown Trout	Brook Trout	Steelhead
1926	5,000			
1929	14,000			
1930	40,000	30,000		19,000
1931	23,000	30,000		
1932	28,000	40,000		
1933	30,000	30,000	10,000	
1934	20,000	90,000		
1935	60,000	50,000		
1936	15,000			
1937		30,000		
1938	22,600	20,900		
1939	11,750	20,100		
1940				
1941				
1942	9,000			
1943	15,000			
1944				
1945	4,000			
1946	4,000			
1947	5,000			
1948	2,500			
1949	8,000			
1950	11,376			
1951	15,518			
1952	17,002			
1953	12,627	2,240		

Table 6-A-2. Historical Fish Stocking Records for Hell Hole Reservoir.

Year	Rainbow Trout[1]	Brown Trout	Lake Trout	Kokanee	Coho Salmon	Cutthroat Trout[2]	Brook Trout
1967	60,000						
1968	32,386						
1969	1,855	6,500					
1970	5,040						
1971	10,780						
1972	20,500						
1973	10,200					6,000	
1974	1,000				1,000	5,004	
1975						4,950	3,740
1976		10,200				22,300	
1978			2,852				
1979			3,000				
1989				45,000			
1992				73,500			
1994				74,960			
1995				71,750			
1996				51,975			
1997				50,050			
1998				35,600			
1999				25,000			
2000				25,026			
2001		6,380		26,600			
2002		8,100		25,272			
2003		7,500		24,960			
2004		4,200		22,275			
2005	[A]	4,400		25,012			

[1] Includes 2,800 Eagle Lake rainbows planted in 1971.
[2] Including cutthroat hybrids.
[A]The USFS-Eldorado National Forest (ENF 2006) reports that Hell Hole presently is stocked with catchable rainbow trout; however, recent stocking records have not been located.

Table 6-A-3. Historical Fish Stocking Records for French Meadows Reservoir.

Year	Rainbow Trout	Brown Trout	Eagle Lake Trout
1968	29,938		
1969	60,255		
1970	100,600		
1971	79,480		3,000
2001	10,050	6,380	
2002	12,500		4,000
2003	9,700		
2004	5,200		
2005	5,500		

Table 6-A-4. Historical Fish Stocking Records for the Rubicon River.

Year	Rainbow Trout	Brown Trout	Brook Trout	Steelhead
1928		2,380	8,572	
1931		35,000		
1932		31,000		
1933		30,000		
1934	15,000	30,000		
1935		24,000		
1936	11,500	30,000	10,000	
1937		35,000		5,000
1938	4,500	30,000		
1939	30,000			
1940	60,000			
1941	60,000			
1942	27,740			
1943	44,120			
1944	41,430			
1945	28,000			
1946	33,960			
1947	10,200			
1948	28,020			
1949	13,780			
1950	20,000			
1951	18,410			
1952	18,960			
1953	20,000			

Table 6-A-5. Historical Fish Stocking Records for Duncan Creek.

Year	Rainbow Trout	Brown Trout	Brook Trout	Steelhead
1930	10,000	10,000		
1931	10,000	10,000		
1932	5,000	15,000		
1933	10,000			
1934	15,000		10,000	
1935				
1936				
1937				20,000
1938	18,000			
1939	25,000			
1940	30,240			
1941	42,725			
1942	25,920			
1943	6,000			
1944	5,000			
1945	9,600			
1946	19,600			
1947	20,160			
1948	15,002			
1950	6,996			
1951	3,024			
1952	4,000			
1953	7,005			

APPENDIX 6-B

Life History and Habitat Requirements of Special-Status Fish Species Known to Occur or with a Reasonable Potential to Occur in the Middle Fork American River Watershed

Overview

The information presented in this Appendix is intended to provide a brief overview of the life histories and habitat requirements of special status and recreationally-important fish species known or reasonably expected to occur in the vicinity of the MFP.

Hardhead (*Mylopharodon conocephalus*)

Hardhead are a large (occasionally exceeding 600 mm standard length [SL]), native cyprinid species that generally occurs in large, undisturbed low- to mid-elevation rivers and streams of the region (Moyle 2002). The species is widely distributed throughout the Sacramento-San Joaquin River system, although it is absent from the valley reaches of the San Joaquin River. Hardhead are listed as a state "species of special concern" and a USFS sensitive species.

Hardhead mature following their second year. Spawning migrations, which occur in spring, into smaller tributary streams, are common. The spawning season may extend into August in the foothill streams of the Sacramento River and San Joaquin River basins. Spawning behavior has not been documented, but hardhead are believed to elicit mass spawning in gravel riffles (Moyle 2002). It is reported that little is known about life stage specific temperature requirements of hardhead.

Hardhead are omnivores, feeding primarily on benthic invertebrates and aquatic plant material (Moyle 2002). In small streams, adult hardhead attain lengths of up to 11 inches and in larger river systems can obtain lengths up to 23 inches.

Brown Trout (*Salmo trutta*)

Brown trout are a non-native gamefish first introduced to California in 1893 (Moyle 2002). Currently, brown trout provide some of the finest wild trout angling opportunities in California (Moyle 2002). Brown trout are widely distributed throughout California; however, the waters with abundant populations are relatively few (CDFG 2006). Historically, the species was planted in most California trout waters, but in recent years only a few lakes and streams have been stocked (CDFG 2006). Nevertheless, brown trout can be found in many lakes reservoirs and streams on the east and west slopes of the Sierra where they appear to spawn quite successfully (CDFG 2006).

Brown trout normally spawn from November through December in small tributaries although some successful spawning has been reported to occur in lakes (Raleigh 1986). Riverine spawning brown trout construct redds (nests) in gravel substrate, with diameters of 0.7 to 2.8 inches, at depths ranging from 4.8 to 36.0 inches (Raleigh 1986). Raleigh et al (Raleigh 1986) reports that water velocity may be a more important factor in selecting redd sites than water depth and that velocities of 1.3 to 2.3 fps are considered optimal. Embryo incubation normally requires seven to eight weeks depending on water temperatures with alevins emerging from the gravel three to six weeks later (Moyle 2002).

Brown trout over 9 inches in length are active pursuers of large prey, particularly fish (including their own young) and active invertebrates such as crayfish. Adult brown trout

largely are bottom-oriented pool dwellers in streams and rivers, but juvenile brown trout reportedly are found equally often in pools and riffles. Sexual maturity normally occurs in the second or third year (Moyle 2002). Brown trout generally are longer lived than rainbow trout, with a maximum recorded age in California of nine years and a maximum age on record of 38 years (Moyle 2002).

Rainbow Trout (*Oncorhynchus mykiss*)

Rainbow trout are native to California coastal streams from the Los Angeles River system north to the Klamath River. They are also native to most areas within the Sacramento-San Joaquin system (Moyle 2002). The species is the most popular and widely distributed gamefish in California (Moyle 2002). Rainbow trout and steelhead are the same species. Steelhead are differentiated from rainbow trout in having an anadromous life history. Regardless of their life history strategy, for the first year or two of life, both steelhead and rainbow trout exhibit similar juvenile life history characteristics (Moyle 2002 1220 /id).

Most wild rainbow trout spawn in the spring between February and June (Moyle 2002). Rainbow trout normally spawn by constructing redds in coarse gravel substrate, 0.5 to 5.1 inches in diameter, in the tail of a pool or riffle (Moyle 2002); preferred gravel size is reported to be 0.25 to 3.0 inches in diameter (USFWS 1995). The number of eggs per female normally depends on size of the fish at spawning, and ranges from 2,000 to 12,000 eggs (Moyle 2002). Most spawning is observed when water temperatures are between 46°F and 52°F in water flowing from 0.2 to 3.6 ft/sec (USFWS 1995). Water temperatures above 63°F are reportedly lethal to developing rainbow trout embryos (Moyle 2002). Eggs normally hatch in three to four weeks with alevins remaining in the gravel for another two to three weeks (Moyle 2002).

For the first year of life, juvenile rainbow trout normally inhabit cool, fast-flowing streams and rivers where riffles predominate over pools and there is cover from riparian vegetation and undercut banks (Moyle 2002). Older rainbow trout tend to move into deeper runs or pools (Moyle 2002). Rainbow trout are reportedly found where daytime water temperatures range from 32°F in the winter to 80.6°F in the summer, although 73.4°F is reportedly lethal for unacclimated fish (Moyle 2002). Although primarily a riverine species, suitable habitat for rainbow trout can often be found in mountain lakes and cold water reservoirs (Moyle 2002). In California, lake and reservoir populations are artificially maintained when access to suitable spawning habitat in tributaries is not available (Moyle 2002).

Rainbow trout feed mainly on insects, with fish becoming an important part of their diet when lengths exceed 11 inches (Moyle 2002). Rainbow trout normally become sexually mature in their second or third year and normally live to age five, although 11 year-old rainbow trout have been reported (Moyle 2002).

APPENDIX 6-C

Life History and Habitat Requirements of Special-Status Amphibians, Aquatic Reptiles, and Mollusks Known to Occur or Potentially Occurring in the Vicinity at the Middle Fork American River Project

Special-status Aquatic Species Known to Occur in the Vicinity at the Middle Fork American River Project

Amphibians

Foothill yellow-legged frog (Rana boylii; FSS, CSC)

From: California Wildlife Habitat Relationships System, California Department of Fish and Game, Database Version 8.1 (2005)
Written by: S. Morey
Reviewed by: T. Papenfuss
Edited by: R. Duke, E. C. Beedy
Updated by: CWHR Program Staff, January 2000

Distribution, Abundance, and Seasonality

The foothill yellow-legged frog occurs in the Coast Ranges from the Oregon border south to the Transverse Mountains in Los Angeles Co., in most of northern California west of the Cascade crest, and along the western flank of the Sierra south to Kern Co. Livezey (1963) reported an isolated population in San Joaquin Co. on the floor of the Central Valley. Isolated populations are also known from the mountains of Los Angeles County. Its elevation range extends from near sea level to 1940 m (6370 ft) in the Sierra (Jennings and Hayes 1994). The foothill yellow-legged frog is found in or near rocky streams in a variety of habitats, including valley-foothill hardwood, valley-foothill hardwood-conifer, valley-foothill riparian, ponderosa pine, mixed conifer, coastal scrub, mixed chaparral, and wet meadow types.

Specific Habitat Requirements

Feeding: Adults eat both aquatic and terrestrial invertebrates. Adult insects appear to be favored, but snails, and pieces of molted skin have also been found in stomach samples (Fitch 1936). Tadpoles probably graze on algae and diatoms along rocky stream bottoms.

Cover: Adults often bask on exposed rock surfaces near streams. When disturbed, they dive into the water and take refuge under submerged rocks or sediments. During periods of inactivity, especially during cold weather, individuals seek cover under rocks in the streams or on shore within a few meters of water.

Reproduction: Egg clusters are attached to gravel or rocks in moving water near stream margins.

Water: Unlike most other ranid frogs in California, this species is rarely encountered (even on rainy nights) far from permanent water. Tadpoles require water for at least three or four months while completing their aquatic development.

Pattern: Foothill yellow-legged frogs are found in or near rocky streams in a variety of habitats.

Species Life History

Activity Patterns: Terrestrial individuals are primarily diurnal. Frogs may be active all year in the warmest localities, but may become inactive or hibernate in colder areas.

Seasonal Movements/Migration: Significant seasonal movements or migrations from breeding areas have not been reported. Nussbaum et al. (1983) found frogs underground and beneath surface objects more than 50 m (155 ft) from water in April. These frogs probably spend most of their time in or near streams at all seasons.

Home Range: Normal home ranges are probably less than 10 m (33 ft) in the longest dimension. Occasional long distance movements (up to 50 m) (165 ft) may occur during periods with high water conditions.

Territory: Like most ranid frogs, males of this species probably defend areas around themselves during the breeding season (Martof 1953, Emlen 1968).

Reproduction: In California, breeding and egg laying usually await the end of spring flooding and may commence any time from mid-March to May, depending on local water conditions. The breeding season at any locality is usually about two weeks for most populations. Females deposit eggs in clusters of 200 to 300 (range 100 to 1000). They hatch in about five days. Tadpoles reach maximum sizes of 50 to 55 mm (2.2 in) and transform in three to four months.

Niche: Garter snakes (Fitch 1941) feed heavily on tadpoles and adults. The foothill yellow-legged frog coexists with the Cascades frog and the red-legged frog at some localities, but different microhabitat preferences probably diminish competition. Moyle (1973) implicated the bullfrog in the observed reduction of foothill yellow-legged frog populations in the Sierra. Centrachid fishes readily eat Rana eggs (Werschkul and Christensen 1977), and, where introduced into foothill streams, may also contribute to the eliminiation of R. boylii.

References

Emlen, S. T. 1968. Territoriality in the bullfrog, Rana catesbeiana. Copeia 1968:240-243.

Fitch, H. S. 1936. Amphibians and reptiles of the Rogue River Basin,Oregon. Am. Midl. Nat. 17:634-652.

Fitch, H. S. 1941. The feeding habits of California garter snakes. Calif. Dept. Fish and Game 27:1-32.

Jennings, M. R. and M. P. Hayes. 1994. Amphibian and reptile species of special concern in California. California Department of Fish and Game. Rancho Cordova 255 pp.

Livezey, R. L. 1963. Distribution of some California amphibians and reptiles. Herpetologica 18:279-281.

Martof, B. S. 1953. Territoriality in the green frog, Rana clamitans. Ecology 34:165-174. Moyle, P. B. 1973. Effects of introduced bullfrogs, Rana catesbeiana, on the native frogs of the San Joaquin Valley, California. Copeia 1973:18-22.

Nussbaum, R. A., E. D. Brodie, Jr., and R. M. Storm. 1983. Amphibians and reptiles of the Pacific Northwest. Univ. Press of Idaho. 332pp.

Stebbins, R. C. 1985. A field guide to western reptiles and amphibians. 2nd ed., revised. Houghton Mifflin, Boston. 336pp.

Werschkul, D. F., and M. T. Christensen. 1977. Differential predation by Lepomis macrochirus on the eggs and tadpoles of Rana. Herpetologica 33:237-241.

Zweifel, R. G. 1955. Ecology, distribution, and systematics of frogs of the Rana boylei group. Univ. Calif. Publ. Zool. 54:207-292.

Zweifel, R. G. 1968. Rana boylii. Cat. Am. Amphibians and Reptiles 71.1-71.2.flin, Boston. 336pp.

Special-status Aquatic Species Potentially Occurring in the Vicinity at the Middle Fork American River Project

Amphibians

California red-legged frog (*Rana aurora draytonii*; FT, CSC)

From: California Wildlife Habitat Relationships System, California Department of Fish and Game, Database Version 8.1 (2005)

Written by: S. Morey, H. Basey
Reviewed by: T. Papenfuss
Edited by: R. Duke
Updated by: CWHR Program Staff, September 1999

Distribution, Abundance, And Seasonality

The red-legged frog inhabits quiet pools of streams, marshes, and occasionally ponds. Occurs west of the Sierra-Cascade crest and along the Coast Ranges the entire length of the state (Stebbins 1985), usually below 1200 m (3936 ft). Uncommon in Sierra-Cascade portion of range, uncommon to common elsewhere.

Specific Habitat Requirements

Feeding: Highly variable. Adults take aquatic and terrestrial insects and crustaceans and snails (Stebbins 1951), as well as worms, fish, tadpoles, smaller frogs, and small mammals. (Dickerson 1906, Baldwin and Stanford 1987). Aquatic larvae are mostly herbivorous.

Cover: Highly aquatic. Prefers shorelines with extensive vegetation. Usually escapes to water 1 m (3 ft) deep or more, at the bottom of pools.

Reproduction: Eggs are deposited in permanent pools attached to emergent vegetation (Stebbins 1954). Northern red-legged frog (R. a. aurora) eggs are typically submerged whereas California red-legged frog (R. a. draytonii) eggs are in contact with waters surface (Hayes and Kremples 1986).

Water: Requires permanent or nearly permanent pools for larval development, which takes 11 to 20 weeks (Storer 1925, Calef 1973). Intermittent streams must retain surface water in pools year-round for frog survival (Jennings et al. 1993). May require rains for dispersal. Individuals have been found considerable
distances from breeding sites on rainy nights. Water salinity may have an important influence on embryo survival (Jennings and Hayes 1989).

Pattern: Occurs in the vicinity of quiet, permanent pools of streams, marshes, and occasionally ponds.

Species Life History

Activity Patterns: Active all year coastally, but with periods of inactivity (late summer to early winter) elsewhere.

Seasonal Movements/Migration: A highly aquatic species with little movement away from streamside habitats. Individuals are occasionally found on roads at night during winter and spring rains. The nature of these movements is unknown.

Home Range: Unknown; possibly large for dispersing juveniles but probably smaller for adults.

Territory: Males probably defend a space for sexual display during the breeding season, as in other ranids (Martof 1953, Emlen 1968).

Reproduction: Breeds January to July (peak in February) in the south, and March to July in the north. Females lay 750 to 4000 eggs in clusters up to 10 in across, attached to vegetation 7 to 15 cm (2 to 6 in) below the surface (Stebbins 1954). Tadpoles require 11 to 20 weeks to reach metamorphosis (Stebbins 1951, Calef 1973).

Niche: Probably subject to predation by aquatic invertebrates and vertebrates such as fishes, other amphibians, snakes, and occasionally birds and mammals, during all life history stages.

General Comments: Sierra populations are highly restricted and consist of small numbers of individuals. Human activities that result in habitat destruction and/or the introduction of exotic competitors such as bullfrogs and green sunfish may have a negative effect on these few existing Sierra populations (Moyle 1973).

References

Baldwin, K. S. and R. A. Stanford. 1987. Life history notes: Ambystoma tigrinum californiense (California tiger salamander): predation. Herpetological Review 18 (2): 33. Calef, G. W. 1973. Natural mortality of tadpoles in a population of Rana aurora. Ecology 54:741-758.

Dickerson, M. C. 1906. The frog book. Doubleday, New York. 253pp.

Emlen, S. T. 1968. Territoriality in the bullfrog, Rana catesbeiana. Copeia 1968:240-243.

Hayes, M. P. and Kremples. 1986. Vocal sac variation among frogs of the genus Rana from western North America. Copeia 4: 927-936.

Hayes, M. P. and M. R. Jennings. 1988. Habitat correlates of distribution of the California red-legged frog (Rana aurora draytonii) and the foothill yellow-legged frog (Rana boylii): implications for management. Pages 144-158 in R. C. Szaro, K. E. Severson and D. R.

Patton, eds. Management of amphibians, reptiles, and small mammals in North America. Gen. Tech. Rep. RM-166. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO.

Jennings, M. R. and M. P. Hayes. 1989. Final report of the status of the California red-legged frog (Rana aurora draytonii) in the Pescadero Marsh Natural Preserve. Contract No. 4-823-9018. California Academy of Sciences, pp. 56.

Jennings, M. R., M. P. Hayes and D. C. Holland. 1993. A petition to the U. S. Fish and Wildlife Service to place the California Red-legged Frog (Rana aurora draytonii) and the Western Pond Turtle (Clemmys marmorata) on the list of endangered and threatened wildlife and plants.

Martof, B. S. 1953. Territoriality in the green frog, Rana clamitans. Ecology 34:165-174.

Moyle, P. B. 1973. Effects of introduced bullfrogs, Rana catesbeiana, on the native frogs of the San Joaquin Valley, California. Copeia 1973:18-22.

Stebbins, R. C. 1951. Amphibians of western North America. Univ. California Press, Berkeley. 538 pp.

Stebbins, R. C. 1954. Amphibians and reptiles of western North America. McGraw-Hill, New York. 536pp.

Stebbins, R. C. 1985. A field guide to western reptiles and amphibians. 2nd ed., revised. Houghton Mifflin, Boston. 336pp.

Storer, T. I. 1925. A synopsis of the Amphibia of California. Univ. Calif. Publ. Zool. 27:1-342.

Mount Lyell Salamander (hydromantes platycephalus; CSC)

From: California Wildlife Habitat Relationships System, California Department of Fish and Game, Database Version 8.1 (2005)
Reviewed by: T. Papenfuss
Edited by: R. Duke, J. Harris
Updated by: CWHR Program Staff, January 2000

Distribution, Abundance, And Seasonality

The Mount Lyell salamander occurs only in the Sierra Nevada from Sierra Co. south to Tulare Co. Populations are discontinuously distributed in isolated patches of suitable habitat. Usually common where they occur, individuals are active on the surface only when free water in the form of seeps, drips, or spray is available. This species occurs in massive rock areas in mixed conifer, red fir, lodgepole pine, and subalpine habitats. Elevation range extends from 1260 m (4130 ft) to about 3640 m (11,940 ft) (Jennings and Hayes 1994).

Specific Habitat Requirements

Feeding: Stebbins (1972) listed centipedes, spiders, termites, beetles, and adult and larval flies as food items of this salamander. Food is obtained under surface objects, or while foraging on the surface at night.

Cover: Cover is provided during the period of surface activity primarily by flat granite rocks. Winter hibernation probably occurs within deep rock fissures or under slabs of exfoliating granite.

Reproduction: Little is known about specific microhabitat requirements for breeding and egg laying. Eggs are probably deposited beneath granite rocks or slabs covering moist granite soil.

Water: No information on water requirements, but Adams (1942) pointed out the apparent importance of high humidity and substrate moisture as habitat requirements of this species. Water requirements during the period of surface activity are met by snowmelt, seepages, and spray from waterfalls. During the remainder of the year moisture is provided by seepages within rock fissures or other subsurface refugia.

Pattern: Almost always associated with masslve rock areas in mixed-conifer, red fir, lodgepole, and subalpine habitat types. Such areas must include a water source. North and east slopes, often at the base of cliffs or rockpiles, appear to be favored. Preferred rocky areas are often over decomposed granite soils, which are moistened by seeps or melting snow.

Species Life History

Activity Patterns: Individuals are nocturnal during the period of surface activity and are

most likely to be encountered on the surface during or after rains. Individuals occupy surface microhabitats during periods of surface moisture in the spring, summer, and fall but retreat to moist subsurface refugia during dry periods and winter. Seasonal Movements/Migration: Individuals retreat to moist areas within deep rock fissures (Adams 1942) as snow banks retreat and the substratum dries.

Home Range: Individuals are not known to have home ranges exceeding 100 m in the longest dimension. Most individuals probably move much shorter distances.

Territory: Unknown, but females of the related species H. shastae appear to stay with eggs (Gorman 1956) and may defend egg clusters from certain predators. Reproduction: Museum specimens (Stebbins 1951, 1954) collected during summer possessed from 6 to 14 eggs (2.0 to 3.8 mm). It is possible that oviposition occurs during the fall with hatching occurring in the spring or early summer.

Niche: Because of their secretive habits and the relative absence of potential predators in the habitats where they normally occur, this species is probably not taken in large numbers as prey by any vertebrate species. No other salamander normally occurs in the preferred habitat of this species.

References

Adams, L. 1942. The natural history and classification of the Mount Lyell salamander, Hydromantes platycephalus. Univ. Calif. Publ. Zool. 46:179-204.

Gorman, J. 1956. Reproduction in plethodont salamanders of the genus Hydromantes. Herpetologica 12:249-259.

Gorman, J. 1964. Hydromantes brunus, H. Platycephalus, and H. Shastae. Cat. Am. Amphibians and Reptiles 11.

Jennings, M. R. and M. P. Hayes. 1994. Amphibian and reptile species of special concern in California. California Department of Fish and Game. Rancho Cordova 255 pp.

Stebbins, R. C. 1951. Amphibians of western North America. Univ. California Press, Berkeley. 538 pp.

Stebbins, R. C. 1954. Amphibians and reptiles of western North America. McGraw-Hill, New York. 536pp.

Stebbins, R. C. 1972. California amphibians and reptiles. Univ. California Press, Berkeley. 152 pp.

Reptiles

Western pond turtle (*Actinemys marmorata*; FSS, CSC)

From: California Wildlife Habitat Relationships System, California Department of Fish and Game, Database Version 8.1 (2005)
Written by: S. Morey
Reviewed by: T. Papenfuss
Edited by: R. Duke
Updated by: CWHR Program Staff, March 2000

Distribution, Abundance, And Seasonality

The western pond turtle is uncommon to common in suitable aquatic habitat throughout California, west of the Sierra-Cascade crest and absent from desert regions, except in the Mojave Desert along the Mojave River and its tributaries. Elevation range extends from near sea level to 1430 m (4690 ft) (Jennings and Hayes 1994). Associated with permanent or nearly permanent water in a wide variety of habitat types.

Specific Habitat Requirements

Feeding: This species is considered omnivorous. Aquatic plant material, including pond lilies, beetles and a variety of aquatic invertebrates as well as fishes, frogs, and even carrion have been reported among their food (Stebbins 1972, Nussbaum et al. 1983).

Cover: Pond turtles require basking sites such as partially submerged logs, rocks, mats of floating vegetation, or open mud banks. Turtles slip from basking sites to underwater retreats at the approach of humans or potential predators. Hibernation in colder areas is passed underwater
in bottom mud.

Reproduction: Storer (1930) suggested that two distinct habitats may be used for oviposition. Along large slow-moving streams, eggs are deposited in nests constructed in sandy banks. Along foothill streams, females may climb hillsides, sometimes moving considerable distances to find a suitable nest site. Nussbaum et al. (1983) reports a nest in a clover field 100 m (325 ft) from water. Nests have been observed in many soil types from sandy to very hard. Soil must usually be at least 10 cm (4 in) deep for nesting. Nests must have a relatively high internal humidity for eggs to develop and hatch properly.

Water: Individuals normally associate with permanent ponds, lakes, streams, irrigation ditches or permanent pools along intermittant streams. Hatchlings may be subject to rapid death by desiccation if exposed to hot, dry conditions.

Pattern: Associated with permanent or nearly permanent water in a wide variety of habitats.

Species Life History

Activity Patterns: Most activity is diurnal but some crepuscular and nocturnal activity has been observed. Individuals are active all year where climates are warm but hibernate during cold periods elsewhere.

Seasonal Movements/Migration: During the spring or early summer, females move overland for up to 100 m (325 ft) to find suitable sites for egg-laying. Other long distance movements may be in response to drying of local bodies of water or other factors.

Home Range: The home range is normally quite restricted (Bury 1970, 1972) except for occasional long distance movements as described above.

Territory: The western pond turtle is not known to be territorial, but aggressive encounters including gesturing and physical combat (Bury and Wolfheim 1973) are common and may function to maintain spacing on basking sites and to settle disputes over preferred spots.

Reproduction: Three to 11 eggs (Ernst and Barbour 1972) are laid from March to August depending on local conditions. The incubation period for eggs maintained in the laboratory at 30° C (Feldman 1982) ranged from 73 to 80 days. Sexual maturity is thought to be attained in about eight years.

Niche: This is the only abundant native turtle in California. Hatchlings and juveniles are preyed upon by a variety of vertebrate predators including certain fishes, bullfrogs, garter snakes, wading birds, and some mammals. Competitive interactions with other species have not been reported.

References

Bury, R. B. 1970. Clemmys marmorata. Cat. Am. Amphibians and Reptiles 100.1-100.3.

Bury, R. B. 1972. Habits and home range of the Pacific pond turtle, Clemmys marmorata in a stream community. Ph.D. Thesis, Univ. of California, Berkeley.

Bury, R. B., and J. H. Wolfheim. 1973. Aggression in free-living pond turtles (Clemmys marmorata). Bio-Science 23:659-662.

Ernst, C. H., and R. W. Barbour. 1972. Turtles of the United States. Univ. Kentucky Press, Lexington. 347pp.

Feldman, M. 1982. Notes on reproduction in Clemmys marmorata. Herpetol. Rev. 13:10-11.

Jennings, M. R. and M. P. Hayes. 1994. Amphibian and reptile species of special concern in California. California Department of Fish and Game. Rancho Cordova 255 pp.

Nussbaum, R. A., E. D. Brodie, Jr., and R. M. Storm. 1983. Amphibians and reptiles of the Pacific Northwest. Univ. Press of Idaho. 332pp.

Stebbins, R. C. 1972. California amphibians and reptiles. Univ. California Press, Berkeley. 152pp.

Storer, T. I. 1930. Notes on the range and life-history of the Pacific fresh-water turtle, Clemmys marmorata. Univ. Calif. Publ. Zool. 32:429-441.

Mollusks

Great Basin rams-horn (snail) (*Helisoma newberryi*; FSS)

From: Furnish, J. 2007. Guide to Sensitvie Aquatic Mollusks of the U.S. Forest Service Pacific Southwest Region, USDA Forest Service Pacific Southwest Region.

Abundance: Highly restricted distribution, locally abundant.

Range/Distribution: Type locality: Hat Creek, Shasta County, CA; "the more precise location Rising River... Lakes and larger, slow streams in and around the periphery of the northern Great Basin. In California, known from six local drainages, in which the species survives in probably only four. Lower Klamath Lake, Siskiyou County; possibly extinct in the Lake, but surviving in the spring-fed tributary, Sheepy Creek. Tule Lake, Modoc and Siskiyou counties, where probably extinct. Pit River, including the large spring-pools and their quiet outflows of Fall River and Hat Creek; known downstream to above Squaw Creek, but probably extinct in the lower segment of its range. Eagle Lake, Lassen County. Lake Tahoe and adjacent slow segment of its outflow, Truckee River. Formerly in Fish Springs, Owens Valley, Inyo County; exterminated by construction of a fish hatchery" (Taylor 1981). According to Frest and Johannes (1993) "the UT (Utah Lake) and Owens Valley populations are extinct. Surviving sites are in the Winema National Forest, Upper Klamath Lake National Wildlife Refuge and in Lassen National Forest (i.e. Eagle Lake); others may be located on BLM lands in the vicinity of Fall River Mills, CA." Also recently extirpated from Agency Lake, Klamath Co., OR when the lake went dry (T.J. Frest, personal communication).

Trend: Apparently experiencing major declines in distribution; populations extirpated from many sites. The conservation status for Helisoma newberryi throughout its range is G1, critically imperiled (NatureServe 2003).

Protection of Occurrences: The species is a Forest Service Sensitive Species in Region 5.

Threats: Water diversions, water pollution. Mitigation efforts for sucker species such as adding spawning gravels may harm this species by smothering soft mud habitats. See section on threats to Anodonta californiensis.

Habitat: "Larger lakes and slow rivers, including larger spring sources and spring-fed creeks. The snails characteristically burrow in soft mud and may be invisible even when abundant" (Taylor 1981). Brim Box (2002) states that “Helisoma newberryi were found in Screwdriver Creek, Shasta County, and Eagle Lake, Lassen County. Shells only were found in Screwdriver Creek, and it is possible those shells washed in from upstream, although the thin and delicate nature of H. newberryi shells suggests that they did not travel far. In Eagle Lake, shells only are commonly encountered in shallow waters close to shore. Live animals were only found by SCUBA diving in deeper water (e.g., > 10 feet). Although Taylor (1981) suggested that H. newberryi burrowed in soft mud and could possibly be ‘invisible even when abundant,’ in Eagle Lake live animals were

commonly observed on top of the substrate (sand), but only in deeper water. Additional live H. newberryi were found at a site outside of the LNF, in Hat Creek, Shasta County." According to Frest and Johannes (1993), the species "can occur with Pisidium ultramontanum, Lanx klamathensis or several other endemic mollusks." The species may also co-occur with Juga acutifilosa and Fluminicola seminalis.

References

Furnish, J. 2007. Guide to sensitive aquatic mollusks of the U.S. Forest Service Pacific Southwest Region. USDA Forest Service, Pacific Southwest Region.

California Floater (Anodonta californiensis; FSS)

From: Furnish, J. 2007. Guide to Sensitvie Aquatic Mollusks of the U.S. Forest Service Pacific Southwest Region, USDA Forest Service Pacific Southwest Region.

Abundance: Restricted distribution, can be locally common (Howard and Cuffey 2003).

Range/Distribution: " 'Rio Colorado,' actually a former distributary of the river, approximately New River, Imperial County, CA." (Type locality , Taylor 1981). "Historical distribution lower Willamette and lower Columbia rivers in OR and WA from the Dalles to the mouth. In larger slow streams of northern CA as far south as the northern San Joaquin Valley. [In CA] the former range includes....Siskiyou, Shasta, Lassen, Modoc and Tehama cos." (Frest and Johannes 1995). In northeastern California, according to Brim Box (2002), this species historically occurred in the Susan River outside of Susanville (Ingram 1948). A search of museum records by Jayne Brim Box (personal communication) yielded a single record from Donner Lake, Placer County.

Current distribution: Probably eradicated over much of its range (Taylor 1981). "Still survives in Fall and Pit rivers, Shasta Co....Apparently extinct in the Upper Sacramento River...The species appears to be extinct in UT and NV and is very limited in distribution in AZ." (Frest and Johannes 1995). According to Glenn Clemmer of USFW Service, Carson City, NV (personal communication), A. californiensis has been located in Nevada at the following sites: 1) Truckee River, 2) Humboldt River, Humboldt Basin, Elko Co. in 1979, 3) Thousand Springs Valley, 18 mi N and 5.5 mi E of Wells, Elko Co., Lake Bonneville Basin in 1989. Frest and Johannes (1995) collected the species from Blue Lake in Modoc County. A fairly large population (thousands of individuals) occurs in the South Fork of the Eel River, within the Angelo Coast Range Reserve, part of the University of California Natural Reserve System, Mendocino County (Howard and Cuffey 2003).

The phylogenetic relationships and taxonomy of Anodonta species in California is presently in a state of uncertainty because few reliable collection records and specimens are available to verify identities. In a genetic study of Anodonta populations from the Bonneville Basin and additional scattered records in the western United States, Mock and others (2004) observed that "overall the amount of cytochrome c oxidase subunit I (COI) sequence divergence and resolution among Anodonta populations in the western USA was low, although observed levels of divergence (4– 5%) did exceed levels of intraspecific divergence in other unionid studies (0–2.82%)." The authors further reported that "…species identifications were not congruent with the observed phylogenetic structure among these populations. Specimens identified tentatively as Anodonta californiensis, A. oregonensis and A. wahlamatensis did not consistently form monophyletic groups in our analyses. This lack of congruence could be due to the generally low level of phylogenetic signal and resolution in the dataset, phenotypic plasticity in conchological features, inappropriate local taxonomic designations, or a combination of these factors."

Trend: Historical distribution has been severely restricted. According to Taylor (1981), populations have been extirpated from most of California and several states. The species is declining with respect to the number of sites occupied and abundance at those sites.

Protection of Occurrences: The species is a Forest Service Sensitive Species in Region 5. The State of California has designated A. californiensis as a “special status species”.

Threats: Eutrophication due to agricultural runoff and urbanization, sedimentation that smothers mussel beds, water diversions that reduce instream flows, introduction of exotic species, grazing, water impoundments that reduce current velocities and allow for sediment deposition. Also, possibly the decline of an as yet unknown host fish species that serves as a dispersal mechanism for the clams' larvae. Although the fish hosts are presently unknown, Brim Box and others (2004) reported that almost 75% of the speckled dace (Rhinicthys osculus) inspected during their study of the Middle Fork of the John Day River had attached and encysted glochidia that appeared to be from A. californiensis. The glochidia attached to the gills, fins and body of their hosts and an average of about four glochidia per infected fish was observed. According to Brim Box (2002), “D’Eliscu (1972) reported that A. californiensis glochidia successfully transformed on the gills and fins of Gambusia affinis, a species not native to the western United States. The subfamily Anodontinae are the least host-specific of unionid mussels, and a wide-range of host fish have been reported for many eastern Anodonta species (Watters 1994).”

For aquatic mollusks and many aquatic invertebrates in general, the following types of disturbances should be considered as threats (Furnish and Monthy 1998).

- Chemical spills and other forms of water pollution (e.g., livestock use of springs and spring runs, urban runoff, other agriculture, other industrial) resulting in effects such as: 1) direct mortality of species as evidenced by the recent (1991) Cantara Spill on the Upper Sacramento River, and 2) deleterious habitat alterations resulting from factors such as eutrophication caused by excessive nitrogen and phosphorus levels, reduced dissolved oxygen levels, or elevated water temperatures. Freshwater mussels are filter feeders, with the capability of concentrating contaminants far above ambient levels in the water column.
- Water diversions for such activities as irrigation, hydropower generation and livestock watering, resulting in reduced discharge and loss of suitable habitat.
- Dam construction which submerges cold springs, slows current velocities, lowers the availability of oxygen and allows fine sediments to accumulate. For example, dams on the Sacramento River have submerged and destroyed habitats in many formerly occupied sites.
- Excessive sedimentation from a variety of activities such as logging, mining, road and railroad grade construction, and grazing may smother substrates causing death by preventing feeding and movement, and obstructing gills.

Habitat: Occurs in "lakes and slow rivers" (Taylor 1981). "Generally on soft substrates (mudsand), in fairly large streams and lakes only, in relatively slow current; a low elevation species" (Frest and Johannes 1995). Howard and Cuffey (2003) found that A. californiensis was almost exclusively found in pools with no occurrences in riffles and very few in runs in the South Fork of the Eel River. Anodonta of unelucidated identity have been observed and their life histories studied by Ellis and Hadley (2005) in the Pit River, and Fall and Hat creeks.

References

Furnish, J. 2007. Guide to sensitive aquatic mollusks of the U.S. Forest Service Pacific Southwest Region. USDA Forest Service, Pacific Southwest Region.

Scalloped Juga (*Juga (Calibasis) occata*; FSS)

From: Furnish, J. 2007. Guide to Sensitvie Aquatic Mollusks of the U.S. Forest Service Pacific Southwest Region, USDA Forest Service Pacific Southwest Region.

Abundance: Localized endemic, rare.

Range/Distribution: Type locality: Sacramento River between American River and mouth. Original distribution was Sacramento and Pit Rivers. Current distribution "surviving in the lower Pit River, but status in the Sacramento River unknown- no records in the present century. Changes in the riverbed due to extensive placer-mining in the past century might have eliminated it in most of the Sacramento River" (Taylor 1981). According to Frest and Johannes (1993) "only three river miles in the upper Sacramento River survive relatively unimpacted after the July, 1991 toxic spill; we found the species to be extirpated there; but it still survives in a few widely separated sites in the Pit River below the Falls in Shasta Co., CA, including sites in Shasta National Forest, including area DCA CD-82. Additional sites (in limited numbers) are likely in Shasta National Forest and in lands administered by Lassen National Forest, e.g. east of Rising River."

Trend: Definite declines in range and abundance over the last 150 years. Extirpated throughout much of the Sacramento River system.

Protection of Occurrences: The species is a Forest Service Sensitive Species in Region 5.

Threats: Water pollution, impoundments, mining.

Habitat: According to Frest and Johannes (1993) "this is a large river form, restricted to swift, unpolluted, well-oxygenated areas with gravel boulder substrate, generally at low elevations. Often found with Lanx patelloides or other rare mollusc species." This species also occurs with the nugget pebblesnail Fluminicola seminalis and the canary duskysnail, formerly known as the NWFP Survey and Manage species Lyogyrus new sp. 3, but recently described as Colligyrus convexus by Hershler and others (2003).

References

Furnish, J. 2007. Guide to sensitive aquatic mollusks of the U.S. Forest Service Pacific Southwest Region. USDA Forest Service, Pacific Southwest Region.

