State of California
The Resources Agency
Department of Water Resources

FINAL ASSESSMENT OF STURGEON DISTRIBUTION AND HABITAT USE SP-F3.2 TASK 3A

Oroville Facilities Relicensing FERC Project No. 2100

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REPORT SUMMARY

The goal of SP-F3.2 Task 3A was to determine the distribution, spawning locations and timing, habitat usage, residence time, and outmigration patterns of sturgeon in the lower Feather River. Flows were unlikely to have prevented passage and temperature ranges of 48-68°F were within the thermal tolerances of these fish. However, angling (for the planned radio telemetry study), a scuba survey, and egg and larval methodologies were unable to detect any sturgeon.

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1.0 INTRODUCTION

The Oroville Dam and its associated facilities prevent sturgeon migration to the upper Feather River so it is important to evaluate the suitability of spawning and holding areas in the lower river below the Fish Barrier Dam. As a result, this study was initiated to help identify how operation of the Oroville Facilities may impact sturgeon in the lower Feather River through its effects on flow, temperature and habitat. This report covers exploratory scuba surveys, radio tagging and tracking, and egg and larval surveys for sturgeon in the 2003 field season. The objectives of this study seek to 1) define sturgeon spawning and rearing distribution and timing; 2) relate habitat usage to environmental variables and 3) provide data to evaluate management decisions concerning future monitoring programs, operational changes of the dam and/or habitat enhancement within the lower Feather River.

1.1 BACKGROUND INFORMATION

Sturgeon are anadromous fish that spawn in rivers on the west coast, but spend most of their life in estuarine and marine environments, ranging geographically from southern Alaska to Mexico (Beamesderfer and Webb 2002). Most of the adult lifestage is spent in the ocean, and adults may undergo long migrations (Beamesderfer and Webb 2002). Adult green sturgeon females are generally mature by age 20-25 years (6-7 feet in length), while males mature at approximately 15-17 years (5-6 feet in length) (Beamesderfer and Webb 2002). Although little information on green sturgeon life history and habitat requirements exists, adult green sturgeon appear to migrate upstream into freshwater beginning in the latter part of February and, in the Sacramento River, may continue migrating as far as 200 miles upstream before spawning (Beamesderfer and Webb 2002). Adult white sturgeon migrate into the Sacramento River beginning in October (USFWS 1995). On the Rogue River in Oregon, holding sites were typically deeper than 5 meters, with in-river residence time ranging upwards of 6 months (Grimaldo and Zeug 2001; Erickson et al. 2002). Green sturgeon prefer spawning temperatures between 50-63°F (pers. comm., Doroshov 2001).

In areas outside of the Central Valley, sturgeon spawn over rocks, compact clay substrates, or large gravels at depths of approximately 30 feet with water velocities ranging from 5-10 feet per second (fps), while Central Valley sturgeon have been observed using gravel, rubble or soft-bottom stream reaches for spawning (USFWS 1995). Although most white sturgeon spawning occurs in March and April, spawning may begin as early as February and may continue into June (USFWS 1995). Sturgeon eggs have been found in the Sacramento River from mid-February through late May (Kohlhorst 1976). Juveniles may spend 1 to 4 years in freshwater and estuarine environments before entering saltwater habitats (Beamesderfer and Webb 2002).

Sturgeon are known to migrate into the Feather River, but detailed information regarding their reproduction is limited (USFWS 1995). In the mid-70s, green sturgeon were caught each year, with the majority of catches occurring from March to May and a few additional catches occurring in July and August (USFWS 1995). Catch data indicate that most green and white sturgeon spawning in the Feather River occurs from March through May (USFWS 1995). As recently as 1993, adult green sturgeon have been caught at the Thermalito Afterbay outlet (USFWS 1995). Spawning locations for green sturgeon in the Feather River are unknown, but it has been suggested that spawning may be limited to areas just downstream of the Thermalito Afterbay outlet (USFWS 1995). Based on angler catch rates, spawning has been suggested to occur downstream of the Thermalito Afterbay Outlet, River Mile 59, and Gridley Bridge, River Mile 50.75 (USFWS 1995).

1.1.1 Statutory/Regulatory Requirements

Section 4.51(f)(3) of 18 CFR requires reporting of certain types of information in the FERC Application for License for major hydropower projects, including a discussion of the fish, wildlife and botanical resources in the vicinity of the project. The discussion needs to identify the potential impacts of the project on these resources, including a description of any anticipated continuing impact for on-going and future operation of the project. In addition to helping fulfill these requirements, information developed in this study plan also may be used in determining appropriate protection, mitigation and enhancement (PM&E) measures.

1.1.2 Study Area

1.1.2.1 Description

Field activities for sturgeon occurred from the Fish Barrier Dam downstream to the confluence of the Sacramento River with the Feather River at Verona (Figure 1.1.2.1-1). Angling for sturgeon for the radio telemetry study occurred from Verona to Star Bend, and at Shanghai Bend, the Jesus Hole, and Sunset Pumps. The Scuba Survey was conducted in Fish Barrier Dam Pool. And the egg and larval surveys took place at Eye Pool, Big Hole Islands, and Shanghai Bend.

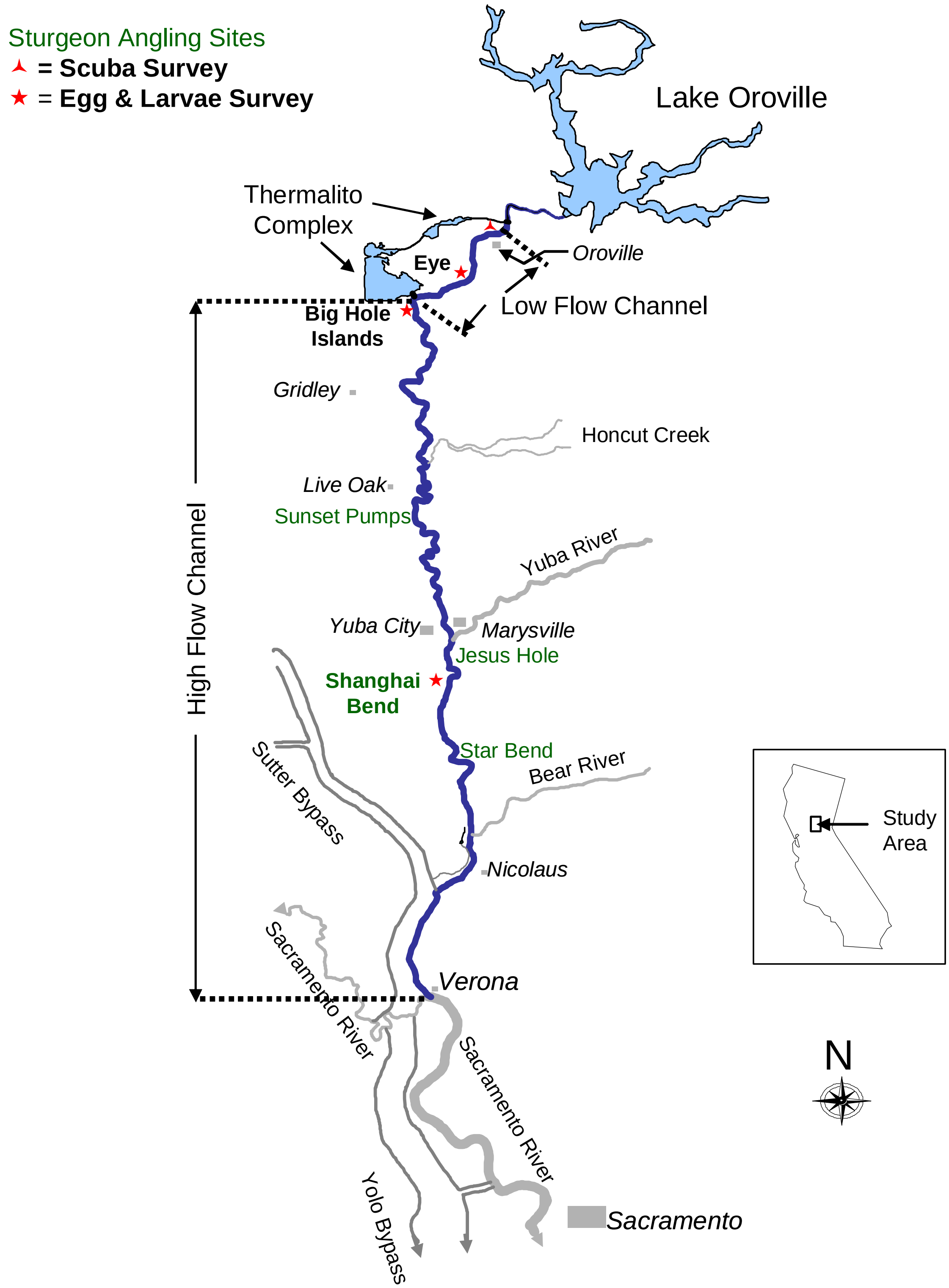

Figure 1.1.2.1-1. Sturgeon angling, scuba survey, and egg and larval sites.

1.1.2.2 History

No known adult studies have been conducted on sturgeon in the Feather River. In 1973, efforts to sample larval sturgeon at the mouth of the river were unsuccessful (USFWS 1995). In 2000 and 2001, the Department of Fish and Game sampled for sturgeon eggs and larvae near Shanghai Bend, the Thermalito Afterbay Outlet (Outlet), and near boat ramps at Gridley Bridge, Live Oak and Boyd's Landing (Schaffter and Kolhorst 2001). A small white sturgeon was observed. The researchers concluded that while the methods used were successful in sampling white sturgeon in the Sacramento River, they were likely ineffective for green sturgeon. Since green sturgeon eggs exhibit poor adhesion (Van Eenennaam et al. 2001), the probability of capture using an artificial substrate composed of latex-coated animal hair (McCabe and Beckman 1990; Schaffter 1997) is likely reduced. Lack of swim-up behavior and the limited activity of green sturgeon larvae (Van Eenennaam et al. 2001) were cited for lack of capture with larval nets.

1.2 DESCRIPTION OF FACILITIES

The Oroville Facilities were developed as part of the State Water Project (SWP), a water storage and delivery system of reservoirs, aqueducts, power plants, and pumping plants. The main purpose of the SWP is to store and distribute water to supplement the needs of urban and agricultural water users in northern California, the San Francisco Bay area, the San Joaquin Valley, and southern California. The Oroville Facilities are also operated for flood management, power generation, to improve water quality in the Delta, provide recreation, and enhance fish and wildlife.

FERC Project No. 2100 encompasses 41,100 acres and includes Oroville Dam and Reservoir, three power plants (Hyatt Pumping-Generating Plant, Thermalito Diversion Dam Power Plant, and Thermalito Pumping-Generating Plant), Thermalito Diversion Dam, the Feather River Fish Hatchery and Fish Barrier Dam, Thermalito Power Canal, Oroville Wildlife Area (OWA), Thermalito Forebay and Forebay Dam, Thermalito Afterbay and Afterbay Dam, and transmission lines, as well as a number of recreational facilities. An overview of these facilities is provided on Figure 1.2-1. The Oroville Dam, along with two small saddle dams, impounds Lake Oroville, a 3.5-million-acre-feet (maf) capacity storage reservoir with a surface area of 15,810 acres at its normal maximum operating level.

The hydroelectric facilities have a combined licensed generating capacity of approximately 762 megawatts (MW). The Hyatt Pumping-Generating Plant is the largest of the three power plants with a capacity of 645 MW. Water from the six-unit underground power plant (three conventional generating and three pumping-generating units) is discharged through two tunnels into the Feather River just downstream of Oroville Dam. The plant has a generating and pumping flow capacity of 16,950 cfs and

5,610 cfs, respectively. Other generation facilities include the 3-MW Thermalito Diversion Dam Power Plant and the 114-MW Thermalito Pumping-Generating Plant.

Thermalito Diversion Dam, four miles downstream of the Oroville Dam creates a tail water pool for the Hyatt Pumping-Generating Plant and is used to divert water to the Thermalito Power Canal. The Thermalito Diversion Dam Power Plant is a 3-MW power plant located on the left abutment of the Diversion Dam. The power plant releases a maximum of 615 cubic feet per second (cfs) of water into the river.

The Power Canal is a 10,000-foot-long channel designed to convey generating flows of 16,900 cfs to the Thermalito Forebay and pump-back flows to the Hyatt Pumping-Generating Plant. The Thermalito Forebay is an off-stream regulating reservoir for the 114-MW Thermalito Pumping-Generating Plant. The Thermalito Pumping-Generating Plant is designed to operate in tandem with the Hyatt Pumping-Generating Plant and has generating and pump-back flow capacities of 17,400 cfs and 9,120 cfs, respectively. When in generating mode, the Thermalito Pumping-Generating Plant discharges into the Thermalito Afterbay, which is contained by a 42,000-foot-long earth-fill dam. The Afterbay is used to release water into the Feather River downstream of the Oroville Facilities, helps regulate the power system, provides storage for pump-back operations, and provides recreational opportunities. Several local irrigation districts receive water from the Afterbay.

The Feather River Fish Barrier Dam is downstream of the Thermalito Diversion Dam and immediately upstream of the Feather River Fish Hatchery. The flow over the dam maintains fish habitat in the low-flow channel of the Feather River between the dam and the Afterbay outlet, and provides attraction flow for the hatchery. The hatchery was intended to compensate for spawning grounds lost to returning salmon and steelhead trout from the construction of Oroville Dam. The hatchery can accommodate 15,000 to 20,000 adult fish annually.

The Oroville Facilities support a wide variety of recreational opportunities. They include: boating (several types), fishing (several types), fully developed and primitive camping (including boat-in and floating sites), picnicking, swimming, horseback riding, hiking, off-road bicycle riding, wildlife watching, hunting, and visitor information sites with cultural and informational displays about the developed facilities and the natural environment. There are major recreation facilities at Loafer Creek, Bidwell Canyon, the Spillway, North and South Thermalito Forebay, and Lime Saddle. Lake Oroville has two full-service marinas, five car-top boat launch ramps, ten floating campsites, and seven dispersed floating toilets. There are also recreation facilities at the Visitor Center and the OWA.

The OWA comprises approximately 11,000-acres west of Oroville that is managed for wildlife habitat and recreational activities. It includes the Thermalito Afterbay and surrounding lands (approximately 6,000 acres) along with 5,000 acres adjoining the

Feather River. The 5,000 acre area straddles 12 miles of the Feather River, which includes willow and cottonwood lined ponds, islands, and channels. Recreation areas include dispersed recreation (hunting, fishing, and bird watching), plus recreation at developed sites, including Monument Hill day use area, model airplane grounds, three boat launches on the Afterbay and two on the river, and two primitive camping areas. California Department of Fish and Game's (DFG) habitat enhancement program includes a wood duck nest-box program and dry land farming for nesting cover and improved wildlife forage. Limited gravel extraction also occurs in a number of locations.

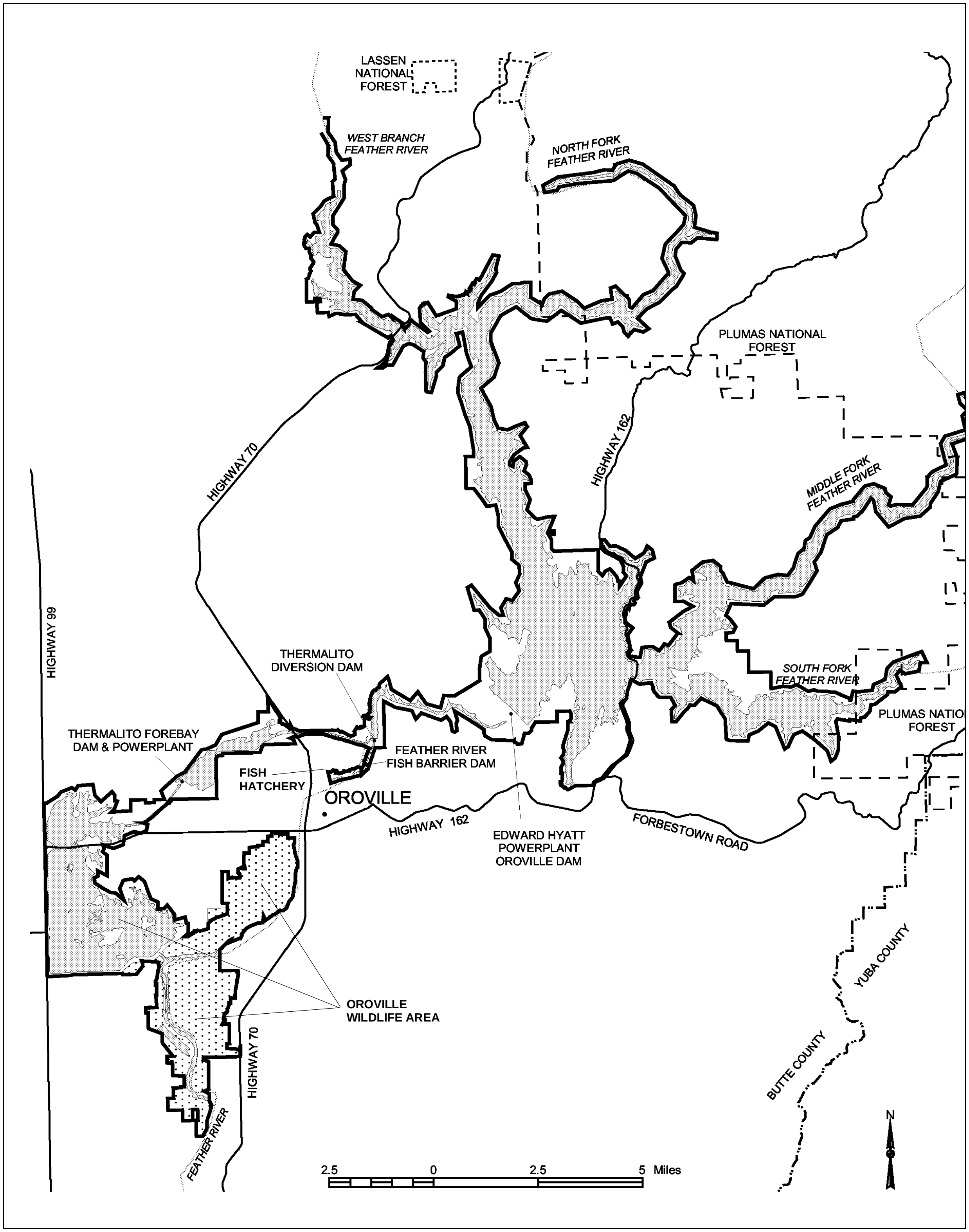

Figure 1.2-1. Oroville Facilities FERC Project Boundary

1.3 CURRENT OPERATIONAL CONSTRAINTS

Operation of the Oroville Facilities varies seasonally, weekly and hourly, depending on hydrology and the objectives DWR is trying to meet. Typically, releases to the Feather River are managed to conserve water while meeting a variety of water delivery requirements, including flow, temperature, fisheries, recreation, diversion and water quality. Lake Oroville stores winter and spring runoff for release to the Feather River as necessary for project purposes. Meeting the water supply objectives of the SWP has always been the primary consideration for determining Oroville Facilities operation (within the regulatory constraints specified for flood control, in-stream fisheries, and downstream uses). Power production is scheduled within the boundaries specified by the water operations criteria noted above. Annual operations planning is conducted for multi-year carry over. The current methodology is to retain half of the Lake Oroville storage above a specific level for subsequent years. Currently, that level has been established at 1,000,000 acre-feet (af); however, this does not limit draw down of the reservoir below that level. If hydrology is drier than expected or requirements greater than expected, additional water would be released from Lake Oroville. The operations plan is updated regularly to reflect changes in hydrology and downstream operations. Typically, Lake Oroville is filled to its maximum annual level of up to 900 feet above mean sea level (msl) in June and then can be lowered as necessary to meet downstream requirements, to its minimum level in December or January. During drier years, the lake may be drawn down more and may not fill to the desired levels the following spring. Project operations are directly constrained by downstream operational constraints and flood management criteria as described below.

1.3.1 Downstream Operation

An August 1983 agreement between DWR and DFG entitled, “Agreement Concerning the Operation of the Oroville Division of the State Water Project for Management of Fish & Wildlife,” sets criteria and objectives for flow and temperatures in the low flow channel and the reach of the Feather River between Thermalito Afterbay and Verona. This agreement: (1) establishes minimum flows between Thermalito Afterbay Outlet and Verona which vary by water year type; (2) requires flow changes under 2,500 cfs to be reduced by no more than 200 cfs during any 24-hour period, except for flood management, failures, etc.; (3) requires flow stability during the peak of the fall-run Chinook spawning season; and (4) sets an objective of suitable temperature conditions during the fall months for salmon and during the later spring/summer for shad and striped bass.

1.3.1.1 Instream Flow Requirements

The Oroville Facilities are operated to meet minimum flows in the Lower Feather River as established by the 1983 agreement (see above). The agreement specifies that Oroville Facilities release a minimum of 600 cfs into the Feather River from the

Thermalito Diversion Dam for fisheries purposes. This is the total volume of flows from the diversion dam outlet, diversion dam power plant, and the Feather River Fish Hatchery pipeline.

Generally, the instream flow requirements below Thermalito Afterbay are 1,700 cfs from October through March, and 1,000 cfs from April through September. However, if runoff for the previous April through July period is less than 1,942,000 af (i.e., the 1911-1960 mean unimpaired runoff near Oroville), the minimum flow can be reduced to 1,200 cfs from October to February, and 1,000 cfs for March. A maximum flow of 2,500 cfs is maintained from October 15 through November 30 to prevent spawning in overbank areas that might become de-watered.

1.3.1.2 Temperature Requirements

The Diversion Pool provides the water supply for the Feather River Fish Hatchery. The hatchery objectives are 52°F for September, 51°F for October and November, 55°F for December through March, 51°F for April through May 15, 55°F for last half of May, 56°F for June 1-15, 60°F for June 16 through August 15, and 58°F for August 16-31. A temperature range of plus or minus 4°F is allowed for objectives, April through November.

There are several temperature objectives for the Feather River downstream of the Afterbay Outlet. During the fall months, after September 15, the temperatures must be suitable for fall-run Chinook. From May through August, they must be suitable for shad, striped bass, and other warmwater fish.

The National Marine Fisheries Service has also established an explicit criterion for steelhead trout and spring-run Chinook salmon. Memorialized in a biological opinion on the effects of the Central Valley Project and SWP on Central Valley spring-run Chinook and steelhead as a reasonable and prudent measure; DWR is required to control water temperature at Feather River mile 61.6 (Robinson's Riffle in the low-flow channel) from June 1 through September 30. This measure requires water temperatures less than or equal to 65°F on a daily average. The requirement is not intended to preclude pump-back operations at the Oroville Facilities needed to assist the State of California with supplying energy during periods when the California ISO anticipates a Stage 2 or higher alert.

The hatchery and river water temperature objectives sometimes conflict with temperatures desired by agricultural diverters. Under existing agreements, DWR provides water for the Feather River Service Area (FRSA) contractors. The contractors claim a need for warmer water during spring and summer for rice germination and growth (i.e., 65°F from approximately April through mid May, and 59°F during the remainder of the growing season). There is no obligation for DWR to meet the rice water temperature goals. However, to the extent practical, DWR does use its operational flexibility to accommodate the FRSA contractor's temperature goals.

1.3.1.3 Water Diversions

Monthly irrigation diversions of up to 190,000 (July 2002) af are made from the Thermalito Complex during the May through August irrigation season. Total annual entitlement of the Butte and Sutter County agricultural users is approximately 1 maf. After meeting these local demands, flows into the lower Feather River continue into the Sacramento River and into the Sacramento-San Joaquin Delta. In the northwestern portion of the Delta, water is pumped into the North Bay Aqueduct. In the south Delta, water is diverted into Clifton Court Forebay where the water is stored until it is pumped into the California Aqueduct.

1.3.1.4 Water Quality

Flows through the Delta are maintained to meet Bay-Delta water quality standards arising from DWR's water rights permits. These standards are designed to meet several water quality objectives such as salinity, Delta outflow, river flows, and export limits. The purpose of these objectives is to attain the highest water quality, which is reasonable, considering all demands being made on the Bay-Delta waters. In particular, they protect a wide range of fish and wildlife including Chinook salmon, Delta smelt, striped bass, and the habitat of estuarine-dependent species.

1.3.2 Flood Management

The Oroville Facilities are an integral component of the flood management system for the Sacramento Valley. During the wintertime, the Oroville Facilities are operated under flood control requirements specified by the U.S. Army Corps of Engineers (USACE). Under these requirements, Lake Oroville is operated to maintain up to 750,000 af of storage space to allow for the capture of significant inflows. Flood control releases are based on the release schedule in the flood control diagram or the emergency spillway release diagram prepared by the USACE, whichever requires the greater release. Decisions regarding such releases are made in consultation with the USACE.

The flood control requirements are designed for multiple use of reservoir space. During times when flood management space is not required to accomplish flood management objectives, the reservoir space can be used for storing water. From October through March, the maximum allowable storage limit (point at which specific flood release would have to be made) varies from about 2.8 to 3.2 maf to ensure adequate space in Lake Oroville to handle flood flows. The actual encroachment demarcation is based on a wetness index, computed from accumulated basin precipitation. This allows higher levels in the reservoir when the prevailing hydrology is dry while maintaining adequate flood protection. When the wetness index is high in the basin (i.e., wetness in the watershed above Lake Oroville), the flood management space required is at its greatest amount to provide the necessary flood protection. From April through June, the maximum allowable storage limit is increased as the flooding potential decreases, which allows capture of the higher spring flows for use later in the year. During September, the maximum allowable storage decreases again to prepare for the next flood season. During flood events, actual storage may encroach into the flood reservation zone to prevent or minimize downstream flooding along the Feather River.

2.0 NEED FOR STUDY

This study is needed because project operations influence flow rates, river stage, habitat availability, water temperature and other factors contributing to the success of sturgeon populations within the study area. Changes in river stage can change the availability of habitat for spawning and rearing, therefore affecting spawning and rearing success and subsequent year-class strength. Project operations may affect the distribution of Feather River sturgeon, change the availability and quality of habitat, and change the magnitude, frequency and timing of flow and water temperatures in the Feather River, thus potentially influencing migration and emigration timing as well as egg and juvenile development. Therefore, this study is necessary to evaluate potential project impacts on sturgeon and their habitat in the Feather River downstream of the Fish Barrier Dam.

3.0 STUDY OBJECTIVE(S)

The study plan objective was to gather baseline information about sturgeon life history, distribution and habitat use in the lower Feather River and to evaluate potential project effects on sturgeon habitat within the study area. Additionally, the study plan will establish tools to evaluate future potential operational scenarios and other protection, mitigation and enhancement measures (PMEs).

Several study techniques were utilized in an attempt obtain the following:

- Radio telemetry: to determine distribution, habitat preferences, residence time, emigration patterns and potential passage impediments;
- Scuba surveys: to explore potential holding habitat;
- Egg and larval surveys: to determine if sturgeon spawn in the Lower Feather river, and if so, acquire information on distribution and rearing habitat.

Little information exists regarding either green or white sturgeon in the Feather River (USFWS 1995) and therefore specific field studies designed to provide additional information on green sturgeon distribution and habitat characteristics were proposed in Task 3A.

4.0 METHODOLOGY

4.1 STUDY DESIGN

Radio telemetry was to be used to determine sturgeon pre-spawning habitat use, spawning locations and timing, the upstream extent of green sturgeon migration in the Feather River, post-spawning habitat use, residence time in the Feather River, and outmigration patterns. Exploratory scuba surveys were conducted to establish whether adult sturgeon were holding downstream of potential upmigration barriers. Egg and larval studies were conducted to determine if spawning took place and if so their habitat characteristics and distribution.

4.2 HOW AND WHERE THE STUDIES WERE CONDUCTED

4.2.1 Radio telemetry

Angling efforts to catch sturgeon for radio telemetry began in March after receiving the Combined Radio and Acoustic Tags (CART). The first outing was guided by Craig Smith of Craig Smith Fishing Guide Service. Four anglers fished from Verona upstream to Star Bend for a total of 32 angler hours. All other angling attempts were conducted with three anglers for approximately seven hours. Salmon roe and lamprey was used as bait. Not including the guided trip, Table 4.2.1-1 summarizes the 2003 sturgeon angling efforts.

Table 4.2.1-1. Location and occurrence of 2003 sturgeon angling efforts.

Month	Night Angler Hours	Day Angler Hours
March	0	21 at Sunset Pumps
April	42 at Sunset Pumps	21 at Star Bend 21 at the Jesus Hole 42 at Sunset Pumps
May	21 at Sunset Pumps	42 at Star Bend 63 at Shanghai Bend 21 at the Jesus Hole
Total	63	231

No sturgeon were caught, therefore, radio telemetry methods are not presented.

4.2.2 Scuba Survey

A dive survey, which consisted of three individual dives, was conducted August 19, 2003 in the pool below Fish Barrier Dam by four National Marine Fisheries Service (NMFS) divers. The dive team included Jon Mann, Steve Thomas, David White, and Kurt Dreflak.

4.2.2.1 Dive #1

Jon Mann and Steve Thomas made the initial dive. Jon and Steve entered the water from the small boat ramp upstream of the railroad bridge near the Fish Barrier Dam. The dive lasted 25 minutes and reached a maximum depth of 30 feet.

4.2.2.2 Dive #2

Two DWR staff provided a small motor boat and assistance on the second dive. Jon and Steve were transported in the boat up to the Fish Barrier Dam. The boat anchored on the right bank of the river, and the divers entered the water from the boat with the underwater video head and tether and supplying images to the video recorder being operated by the DWR staff in the boat. The divers continued out into the channel, to river left, as far as the tether would allow. The dive lasted 30 minutes and reached a maximum depth of 30 feet. Between these two dives, all significant deep holes between the Fish Barrier Dam and the first riffle downstream of the Fish Barrier Dam were surveyed.

4.2.2.3 Dive #3

Kurt Dreflak and Dave White entered the water from the small boat ramp upstream of the railroad bridge near the Fish Barrier Dam. Kurt and Dave continued across the river on the bottom to the deep water on river right. Kurt and Dave looked in the holes and under the railroad bridge. The divers then returned to the shore. The dive lasted 25 minutes and reached a maximum depth of 24 feet.

4.2.3 Egg and Larval Surveys

Two different techniques, drift nets and artificial substrates, were used to reveal if sturgeon spawn in the lower Feather River. Both sampling techniques were extended beyond May because of angler information that sturgeon were still in the system. In addition, green sturgeon spawning periods in the Klamath River and Sacramento River extend into July (Brown 2002).

4.2.3.1 Larval Drift Nets

Larval sampling was conducted three times a week at night, February 24 through August 21, 2003 using both a surface and a benthic conical drift net. Collections took place once every week at each of the following locations: 1) in the Low Flow Channel (LFC) at Eye Pool; 2) in the High Flow Channel (HFC) at Big Hole Islands approximately one mile below the Thermalito Afterbay Outlet and; 3) in the HFC downstream of Shanghai Bend.

Each site had a plume of water that flowed into a pool of water. The nets were deployed on the fringe of the plume in a high flow area that would not cause backwash in the nets. One to two sets were made each night with both nets fished simultaneously between the two hours before sunrise. Each set was deployed from a boat and held stationary for approximately 20-40 minutes depending on debris build-up.

The surface net was constructed of 505 µm mesh with a round-mouthed opening of 0.5 m^2. The net was attached to a 3-m pole that held the mouth opening below the surface of the water off the side of the boat. The benthic net was constructed of 1200 µm square polyester mesh with a square-mouthed opening of 1.5 m^2. The net was attached to a weighted, galvanized iron frame that placed the bottom of the mouth opening approximately 5 cm above the substrate. It was fished off the back of the boat. A YSI 85 multi-parameter instrument was used to measure surface and bottom temperature, dissolved oxygen and conductivity. Samples were preserved in 10% formalin containing Rose Bengal. Samples were searched for sturgeon eggs and larvae.

4.2.3.2 Artificial Substrates

Surveys took place in the High Flow Channel above Big Hole Islands boat ramp (RM 58.5) and from Shanghai Bend to Boyd's Pump (RM 25-23) from March 17 through June 26, 2003. Each set consisted of four to five shelters suspended six feet apart, all attached to a main line. Generally, five sets were made at each site but due to vandalism and shelter loss this number changed as the season went on. At Big Hole Island, the main line was weighted on one end and had a float suspended approximately 3-6 feet under the surface of the water on the other end. At sites downstream of Shanghai Bend, the main line was weighted on one end and the other end was tied to a stationary object (e.g., root wad, pilings) because of higher flow velocities. Big Hole Island had substrate consisting of sand and rock mixtures with regions downstream of Shanghai consisting mostly of sand. Sets were checked and reset weekly except when flows increased to the point that traps were too deep to retrieve or were not detectable due to increased turbidity. Samples were searched for sturgeon eggs and larvae.

5.0 STUDY RESULTS AND DISCUSSION

5.1 RADIO TELEMETRY

No sturgeon were caught during the 326 hours of fishing effort. It is likely that a pulse of sturgeon could have entered the lower Feather River on or after February 11 when the combined flows of the Feather and Yuba rivers totaled 7098 cfs. The next day combined flows were at 9340 cfs. These flows negated passage issues at Shanghai Bend while it was uncertain if sturgeon could pass Sunset Pumps (Niggemyer and Duster 2003).

Planned changes for the 2004 sampling season include more night angling and use of a 10-foot diameter fyke.

5.2 SCUBA SURVEY

Ambient air temperature was 90ºF with clear skies and no wind. The water was 55ºF and had a visibility of 10 feet for all dives.

Due to visibility conditions and observational limitations it is very possible that even if sturgeon were present they could be missed.

5.2.1 Dive #1

No sturgeon were seen.

5.2.2 Dive #2

No sturgeon were seen. NMFS captured video footage of large schools of adult salmon, and some trout, suckers, pikeminnows and tule perch.

5.2.3 Dive #3

No sturgeon were seen. A few large salmon were seen, but not the large schools seen near the Fish Barrier Dam.

5.3 EGG AND LARVAL SURVEYS

While no sturgeon eggs or larvae were collected, incidental catch suggests that both the nets and artificial substrates were sampling effectively. In 2001, a sturgeon spawning study conducted in the upper Sacramento River, a system with a relatively well documented population of green sturgeon, only collected two eggs and one larva (Brown 2002). This result demonstrates the difficulties associated with capturing sturgeon at the egg and larval stages. Keiffer and Kynard (1996) indicated that telemetry used as an indicator of spawning timing and location followed by focused larval net sampling could verify successful spawning much more efficiently.

5.3.1 Larval Drift Nets

No sturgeon eggs or larvae were identified in the 288 samples taken. Water temperatures ranged from 48-68^{o}F. Depth of benthic net ranged from 3-31 feet. Preliminary sorting of samples to search for sturgeon indicates that the nets were efficient at sampling prickly sculpin, Sacramento suckers, wakasagi and American shad eggs. Larval catch is presently being identified to family and if possible species. This information will be analyzed and reported at a latter date.

5.3.2 Artificial Substrates

No sturgeon eggs or larvae were sampled in the 85 sets made. Water temperatures ranged from 53-64^{o}F. Depth of traps ranged from 3-15 feet. The substrates were efficient at sampling benthic species such as sculpin fish and eggs and crayfish. In addition, several lamprey and American shad eggs were sampled. Other species sampled included Chinook salmon, bigscale logperch, Sacramento sucker, tule perch, and smallmouth bass.

6.0 CONCLUSION

Insufficient data were collected through the use of angling, diving, and egg and larval surveys conducted from March-August, 2003 to evaluate project effects on adult and juvenile sturgeon. Temperature and flow did not seem to be limiting factors in the attempts to find sturgeon in the lower Feather River.

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