

Study 7.9

# **GREEN STURGEON DOWNSTREAM OF ENGLEBRIGHT DAM<sup>1</sup>**

August 2011

## **1.0 Project Nexus and Issue**

Yuba County Water Agency's (Licensee or YCWA) continued operation and maintenance (O&M) of the Yuba River Development Project (Project) has the potential to affect habitat suitability and availability for the Southern Distinct Population Segment (DPS) of North American green sturgeon (*Acipenser medirostris*)<sup>2</sup> downstream of the United States Army Corps of Engineers' (USACE's) Englebright Dam.<sup>3</sup>

## **2.0 Resource Management Goals of Agencies with Jurisdiction Over the Resource to be Studied**

YCWA believes that four agencies have jurisdiction over green sturgeon that could be potentially affected in the geographic area included in this study proposal: 1) United States Department of Interior, Fish and Wildlife Service (USFWS); 2) United States Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service (NMFS); 3) California Department of Fish and Game (CDFG); and 4) State Water Resources Control Board, Division of Water Rights (SWRCB). Each of these agencies and their jurisdiction and management direction, as understood by YCWA at this time, is discussed below.

### USFWS

USFWS's jurisdiction and goals and objectives are described by USFWS on pages 1 through 3 of USFWS's March 7, 2011 letter to FERC that provided USFWS's comments on YCWA's Pre-Application Document, or PAD (YCWA 2010). USFWS's jurisdiction, goals and objectives are not repeated here.

### NMFS

NMFS's statutory authorities and responsibilities are described by NMFS in Section 2.0 of Enclosure A in NMFS's March 7, 2011 letter to FERC providing NMFS's comments on YCWA's PAD. NMFS's jurisdiction and responsibilities are not repeated here.

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<sup>1</sup> Where this study proposal states that information for the study is being developed by the Lower Yuba River Accord River Management Team (RMT), if the RMT does not develop the information as described in this study proposal, YCWA will develop the information. Also, all information developed as part of the relicensing, whether it is developed in the relicensing process or developed in the RMT process and brought into the relicensing, will be made public when YCWA files its final study report. Further, if this study relies on information from RMT data, report or analytics, YCWA will attach the relevant RMT work product to the relicensing report for this study.

<sup>2</sup> Federally listed as threatened; including critical habitat designation.

<sup>3</sup> Englebright Dam was constructed by the California Debris Commission in 1941, is owned, operated and maintained by the United States Army Corps of Engineers, and is not included as a Project facility in FERC licenses for the Yuba River Development Project.

### CDFG

CDFG's jurisdiction is described by CDFG on page 1 of CDFG's March 2, 2011 letter to FERC providing CDFG's comments on YCWA's PAD. CDFG's goal, as described on page 2 of CDFG's letter is to preserve, protect, and as needed, to restore habitat necessary to support native fish, wildlife and plant species.

### SWRCB

SWRCB has authority under the federal Clean Water Act (33 U.S.C. §11251-1357) to restore and maintain the chemical, physical and biological integrity of the Nation's waters. Throughout the relicensing process the SWRCB maintains independent regulatory authority to condition the operation of the Project to protect water quality and the beneficial uses of stream reaches consistent with Section 401 of the federal Clean Water Act, the Regional Water Quality Control Board Basin Plans, State Water Board regulations, CEQA, and any other applicable state law.

## **3.0 Study Goals and Objectives**

The goal of the study is to attempt to document the occurrence, temporal, and spatial distribution and movement of the North American green sturgeon in the Yuba River downstream of Englebright Dam. The objectives are to identify the availability of habitat for adult holding and spawning under variable flow and water temperature regimes.

## **4.0 Existing Information and Need for Additional Information**

The Yuba River is one of the more thoroughly studied rivers in the Central Valley of California. The fish community of the lower Yuba River has been studied since the mid-1970s. The Yuba River downstream of Englebright Dam supports a diverse fish community comprised of anadromous and non-anadromous, native and introduced fish species (CDFG 1991; Kozlowski 2004). Available existing information regarding the North American green sturgeon is presented below.

### **4.1 Existing Information**

#### **4.1.1 Listing Status and Critical Habitat Designation**

The Southern DPS of the North American green sturgeon was listed as a federally threatened species on April 7, 2006 (71 FR 17757) and includes the North American green sturgeon population spawning in the Sacramento River and utilizing the Sacramento-San Joaquin River Delta, and San Francisco Estuary. NMFS (2009) *Draft Environmental Assessment for the Proposed Application of Protective Regulations Under Section 4(D) of the Endangered Species Act for the Threatened Southern Distinct Population Segment of North American Green Sturgeon* indicated that the Southern DPS of North American green sturgeon faces several threats to its survival including the loss of spawning habitat in the upper Sacramento River, and potentially in the Feather and Yuba rivers, due to migration barriers and instream alterations.

On October 9, 2009, NMFS (74 FR 52300) designated critical habitat for North American green sturgeon, which includes the Sacramento River, lower Feather River, lower Yuba River, the Sacramento-San Joaquin River Delta, and San Francisco Estuary (NMFS 2009b). NMFS (74 FR 52300) defined specific habitat areas in the Sacramento, Feather, and Yuba rivers in California to include riverine habitat from the river mouth upstream, to and including the furthest known site of historic and/or current sighting or capture of North American green sturgeon, as long as the site is still accessible. NMFS (74 FR 52300) designated critical habitat in the Yuba River to extend from the confluence with the mainstem Feather River upstream to USACE's Daguerre Point Dam.<sup>4</sup>

#### 4.1.2 Available Information

Since the 1970s, numerous surveys of the Yuba River downstream of Englebright Dam have been conducted including annual salmon carcass surveys, snorkel surveys, beach seining, electrofishing, rotary screw trapping, redd surveys, and other monitoring and evaluation activities (see Attachment A to Study Plan 7.8 ESA-listed Salmonids Downstream of Englebright Dam). Although previous surveys were not specifically designed to address green sturgeon, over the many years of these surveys and monitoring of the Yuba River, only one confirmed observation of an adult North American green sturgeon has been confirmed prior to 2011. Although results are preliminary, in a memorandum dated June 7, 2011 Bergman et. al (2011) stated that during May 2011 they observed what they believed were 4 to 5 green sturgeon near the center of the channel at the edge of the bubble curtain below Daguerre Point Dam. The sturgeon were observed either on a gravel bar approximately 1.5 meters deep, or in a pool approximately 4 meters deep immediately adjacent to the gravel bar. There have been no observations of any North American green sturgeon juveniles, larvae or eggs. Historic anecdotal accounts of sturgeon in the Yuba River have been reported by anglers, but these accounts do not specify whether the fish were white or green sturgeon (Beamesderfer et al. 2004).

The NMFS September 2008 *Draft Biological Report, Proposed Designation of Critical Habitat for the Southern Distinct Population Segment of North American Green Sturgeon* (NMFS 2008a) states that of the three adult or sub-adult sturgeon observed in the Yuba River below Daguerre Point Dam during 2006, only one was confirmed to be a North American green sturgeon. NMFS (2008b) additionally states that “*Spawning is possible in the river, but has not been confirmed and is less likely to occur in the Yuba River than in the Feather River. No green sturgeon juveniles, larvae, or eggs have been observed in the lower Yuba River to date.*”

The two confirmed observations of adult North American green sturgeon below Daguerre Point Dam indicate infrequent utilization of the Yuba River by North American green sturgeon. Although there are fish ladders at Daguerre Point Dam, they were designed for salmonid passage and it is believed that adult sturgeon are unable to ascend the structure (CALFED and YCWA 2005).

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<sup>4</sup> Daguerre Point Dam was constructed by the California Debris Commission in 1910, is owned, operated and maintained by the United States Army Corps of Engineers, and is not included as a Project facility in FERC licenses for the Yuba River Development Project.

Information regarding North American green sturgeon distribution, movement and behavioral patterns, as well as lifestage-specific habitat utilization preferences is generally lacking throughout the rivers in the California Central Valley, including the Yuba River. Further, limited information on North American green sturgeon movement, spawning and timing is available for the Sacramento and the Feather rivers.

North American green sturgeon occasionally range into the Feather River but numbers are low and there is no data documenting historical spawning (Beamesderfer et al. 2007). NMFS (2008b) states that the presence of adult, and possibly subadult, North American green sturgeon within the lower Feather River has been confirmed by photographs, anglers' descriptions of fish catches (P. Foley, pers. comm. cited in CDFG 2002), incidental sightings (DWR 2005), and occasional catches of North American green sturgeon reported by fishing guides (Beamesderfer et al. 2004). Although adult North American green sturgeon occurrence in the Feather River has been documented, larval and juvenile North American green sturgeon have not been collected. These efforts included attempts to collect larval and juvenile sturgeon during early spring through summer using rotary screw traps, artificial substrates, and larval nets deployed at multiple locations (Seesholtz 2003). Moreover, unspecific past reports of North American green sturgeon spawning (Wang 1986; USFWS 1995; CDFG 2002) have not been corroborated by observations of young fish or significant numbers of adults in focused sampling efforts (Schaffter and Kohlhorst 2002; Niggemyer and Duster 2003; Seesholtz 2003; Beamesderfer et al. 2004). Based on these results, NMFS (71 FR 17757) concluded that an effective population of spawning North American green sturgeon does not exist in the Feather River at the present time. However, four fertilized green sturgeon eggs were collected near the Thermalito Afterbay Outlet on June 14, 2011, thus providing the first documentation of at least some successful spawning in the Feather River (A. Seesholtz, CDWR, pers. comm., June 16, 2011).

North American green sturgeon in the Sacramento River have been documented and studied more widely than in either the Feather or the Yuba rivers. North American green sturgeon adults in the Sacramento River are reported to begin their upstream spawning migrations into freshwater during late February, prior to spawning between March and July, with peak spawning believed to occur between April and June (Adams et al. 2002). NMFS (2009a) reports that based on recent data gathered from acoustically tagged adult North American green sturgeon, they migrate upstream during May as far as the mouth of Cow Creek, near Bend Bridge on the Sacramento River.

In the Sacramento River, NMFS (2009a) reports that adult North American green sturgeon prefer deep holes ( $\geq 5$  meters depth) at the mouths of tributary streams, where they spawn and rest on the bottom. After spawning, the adults hold over in the upper Sacramento River between Red Bluff Diversion Dam (RBDD) and Glenn Colusa Irrigation District (GCID) until November (Klimley 2007). Heublein et al. (2006, 2009) reported the presence of adults in the Sacramento River during the spring through the fall into the early winter months, holding in upstream locations prior to their emigration from the system later in the year. North American green sturgeon downstream migration appears to be triggered by increased flows, decreasing water temperatures, and occurs rapidly once initiated (NMFS 2009a). Some adult North American green sturgeon rapidly leave the system following their suspected spawning activity and re-enter the ocean in early summer (Heublein et al. 2006). NMFS (2009a) states that North American

green sturgeon larvae and juveniles are routinely observed in rotary screw traps at RBDD and GCID, indicating spawning occurs upstream of both these sites.

To investigate adult immigration, spawning or juvenile nursery habits of North American green sturgeon in the upper Sacramento River, Brown (2007) developed a study to identify North American green sturgeon spawning locations and dates in the upper Sacramento River. Using a depth finder, study sites were selected at locations upstream of deeper holes in higher velocity water in the Sacramento River (Brown 2007). The study was originally designed in 1997 using the prevalent methodology at the time (e.g., artificial substrate mats) for the capture of eggs and larvae of white sturgeon. Brown (2007) reports that later findings from artificial spawning and larval rearing of North American green sturgeon (Van Eenennaam et al. 2001) indicate that North American green sturgeon eggs may be less adhesive than eggs from other acipenserids, possibly reducing the effectiveness of artificial substrate sampling.

Brown (2007) suggested that spawning in the Sacramento River may occur from April to June, and that the potential spawning period may extend from late April through July as indicated by the rotary screw trap data at the RBDD from 1994 to 2000.

Prior to studies conducted by the University of California at Davis (UC Davis), there were few empirical observations of North American green sturgeon movement in the Sacramento River (Heublein et al. 2009). The study by Heublein et al. (2009) is reportedly the first to describe the characteristics of the adult North American green sturgeon migration in the Sacramento River, and to identify putative regions of spawning habitat, based on the recorded movements of free-swimming adults.

Heublein et al. (2009) observed that North American green sturgeon enter San Francisco Bay in March and April and migrate rapidly up the Sacramento River to the region between GCID to Cow Creek. The fish lingered at these regions at the apex of their migration for 14–51 days, presumably engaged in spawning behavior, before moving back downriver (Heublein et al. 2009).

The Sacramento River adjacent to the GCID pumping plant routinely holds a large aggregation of North American green sturgeon during summer and fall months, although the GCID aggregation site is atypical of overwintering habitats in other systems, being an area of high water velocity (Heublein et al. 2009). The GCID site is over 5 meters deep with structural current refuges and eddy formations. It is possible that North American green sturgeon occupies lower-velocity subsections of the site, although observations of North American green sturgeon capture, and manual tracking estimates, indicate that North American green sturgeon are found in, or in very close proximity to, high velocity areas (Heublein et al. 2009).

Heublein et al. (2009) stated that in contrast to the behavior of North American green sturgeon observed during 2004–2005, the majority of out-migrants detected in 2006 displayed an entirely different movement strategy. Nine of the ten tagged fish detected that year exited the system with no extended hold-over period and with no apparent relation to flow increases, eight leaving before 4 July and the last on 22 August. Heublein et al. (2009) suggested that the rapid out-migration of North American green sturgeon in 2006, and the reduced aggregation period at the GCID site could be a result of consistently higher flows and lower temperatures than previous

study years. Alternatively, this could be an unusual behavior, related to unknown cues, that has not been documented in North American green sturgeon prior to this study (Heublein et al. 2009).

The apex detections of individual fish indicate reaches and dates when spawning might have occurred during the study conducted by Heublein et al. (2009). They reported that spawning may have occurred between May and July, and that high water velocities and extensive bedrock habitat were found in all of the apex detection reaches. Furthermore, water temperatures did not exceed 62.6°F (17°C) in these reaches during this study, which would have permitted normal North American green sturgeon larval development (Van Eenennaam et al. 2005 as cited in Heublein et al. 2009).

The habitat requirements of North American green sturgeon are not well known. Eggs are likely broadcast and externally fertilized in relatively fast water and probably in depths greater than 3 meters (Moyle 2002). Preferred spawning substrate is likely large cobble where eggs settle into cracks, but spawning substrate can range from clean sand to bedrock (Moyle 2002). Water temperatures above 68°F (20°C) are reportedly lethal to North American green sturgeon embryos (Cech et al. 2000; Beamesderfer and Webb 2002).

#### **4.1.3 Ongoing Data Collection and Monitoring Activities**

NMFS' ESA Recovery Program Biennial Report to Congress 2006–2008 (NMFS 2008) recommended several key conservation actions for North American green sturgeon including the need for ongoing green sturgeon-focused research, including fish passage, genetics studies, and acoustic tagging and tracking studies to better understand the distribution and migration of North American green sturgeon.

State and federal resource agencies have partnered with the University of California and others to conduct several areas of research related to North American green sturgeon presence, distribution and life history requirements in the Central Valley. As an example, information about the biology of the North American green sturgeon were presented at the symposium titled "*The Green Sturgeon and Its Environment*" held during the 39<sup>th</sup> Annual Meeting of the California-Nevada Chapter of the American Fisheries Society during 2005 (Klimley et al. 2007). Kelly et al. (2007) provided the first fine-scale description of daily North American green sturgeon estuarine movements and habitat use. Several presentations also addressed the use of acoustic telemetry, which can be used both to follow the fish directly (Kelly et al. 2007) as they move within a region and to automatically monitor long-term and large-scale movements as in the studies presented by Benson et al. (2007). Despite the progress from these studies and other work conducted to date, knowledge of the population biology of North American green sturgeon remains limited and understanding of the movements and behavior of North American green sturgeon is still in its infancy (Klimley et al. 2007).

##### **4.1.3.1 UC Davis Biotelemetry Laboratory Surveys**

Since 2000, the University of California at Davis (UC Davis) Biotelemetry Laboratory has conducted studies to investigate the behavior and physiology of North American green sturgeon

(UC Davis 2009). This research is seeking to obtain information that addresses uncertainties regarding: 1) the parameters (e.g., temperature, dissolved oxygen, salinity, bathymetry, currents) that influence North American green sturgeon movements within the estuary; 2) adult North American green sturgeon movement and habitat utilization in the Sacramento River; 3) adult North American green sturgeon spawning locations and spawning habitat preferences; 4) residence times within the Sacramento River and the estuary; and 5) intervals between spawning runs (UC Davis 2009). The project is comprised of two phases. Phase I was designed to elucidate fine scale movements of individual fish within the San Francisco Estuary over periods of hours, days, and weeks. Phase II was designed to focus on large scale movements of fish throughout the entire Sacramento River system over periods of months and years.

In Phase II, North American green sturgeon were surgically implanted with small ultrasonic tags (VEMCO V16) from 2004 to 2006. Tag life was greater than 4 years. The ultrasonic tags permit long-term monitoring of tagged fish with automated listening stations (VEMCO VR2) in both salt and fresh water. These monitors were deployed throughout the Sacramento River system and remain in place year-round (UC Davis 2009).

Phase II field work was initiated in April 2004 and continued through March 2006 (UC Davis 2009). A total of 212 North American green sturgeon were captured, of which 96 met the tag-size criteria and were tagged and released. An array of 50 automated listening stations was deployed in the Sacramento River and San Francisco Bay between the Anderson Cottonwood Irrigation District (ACID) Dam in Redding, California and the Golden Gate Bridge (UC Davis 2009). Monitors were checked and data downloaded at regular intervals. Sixty tagged North American green sturgeon have been detected within the monitor array (UC Davis 2009). As of 2008, the Phase I and II Biotelemetry Laboratory research activities on North American green sturgeon movements became inactive (UC Davis 2009), although the monitoring framework formed the basis for the larger array now operated by the California Fish Tracking Consortium.

#### 4.1.3.2 Central Valley Fish Tracking Consortium Surveys

Since 2006 the Central Valley Fish Tracking Consortium, with funding from several sources including the CALFED Bay-Delta Program, NMFS and USACE, has established an array of 150 ultrasonic tag-detecting monitors that “listen” for tagged anadromous fish throughout the Central Valley encompassing the area from just above Battle Creek on the Sacramento River to the Golden Gate Bridge, including the Sacramento-San Joaquin Delta (California Fish Tracking Consortium 2009). Collaboration between several academic, government and private organizations, the Central Valley Fish Tracking Consortium is comprised of UC Davis, NMFS/UC Santa Cruz, USACE, USFWS, CDFG, East Bay Municipal Utilities District, Bay Planning Coalition and Hanson Environmental (California Fish Tracking Consortium 2009).

The ultrasonic tags used for this telemetry project are coded beacons, available from VEMCO Ltd. of Halifax, Canada (California Fish Tracking Consortium 2009). The receiver in the monitor measures the different separation times, decodes the identity of the tag, and places the corresponding tag ID along with time and date of detection in the memory of the automated VR2 monitor (California Fish Tracking Consortium 2009). VEMCO V16 coded tags were inserted into the peritoneal (abdominal) cavity of adult North American green sturgeon, a photograph of

the fish is taken, its length and mass are measured, and a description of its condition (scales, fin and eyes) is recorded before release (California Fish Tracking Consortium 2009). The VEMCO acoustic “pinger” tags send a signal (at 69kHz) to underwater monitors. The signal emitted by the tag is a coded transmission that is unique for every tag, and therefore every fish.

Continuous pinger tags with sensors are used to manually track fish, and also to monitor other environmental variables such as temperature and pressure (California Fish Tracking Consortium 2009). A continuous tag transmits sequential pings with a precise interval or a varying interval that is correlated to a physical variable such as temperature or depth (Webber 2009). Using continuous ultrasonic tags allows researchers to spend extended periods tracking a study subject in order to better characterize the movement patterns and behavior of an individual. Several tracks of adult North American green sturgeon (and juvenile steelhead trout) have already been conducted in the Central Valley and more tracks are planned (California Fish Tracking Consortium 2009).

Monitors have been deployed in pairs from the City of Sacramento to Cow Creek, a tributary to the mainstem Sacramento near Redding, California. The monitors are offset at least 100 meters upstream or downstream of one another and typically placed on opposite banks to ensure that fish are detected as they pass by specific locations. The array is downloaded quarterly and the data is compiled in a centralized database at the NMFS office in Santa Cruz.

#### 4.1.3.3 CDFG Acoustic Tagging and Tracking Survey

Utilizing acoustical tags and instream hydrophones, this is a multi-year study to monitor the movement patterns of wild juvenile and adult steelhead/rainbow trout in the Yuba River by CDFG’s Heritage and Wild Trout and the Steelhead Management and Recovery Programs. Fixed-station hydrophone data collection conducted as part of this program also provides the opportunity to identify acoustically tagged North American green sturgeon. Monitoring occurs on the Yuba River from Englebright Dam to the Yuba River and Feather River confluence through the use of acoustic hydrophones currently in place (J. Nelson, CDFG, 2008, pers. comm.). As of February 2009, there were 16 hydrophones located throughout the Yuba River. As of July 2011, 7 additional fixed station hydrophones have been added for a total of 23 static receiver hydrophones, which operate continuously year-round in the Yuba River.

Presently, 10 fixed-station hydrophones are located between the mouth of the Yuba River and Daguerre Point Dam. CDFG downloads acoustic ping data from the fixed-station hydrophones every other month. To download data from the receivers, a receiver is pulled from the river, a Bluetooth key is inserted into the unit, and a laptop equipped with Bluetooth capability and the VEMCO software is used to download the data (J. Nelson, CDFG, 2009, pers. comm.). Because static receivers occasionally create “ghost” acoustic tag numbers (due to ping collisions of two transmitters), those will be manually removed by CDFG. Ping data also will be filtered to remove duplicate tag numbers when the tag was detected numerous times during one occasion. Raw data files with all ping detections will be saved as a separate file prior to data filtering.

#### 4.1.3.4 Lower Yuba River Accord Monitoring and Evaluation Program

The Yuba Accord M&E Program includes study plans, referred to as Protocols and Procedures, which may provide anecdotal information regarding the presence of North American green sturgeon in the lower Yuba River, including:

- Acoustic Tagging and Tracking
- Snorkel Surveys
- Redd Surveys
- Rotary Screw Trapping (discontinued operation in August 2009)

Although none of the aforementioned studies is specifically designed to collect data on green sturgeon, any anecdotal observations of North American green sturgeon during the implementation of these protocols and procedures (refer to [www.yubaaccordrmt.com](http://www.yubaaccordrmt.com)) will be incorporated into the database of information prepared for this study plan.

## 4.2 Need for Additional Information

Compilation of existing data and analysis of habitat characteristics such as flow and water temperature have not been conducted to date. Such analyses would provide information about potential project-related effects on green sturgeon habitat availability. YCWA will collaborate with the Central Valley Fish Tracking Consortium and CDFG's Heritage and Wild Trout and the Steelhead Management and Recovery Programs regarding detection of acoustically tagged North American green sturgeon in the Yuba River, as described below in Phase 1 of this study plan. All information will be assessed and analyzed in consideration of habitat characteristics such as flow and water temperature in Phases 2 and 3 of this study plan.

## 5.0 Study Methods and Analysis

### 5.1 Study Area

This study area includes the Yuba River from Englebright Dam downstream to the confluence with the Feather River. This study area encompasses the locations where fixed-station hydrophones are presently located throughout the Yuba River, and corresponds to the activities to be conducted in Phase 1 of this study plan (as described below). Phase 2 of this study plan will be conducted for that portion of the Yuba River downstream of Daguerre Point Dam because: 1) no North American green sturgeon have been observed upstream of Daguerre Point Dam (NMFS 2008a); 2) the only confirmed observations of adult North American green sturgeon have occurred downstream of Daguerre Point Dam (NMFS 2008a; Bergman et. al 2011); 3) the area of critical habitat designated by NMFS (2009b) (74 FR 52300) for North American green sturgeon is limited to the section of the Yuba River extending from Daguerre Point Dam downstream to the mouth; and 4) Daguerre Point Dam most likely acts as a barrier to upstream migration.

If YCWA proposes an addition to the Project, the study area will be expanded if necessary to include areas potentially affected by the addition.

## 5.2 General Concepts and Procedures

The following general concepts and practices apply to the study:

- Personal safety is the most important consideration of each fieldwork team.
- Licensee will make a good faith effort to obtain permission to access private property where needed well in advance of entering the property.
- Field crews may make minor variances to the FERC-approved study in the field to accommodate actual field conditions and unforeseen problems. When minor variances are made, Licensee's field crew will follow the protocols in the FERC-approved study.
- When Licensee becomes aware of major variances to the FERC-approved study, Licensee will issue an e-mail to the Relicensing Contact List describing the variance and reason for the variance. Licensee will contact by phone the USFWS, NMFS, SWRCB and CDFG to provide an opportunity for input regarding how to address the variance. Licensee will issue an e-mail to the Relicensing Contact List advising them of the resolution of the variance. Licensee will summarize in the final study report all variances and resolutions.
- Licensee's performance of the study does not presume that Licensee is responsible in whole or in part for measures that may arise from the study.
- Global Positioning System (GPS) data will be collected using either a Map Grade Trimble GPS (sub-meter data collection accuracy under ideal conditions), a Recreation Grade Garmin GPS unit (3 meter data collection accuracy under ideal conditions), or similar units. GPS data will be post-processed and exported from the GPS unit into Geographic Information System (GIS) compatible file format in an appropriate coordinate system using desktop software. The resulting GIS file will then be reviewed by both field staff and Licensee's relicensing GIS analyst. Metadata will be developed for deliverable GIS data sets. Upon request, GIS maps will be provided to agencies in a form, such as ESRI Shapefiles, GeoDatabases, or Coverage with appropriate metadata, that is useful for interactive data analysis and interpretation. Metadata will be Federal Geographic Data Committee (FGDC) compliant.<sup>5</sup>
- Licensee's field crews will record incidental observations of aquatic and wildlife species observed during the performance of this study. All incidental observations will be reported in the appropriate Licensee report (e.g., incidental observations of special-status fish recorded during fieldwork for the Special-Status Turtles – Western Pond Turtle Study will be reported in Licensee's Stream Fish Populations Study report). The purpose of this effort is not to conduct a focus study (i.e., no effort in addition the specific field tasks identified for the specific study) or to make all field crews experts in identifying all species, but only to opportunistically gather data during the performance of the study.

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<sup>5</sup> The Forest Service and CDFG each have requested that a copy of the GIS maps be provided to them when the maps are available.

- Field crews will be trained on and provided with materials (e.g. Quat) for decontaminating their boots, waders, and other equipment between study sites. Major concerns are amphibian chytrid fungus, and invasive invertebrates (e.g. zebra mussel, *Dreissena polymorpha*). This is of primary importance when moving: 1) between tributaries and mainstem reaches; 2) moving between basins (e.g. Middle Yuba River, Yuba River, and North Yuba River); and 3) moving between isolated wetlands or ponds and river or stream environments.

## 5.3 Methods

This study is comprised of four Phases. Phase 1 includes a comprehensive review of the recent and ongoing data collection efforts to determine whether any North American green sturgeon have been observed in the Yuba River other than the confirmed observation of one individual during 2006 and more than one individual during 2011. Phase 1 activities specifically include the following steps: 1) compile available information regarding the number and location of acoustically tagged North American green sturgeon in collaboration with the University of California Davis Biotelemetry Laboratory and the Central Valley Fish Tracking Consortium; 2) collaborate with the Central Valley Fish Tracking Consortium to obtain records of detections of acoustically tagged North American green sturgeon in the Yuba River; 3) collaborate with the CDFG Heritage and Wild Trout Program regarding obtaining records of detections, if any, of North American green sturgeon presence and movement in the Yuba River; and 4) collaborate with the Yuba Accord River Management Team (RMT) to review data collected through the Yuba Accord M&E Program and report any observations of North American green sturgeon.

Phase 2 specifically includes identification of potential green sturgeon habitat areas from Daguerre Point Dam downstream to the confluence with the lower Feather River. Phases 3 and 4 include conducting analyses and preparing a report.

### 5.3.1 Phase 1 – Compile Data from Previous and Ongoing Data Collection Activities

Available data from the University of California Davis Biotelemetry Laboratory Sacramento River Green Sturgeon Migration and Population Assessment 2004-2006 activities, and subsequently from the California Fish Tracking Consortium Central Valley Acoustic Telemetry Project will be gathered and reviewed. Specifically, available information regarding the number and location of acoustically tagged North American green sturgeon will be summarized by YCWA.

Review available data from the University of California Davis Biotelemetry Laboratory Sacramento River Green Sturgeon Migration and Population Assessment 2004-2006 activities, and subsequently from the California Fish Tracking Consortium Central Valley Acoustic Telemetry Project to document the presence, if any, of North American green sturgeon in the Yuba River. If acoustically tagged North American green sturgeon are documented in the Yuba River, then available data will be compiled by YCWA reporting the location(s) and time(s) of detections.

Coordinate with CDFG (The Heritage and Wild Trout and the Steelhead Management and Recovery Programs) on acoustic monitoring conducted in the Yuba River to identify if any detection of acoustically tagged North American green sturgeon has occurred. YCWA will report the location and time of detections. If the CDFG Heritage and Wild Trout and the Steelhead Management and Recovery Programs do not specifically examine the database in an effort to identify acoustically tagged North American green sturgeon detections, then YCWA will coordinate with CDFG to examine the database specifically for North American green sturgeon detections. If any acoustically tagged North American green sturgeon are detected in the Yuba River, then YCWA will report the dates and locations of detections, as well as flow at the most proximate gage station (e.g., USGS gage at Marysville) and water temperature (estimated from interpolation between the most proximate upstream and downstream water temperature monitoring stations – see study plan 2.5).

Data from the Yuba Accord River Management Team will be assimilated and reviewed. Specifically, any anecdotal observations of green sturgeon during the implementation of the Yuba Accord M&E Program acoustic tagging and tracking, snorkel surveys, redd surveys, and rotary screw trapping (RST) (refer to [www.yubaaccordrmt.com](http://www.yubaaccordrmt.com)) will be reported for this study plan.

Although population estimates for North American green sturgeon are not available within the Sacramento River System, it is likely that a relatively small percentage of the total population has been acoustically tagged. The two detections (2006 and 2011) of North American green sturgeon in the Yuba River may represent random migratory behavior such as opportunistic foraging, or may be indicative of selective habitat occupancy and utilization. Therefore, YCWA assumes that green sturgeon may regularly utilize this portion of the river, including spawning in addition to adult holding. In the October 9, 2009 final ruling for green sturgeon critical habitat designation, NMFS (2009b) (74 FR 52300) states “*We recognize that spawning has not been confirmed in the lower Yuba River downstream of Daguerre Dam and have revised the final rule accordingly. However, the CHRT determined that the lower Yuba River likely provides spawning habitat for Southern DPS green sturgeon.*” Additionally, YCWA will continue to maintain communications with ongoing telemetry surveys, in case those efforts identify ongoing use of the lower Yuba River by green sturgeon.

Given the assumption that green sturgeon may utilize the Yuba River for adult holding and spawning, the next step of the methodologic procedure is to initially identify potential habitat areas downstream of Daguerre Point Dam to the mouth of the Yuba River.

### **5.3.2 Phase 2 - Document Potential Habitat Areas**

The available information for North American green sturgeon in the Sacramento River system suggest that if North American green sturgeon were to be found in the Yuba River, they would have the greatest potential to be observed in deepwater habitats downstream of Daguerre Point Dam.

NMFS identified a unique specific Primary Constituent Element (PCE) essential for the conservation of the Southern DPS of North American green sturgeon in the document titled

*Designation of Critical Habitat for the Threatened Southern Distinct Population Segment of North American Green Sturgeon - Final Biological Report* (NMFS 2009c). According to NMFS (2009c), deep ( $\geq 5$  m or 16.4 feet) holding pools are required for both upstream and downstream holding of adult or subadult green sturgeon, and deep pools of  $\geq 5$  meters (16.4 feet) deep are critical for adult green sturgeon spawning and for summer holding within the Sacramento River. Moyle (2002) suggests that North American green sturgeon probably spawn in depths greater than 3 meters.

Because the lower Yuba River is smaller than the Sacramento River or other rivers citing a depth criterion of  $> 5$  meters (16.4 feet), use of that criterion may be overly restrictive and not account for local opportunistic habitat utilization by green sturgeon. Therefore, to provide a more rigorous and inclusive identification of potential green sturgeon habitat areas, all pools located downstream of Daguerre Point Dam characterized by water depths of  $> 10.0$  feet will be identified by application of a SRH2D 2-dimensional model. Deepwater habitats will be identified on ArcGIS maps of the Yuba River from Daguerre Point Dam to the confluence with the Feather River. Polygons will be constructed of deepwater habitats equal to or greater than 10 feet in depth in the Yuba River from Daguerre Point Dam to the mouth at a nominal flow of 530 cfs at the Marysville gage, which is the highest minimum instream flow requirement during March corresponding to the Yuba Accord flow schedules. This nominal flow was selected because as previously described, North American green sturgeon adults in the Sacramento River are reported to begin their upstream spawning migrations into freshwater during late February, prior to spawning between March and July. Deepwater habitat polygons, with a minimum internodal spacing of 5 feet, will be developed by YCWA in collaboration with, and using data obtained by the Yuba Accord RMT in support of the M&E Program, through application of the digital elevation model and the SRH-2D 2-dimensional hydrodynamic model.

### **5.3.3 Phase 3 – Conduct Analyses**

The analyses are comprised of assessing deepwater habitat availability and water temperature suitability for green sturgeon in the Yuba River, described below.

#### **5.3.3.1 Deepwater Habitat Availability**

For all pools identified by application of a SRH2D 2-dimensional model located below Daguerre Point Dam greater than 10.0 feet deep at the nominal flow of 530 cfs at the Marysville Gage, the average change in depth associated with change in discharge will be calculated over the range of flows corresponding to the hydrologic period of evaluation. This calculation will be conducted to determine change in depth at green sturgeon habitat areas potentially affected by the Project.

In addition to water depth, the relationship between areal extent ( $\text{ft}^2$ ) of green sturgeon habitat areas and flow will be assessed. The area (acres) of available deepwater habitat polygons from Daguerre Point Dam to the mouth of the Yuba River that are equal to or greater than 10 feet in depth will be calculated in ArcGIS, derived by differencing between the digital elevation model and the SRH-2D 2-dimensional hydrodynamic model results. A relationship between the areas of deepwater habitat available and flows will be developed over the range of flows corresponding to the hydrologic period of evaluation.

The amount of deepwater habitat available in the Yuba River downstream of Daguerre Point Dam to the mouth will be examined by conducting a deepwater habitat duration analysis. The duration analysis will integrate estimates of deepwater habitat availability with hydrology over time (see Study Plan 2.5 Water Balance Operations Model) to provide a dynamic analysis of flow versus deepwater habitat availability.

The deepwater habitat duration curve will be constructed in the same manner as a flow duration curve, but will use estimates of deepwater habitat availability instead of flows as the ordered data. The product of the deepwater habitat duration analysis will be a record of mean daily deepwater habitat availability (acres), presented as an exceedance curve, over the hydrologic period of evaluation. The duration analysis will generate deepwater habitat availability duration metrics and calculate the differences between the existing operational scenario (including the Yuba Accord flow schedules) and other comparative scenarios based on a mean daily time step.

The approach will be characterized and reviewed with the Relicensing Participants. YCWA will review hydrodynamic model development, calibration and validation, and confirm all deepwater habitat availability duration analysis input parameters, extrapolation considerations, scenario assumptions, and desired output in collaboration with Relicensing Participants.

#### 5.3.3.2 Water Temperature Suitability

Technical evaluation guidelines will be developed to assess potential effects of Project operations on North American green sturgeon water temperature suitability. Specifically, North American green sturgeon lifestage periodicities will be explicitly defined, and lifestage-specific water temperature index values will be derived from a comprehensive literature review. Steps in this process will include: 1) clearly defining the periodicities of North American green sturgeon lifestages; 2) providing rationale for each lifestage definition and/or combination of lifestages, and their periodicities; 3) interpreting the literature on the effects of water temperature on the various lifestages of North American green sturgeon; 4) identifying water temperature suitability index values to be used as guidelines for effects assessment; 5) developing water temperature exceedance curves corresponding to specific lifestage periodicities using the water temperature model (see Study Plan 2.6 – Water Temperature Model); and 6) comparing water temperature exceedance curves with North American green sturgeon water temperature suitability index values over the hydrologic period of evaluation between the existing operational scenario (including the Yuba Accord flow schedules) and other comparative scenarios based on a mean daily time step.

#### 5.3.4 Phase 4 - Prepare Report

YCWA will prepare a report that includes the following sections: 1) Study Goals and Objectives; 2) Methods and Analysis; 3) Results; 4) Discussion; and 5) Description of Variances from the FERC-approved study, if any. The report will contain relevant summary tables and graphs. The report will include the following: 1) data and information compiled during Phase 1; 2) data, information and ArcGIS maps developed in Phase 2; and 3) analyses of Phase 1 and Phase 2 results.

## **6.0 Study-Specific Consultation**

As FERC's non-federal representative, YCWA will informally consult with NMFS under section 7 of the federal ESA. In addition, the following are specific areas for which YCWA will consult with the Relicensing Participants, or other entities:

### **Phase 1 - Compile Data from Previous and Ongoing Data Collection Activities**

- YCWA will compile available information regarding the number and location of acoustically tagged North American green sturgeon after contacting the University of California Davis Biotelemetry Laboratory and the Central Valley Fish Tracking Consortium
- YCWA will contact the Central Valley Fish Tracking Consortium to obtain any detections of acoustically tagged North American green sturgeon in the Yuba River
- YCWA will contact the CDFG Heritage and Wild Trout Program regarding obtaining detections, if any, of North American green sturgeon presence and movement in the Yuba River
- YCWA will consult with the Yuba Accord RMT to review data collected through the Yuba Accord M&E Program and report any observations of North American green sturgeon.
- YCWA will convene a collaborative meeting with Relicensing Participants including CDFG, USFWS, and NMFS, to share information that has been compiled during Phase 1.

### **Phase 2 – Document Potential Habitat Areas**

- YCWA will contact the Yuba Accord RMT to obtain data obtained by the RMT in support of the M&E Program, for the application of the digital elevation model and the SRH-2D 2-dimensional hydrodynamic model.

### **Phase 3 – Conduct Analyses**

- The analytical approach will be characterized and reviewed in consultation with the Relicensing Participants. YCWA will review hydrodynamic model development, calibration and validation, and confirm all deepwater habitat availability duration analysis input parameters, extrapolation considerations, scenario assumptions, and desired output in consultation with Relicensing Participants.

## **7.0 Schedule**

YCWA anticipates the schedule to complete the study as follows, assuming FERC issues its Study Determination by September 16, 2011 and the study is not disputed by a mandatory conditioning agency:

|   |                         |
|---|-------------------------|
| Compile Data from Previous Studies (Phase 1)..... | January - April 2012    |
| Document Potential Habitat Areas (Phase 2).....   | May 2012                |
| Analysis (Phase 3).....                           | June - July 2012        |
| Prepare Report (Phase 4) .....                    | August - September 2012 |

## **8.0**            **Consistency of Methodology with Generally Accepted Scientific Practices**

The methods presented in this study plan also are consistent with other generally accepted scientific study methods concerning sonar and acoustic tagging studies, including those conducted by NMFS, CDFG, USFS and the California Fish Tracking Consortium in California. Integration of lower Yuba River acoustic tracking data into the Central Valley acoustic telemetry database is consistent with the overall goals and objectives of the California Fish Tracking Consortium, and will promote inter-agency collaboration. Additionally, the specified flow and water temperature effects evaluations using exceedance probabilities and durations would be consistent with previously conducted evaluations for other regulatory compliance documents in the Central Valley of California.

## **9.0**            **Level of Effort and Cost**

YCWA estimates the cost to complete this study in 2011 dollars is between \$100,000 and \$135,000.

## **10.0**          **References Cited**

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