3.2.5 Endangered Species Act-Listed Species

This section discusses species listed under the federal Endangered Species Act (ESA) as threatened (FT), endangered (FE), proposed or candidates for listing and their critical habitats that could be affected by the Project.

3.2.5.1 Affected Environment

This section is divided into three subsections. Section 3.2.5.1.1 identifies ESA-listed species and their critical habitats that could be affected by the Project. Section 3.2.5.1.2 provides a general life history for each ESA-listed species. Section 3.3.5.1.3 contains available information regarding the distribution, abundance, and condition of the ESA-listed species and their critical habitat within the FERC Project Boundary and in the lower Yuba River.

3.2.5.1.1 Federal Endangered Species Act Listed Species

On June 13, 2020, YCWA generated a list of candidate and ESA-listed species for the Project using the USFWS' Information for Planning and Consultation System (USFWS 2020). The list included five species: two invertebrates, one amphibian, one reptile, and one fish. All of the species are listed as threatened species under the ESA. These are:

- Threatened
  - Vernal pool fairy shrimp (*Branchinecta lynchi*)
  - Valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*)
  - California red-legged frog (*Rana draytonii*)
  - Giant garter snake (*Thamnophis gigas*)
  - Delta smelt (*Hypomesus transpacificus*)

YCWA eliminated Delta smelt from further consideration because this species does not occur in the Yuba River basin.

YCWA searched several additional sources to compile the following for each of the ESA-listed species: 1) a description of the species' habitat requirements; 2) any known occurrences of the species in the Project vicinity, and 3) references to any recovery plans or status reports pertaining to that species. The information sources included CDFW's California Natural Diversity Data Base (CNDDB) (CDFW 2020), and USFWS' and NMFS' online database and recovery plans. For plants, the sources also included the California Native Plant Society's (CNPS) database (CNPS 2020), which were queried for the French Corral, Oregon House, Rough and Ready, and Smartsville USGS topographic quadrangles, which include the Project vicinity.

Based on these searches, YCWA added eight additional species to the list of ESA-listed species that could potentially be affected by continued Project O&M: four plants, one invertebrate and three fish:

- Endangered
  - Stebbins' morning-glory (*Calystegia stebbinsii*)
  - Pine Hill flannelbush (*Fremontodendron decumbens*)
  - Hartweg's golden sunburst (*Pseudobahia bahiifolia*)
  - Vernal pool tadpole shrimp (*Lepidurus packardi*)

- Threatened
  - California Central Valley steelhead (*Oncorhynchus mykiss irideus*) Distinct Population Segment (DPS) and its Critical Habitat[1]
  - Central Valley spring-run Chinook salmon (*O. tshawytscha*) Evolutionary Significant Unit (ESU) and its Critical Habitat[2,3]
  - North American green sturgeon (*Acipenser medirostris*), southern DPS and its Critical Habitat[4]
  - Layne's ragwort (*Packera layneae*)

The Project was visited on May 1 and May 21, 2020, for a focused plant survey and habitat assessment. No ESA-listed species were observed during either visit.

Based on the May 2020 survey and assessment, YCWA eliminated from further consideration, vernal pool fairy shrimp and vernal pool tadpole shrimp because habitat for these species, vernal pools, does not occur in or within 500 feet of the FERC Project Boundary (USFWS 2005). Stebbins' morning-glory, Pine Hill flannelbush and Layne's ragwort were eliminated from further consideration due to the lack of serpentine or gabbro soils, a requirement of these species' habitat, within 500 feet of the FERC Project Boundary (USFWS 2002a). Hartweg's golden sunburst was eliminated from further consideration due to the lack of clay soils and Mima mounds, requirements of this species' habitat, within 500 feet of the FERC Project Boundary (USFWS 2007). In addition, California red-legged frog was removed from further consideration due to lack of appropriate aquatic habitat (the Yuba River is too deep and fast, as well as lacking in vegetative cover, in and around the FERC Project Boundary) and the steepness and inaccessibility of the slopes preventing any upland access for the CRLF (USFWS 2002b). The surveys of the FERC Project Boundary also located no habitat for valley elderberry longhorn

[1] In the lower Yuba River, critical habitat for steelhead and for spring-run Chinook salmon is designated from the confluence with the Feather River upstream to Englebright Dam.

[2] Ibid.

[3] Under the Magnuson-Stevens Fishery Conservation and Management Act, the United States Department of Commerce (USDOC), National Oceanic and Atmospheric Administration (NOAA), National Marine Fisheries Service (NMFS) has identified Essential Fish Habitat (EFH) for Chinook salmon in the Yuba River Basin as from the confluence with the Feather River upstream to "Salmon Creek, near Sierra City" in the North Yuba River; "the lower river, near where the North Fork joins" in the Middle Yuba River; "1-2 miles upstream, [where] perhaps spring run accessed the present town of Washington" in the South Yuba River" and "~5 to 6 miles upstream" on Dry Creek, a tributary to the mainstem. This EFH includes all waterbodies occupied or historically accessible to Chinook salmon within the USGS HUC 18020125.

[4] In the lower Yuba River, critical habitat for green sturgeon includes the river channel to the ordinary high water line extending from the confluence with the Feather River upstream to Daguerre Point Dam.

beetle (elderberry shrub [*Sambucus* spp.]) (USFWS 2017a). Therefore, valley elderberry longhorn beetle was eliminated from further consideration. Giant garter snake was also eliminated from further consideration as the FERC Project Boundary is outside of the known elevation range of the species (10 to 40 feet for snake, versus 300 to 850 feet for the Project) and more than 25 miles from the nearest known occurrence (USFWS 2017b, CDFW 2020).

As a result, YCWA concluded three species and their designated critical habitats have a potential to be affected by the Project. Information regarding ESA listing, suitable habitat, known occurrences, proximal reports of the species to the Project, and relevant status reports and recovery plans is shown in Table 3.2.5-1.

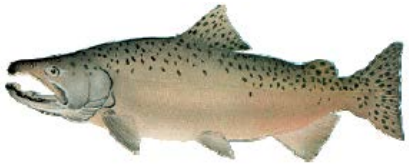
Table 3.2.5-1. ESA-listed species and their designated critical habitat potentially affected by the Project.

Species		Suitable Habitat Type	Known Occurrence in Project Vicinity	Status[2]	Status Reports and Recovery Plans Relevant to Project Vicinity
Common Name[1]	Scientific Name				
FISH					
Central Valley spring-run Chinook salmon Evolutionarily Significant Unit (ESU)	*Oncorhynchus tshawytscha*	Naturally-spawning anadromous Chinook salmon expressing the phenotypic characteristics of spring-run have been observed in the lower Yuba River below the USACE's Englebright Dam (McEwan 2001). RMT (2013) identified the spring-run Chinook salmon adult immigration and holding period as extending from April through September. Adult spring-run Chinook salmon hold in areas in their natal streams of spawning grounds during the summer months until their eggs fully develop and become ready for spawning, generally between late August and mid-October. Spring-run juveniles may emigrate as fry soon after emergence, rear in their natal streams for several months prior to emigration as young-of-year (YOY) or remain in their natal streams for extended periods and emigrate as yearlings. Studies conducted by RMT (2013) suggest that juvenile Chinook salmon appeared to occupy areas in close proximity to the shore, and primarily occupy lateral bar, slackwater, slow glide, and riffle transition morphological units.	Reported on the USFWS species list for Project Vicinity quads and counties (USFWS 2009). One occurrence found on CNDDB within Smartsville quad; Yuba River from Highway 20 Bridge upstream to USACE's Englebright Dam (CDFG 2009). Reported on the NOAA Fisheries species list for Project Vicinity quads and counties (NMFS 2020).	FT, ST	Status Reports CDFG 1996; CDFG 1998; Myers et al. 1998; NMFS 1999; Good et al. 2005; NMFS 2016 Restoration and Management Plan CDFG 1991; CDFG 1993 Recovery Plan NMFS 2014 (Final)
California Central Valley steelhead Distinct Population Segment (DPS)	*Oncorhynchus mykiss*	Naturally-spawning steelhead that exhibit anadromy have been found in the Yuba River below USACE's Englebright Dam (McEwan 2001). Adult steelhead may immigrate and hold in the lower Yuba River from August through March. Spawning generally extends from January through April. After emergence, steelhead fry move to shallow-water, low velocity habitats, and forage in areas both including cover, and open areas lacking instream cover. Juvenile steelhead are reported to increasingly use areas with instream object cover and show a preference for higher velocity, deeper mid-channel areas as they grow larger. In the lower Yuba River, juvenile steelhead exhibit variable durations of rearing. Some juvenile *O. mykiss* may rear in the lower Yuba River for short periods (up to a few months) and others may spend from one to three years rearing in the river.	Reported on the USFWS species list for Project Vicinity quads and counties (USFWS 2009). No nearby records in CNDDB. Reported on the NOAA Fisheries species list for Project Vicinity quads and counties (NMFS 2020).	FT	Status Reports Busby et al. 1996; NMFS 1997; NMFS 1998; Good et al. 2005; Ford 2011; NMFS 2016 Restoration and Management Plan CDFG 1991; CDFG 1993; CDFG 1996 Recovery Plan NMFS 2014 (Final)
Southern DPS of North American green sturgeon	*Acipenser medirostris*	Limited information regarding green sturgeon distribution, movement, and behavioral patterns, as well as lifestage-specific habitat utilization preferences, is available for the Yuba River (as well as for other Central Valley rivers). However, for the lower Yuba River, NMFS (2018) Recovery Plan for the Southern DPS of North American Green Sturgeon states that "*…recent analysis suggests that temperatures fall within optimal ranges....*"	Green sturgeon observed in the lower Yuba River below Daguerre Point Dam as recently as 2018 (CFS 2011; Heublein et al. 2017; Kurth 2018). CDFW (2019) documented green sturgeon spawning in the lower Yuba River for the first time, finding green sturgeon eggs on an egg mat deployed immediately below Daguerre Point Dam.	FT	Status Reports Adams et al. 2002; NMFS 2005 Recovery Plan NMFS 2018 (Final)

3.2.5.1.2 Life Histories of ESA-Listed Species

A brief description of listing status and life history of each ESA-listed species potentially affected by the Project is provided below.

Central Valley Spring-run Chinook Salmon ESU



On September 16, 1999, NMFS listed the Central Valley ESU of spring-run Chinook salmon as a "threatened" species (64 FR 50394). Critical habitat was designated for the Central Valley spring-run Chinook salmon ESU on September 2, 2005 (70 FR 52488) including the Yuba River extending from the confluence with the Feather River upstream to Englebright Dam.

Section 305(b)(2) of the 1996 amendments to the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) (16 USC 1801 et seq.) requires the identification of Essential Fish Habitat (EFH) for federally managed fishery species and the implementation of measures to conserve and enhance this habitat. In the Mid-Pacific Region, the Pacific Fisheries Management Council designates EFH and NMFS approves the designation. EFH includes specifically identified waters and substrate necessary for fish spawning, breeding, feeding, or growth to maturity and covers a species' full life cycle (16 USC 1802(10)). EFH only applies to commercial fisheries. Chinook salmon habitat in the Yuba River (USGS Hydrologic Unit 18020107) has been identified as part of the Pacific salmon freshwater EFH. For the lower Yuba River downstream of Englebright Dam, EFH is applied to all runs (spring-run and fall/late fall-run) of Chinook salmon.

The RMT (2013) developed representative temporal distributions for specific spring-run Chinook salmon lifestages in the lower Yuba River through review of previously conducted studies, as well as ongoing data collection activities of their Monitoring and Evaluation (M&E) Program. These periodicities are shown in Table 3.2.5-2.

Table 3.2.5-2. Lifestage-specific periodicities for spring-run Chinook salmon in the lower Yuba River (shaded boxes indicate temporal utilization of the Yuba River) (RMT 2013; YCWA 2017).

Lifestage	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
Adult Immigration & Holding							■	■	■	■	■	■	■	■	■	■	■	■						
Spawning																	■	■	■					
Embryo Incubation																	■	■	■	■	■	■	■	■
Fry Rearing	■	■	■																			■	■	■
Juvenile Rearing	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Juvenile Downstream Movement	■	■	■	■	■	■	■	■	■	■	■	■										■	■	■
Smolt (Yearling+) Emigration	■	■	■	■	■	■	■	■	■										■	■	■	■	■	■

Adult Immigration and Holding

Spring-run Chinook salmon previously have been reported to migrate immediately to areas upstream of the Highway 20 Bridge after entering the Yuba River from March through October (Vogel and Marine 1991; YCWA et al. 2007), and then over-summer in deep pools located downstream of the Narrows 1 and 2 powerhouses, or further downstream in the Narrows Reach through the reported spawning period of September through November (CDFG 1991; SWRCB 2003). The results from the RMT's M&E Program, including the VAKI Riverwatcher™ monitoring and particularly the three-year acoustic telemetry study, found past characterizations of temporal and spatial distributions to be largely unsupported. Phenotypic adult spring-run Chinook salmon were observed to exhibit a much more diverse pattern of movement, and holding locations in the lower Yuba River were more expansive than previously reported (RMT 2013).

A large longitudinal extent of the lower Yuba River was occupied by the tagged phenotypic adult spring-run Chinook salmon during immigration and holding periods, and temporal migrations to areas upstream of Daguerre Point Dam occurred over an extended period of time. The tagged phenotypic adult spring-run Chinook salmon in the lower Yuba River actually migrated upstream of Daguerre Point Dam from May through September, and utilized a broad expanse of the lower Yuba River during the summer holding period, including areas as far downstream as Simpson Lane Bridge (i.e., ~RM 3.2), and as far upstream as the area just below Englebright Dam.

Prolonged occupancy in pool habitats was observed during the summer months from Simpson Lane Bridge (i.e., ~RM 1.8) upstream to Englebright Dam (i.e., ~RM 24). The majority of tagged spring-run Chinook salmon were detected in the plunge pool located immediately downstream of Daguerre Point Dam from the onset of tagging in May/June, through the over-summer holding period as late as September. Periods of occupation in the Daguerre Point Dam pool during the study ranged from 0 to 116 days. Only the large pool located in the downstream section of the Narrows Reach (i.e., the Narrows Pool) was occupied for a longer temporal period, and no other area of the river was utilized by a higher proportion of the tagged phenotypic adult spring-run Chinook salmon for an extended temporal period than the Daguerre Point Dam pool. There are no definitive explanations for this observation, but it has been suggested that Daguerre Point Dam represented a passage impediment, or that these fish over-summered in the Daguerre Point Dam pool due to suitable habitat conditions available below the dam (e.g., favorable water depths, cover, water temperatures and proximity to spawning gravels).

The RMT (2013) examined the daily number of adult Chinook salmon passing upstream of Daguerre Point Dam obtained by the VAKI Riverwatcher™ system from 2004 through 2011, and mean daily flows at the Marysville Gage, and did not find any consistent trend or relationship between adult Chinook salmon passage upstream of Daguerre Point Dam and flow rate. Chinook salmon passage was observed over a variety of flow conditions, including ascending or descending flows, as well as during extended periods of stable flows. Flow thresholds prohibiting passage of Chinook salmon through the ladders at Daguerre Point Dam were not apparent in the data.

Adult Spawning and Embryo Incubation

The RMT's (2013) examination of the 2009, 2010 and 2011 acoustically-tagged spring-run Chinook salmon data revealed a consistent pattern in fish movement. In general, acoustically-tagged spring-run Chinook salmon exhibited an extended holding period, followed by a rapid movement into upstream areas (upper Timbuctoo Reach, Narrows Reach, and Englebright Dam Reach) during September. Then, a period encompassing approximately one week was observed when fish held at one specific location followed by rapid downstream movement. The approximate 1-week period appeared to be indicative of spawning events, which ended by the first week in October.

The earliest spawning (presumed to be spring-run Chinook salmon) generally occurs in the upper reaches and progressively moves downstream. This spatial trend reflects cooler water temperatures extending farther downstream as the spawning season progresses (RMT 2013).

Spring-run Chinook salmon spawning in the lower Yuba River is believed to occur upstream of Daguerre Point Dam. With the exception of the Englebright Dam Reach, there is an abundance of suitable spawning gravel in the lower Yuba River.

Juvenile Rearing and Outmigration

Snorkel observations conducted by the RMT (2013) indicate that the density of juvenile Chinook salmon was highly variable throughout the lower Yuba River although, with the exception of the upstream-most survey reach (i.e., Englebright Dam Reach); the density of juvenile Chinook salmon generally was higher in the survey reaches located upstream rather than downstream of Daguerre Point Dam. These observations are consistent with previous reports (Beak 1989; CDFG 1991; Kozlowski 2004). This may be due to larger numbers of spawners, greater amounts of more complex, high-quality cover, and lower densities of predators such as striped bass (*Morone saxatilis*) and American shad (*Alosa sapidissima*), which reportedly are generally restricted to areas below the dam (YCWA et al. 2007).

The RMT (2013) reported that juvenile Chinook salmon appeared to occupy areas in close proximity to the shore during most survey months and in most survey reaches. However, in the Marysville Reach, juveniles were distributed considerably further from shore relative to the other reaches. The Marysville Reach has an extended shallow sandy bar on the north bank on which large woody debris collects, which may provide refuge to juveniles away from the shoreline. The overall findings indicate that juvenile Chinook salmon in the lower Yuba River initially prefer slower, shallower habitat, and move into faster and deeper water as they grow.

Smolt Emigration

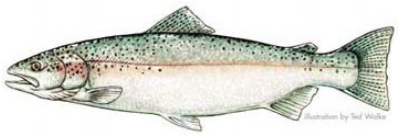
Although it has been previously suggested that spring-run Chinook salmon emigrate as smolts from November through June in the Yuba River (CALFED and YCWA 2005; CDFG 1998; SWRI 2002), more recent RST monitoring data indicate that the vast majority of spring-run Chinook salmon emigrate as post-emergent fry during (late) November and December. Overall, most (about 84%) of the juvenile Chinook salmon were captured at the Hallwood Boulevard RSTs soon after emergence from November through February with relatively small numbers continuing to be captured through June. Although not numerous, captures of (over-summer) holdover juvenile Chinook salmon ranging from about 70 to 140 mm FL primarily occurred from

October through January with a few individuals captured into March (Massa 2005; Massa and McKibbin 2005). These fish likely reared in the river over the previous summer, representing an extended juvenile rearing strategy characteristic of spring-run Chinook salmon (RMT 2013).

NMFS Recovery Plan for Central Valley Chinook Salmon and Steelhead

The NMFS (2014) Final Recovery Plan for Central Valley Chinook Salmon and Steelhead establishes three population levels to help guide recovery efforts for existing populations, referred to as Core 1, 2, and 3 populations. The NMFS Recovery Plan (pg. 76) identifies the lower Yuba River spring-run Chinook salmon population below Englebright Dam as Core 2 population. Core 2 populations meet, or have the potential to meet, the biological recovery standard for moderate risk of extinction. Core 2 populations provide increased life history diversity to the ESU and are likely to provide a buffering effect against local catastrophic occurrences that could affect other nearby populations, especially in geographic areas where the number of Core 1 populations is lowest (NMFS 2014). Additionally, NMFS (2014) Recovery Plan states that "*Implementation of the flow schedules specified in the Fisheries Agreement of the Yuba Accord is expected to address the flow-related major stressors including flow-dependent habitat availability, flow-related habitat complexity and diversity, and water temperatures.*"

California Central Valley Steelhead DPS



On March 19, 1998 (63 FR 13347) NMFS listed the Central Valley DPS of steelhead as a "threatened" species. NMFS published the final rule designating critical habitat for steelhead on September 2, 2005, which includes the lower Yuba River (70 FR 52488) extending from the confluence with the lower Feather River upstream to Englebright Dam.

Steelhead exhibits perhaps the most complex suite of life-history traits of any species of Pacific salmonid. Members of this species can be anadromous or freshwater residents and, under some circumstances, members of one form can apparently yield offspring of another form (YCWA 2010). The RMT developed representative temporal distributions for specific steelhead lifestages[5] in the lower Yuba River through review of previously conducted studies, as well as ongoing data collection activities of their M&E Program. These periodicities are shown in Table 3.2.5-3.

Table 3.2.5-3. Lifestage-specific periodicities for steelhead in the lower Yuba River (shaded boxes indicate temporal utilization of the Yuba River) (RMT 2013; YCWA 2017).

Lifestage	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
Adult Immigration & Holding	■	■	■	■	■	■									■	■	■	■	■	■	■	■	■	■
Spawning	■	■	■	■	■	■	■	■																
Embryo Incubation	■	■	■	■	■	■	■	■	■	■														

[5] As with spring-run Chinook salmon, the resultant lifestage periodicities are intended to encompass the majority of activity for a particular lifestage, and are not intended to be inclusive of every individual in the population.

Table 3.2.5-3. (continued).

Lifestage	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
Fry Rearing							■	■	■	■	■	■	■	■										
Juvenile Rearing	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Juvenile Downstream Movement							■	■	■	■	■	■	■	■	■	■	■	■						
Smolt (Yearling+) Emigration	■	■	■	■	■	■	■												■	■	■	■	■	■

Adult Immigration and Holding

RMT (2010a; 2013) examined preliminary data and identified variable annual timing of *O. mykiss* ascending the fish ladders at Daguerre Point Dam since the VAKI Riverwatcher™ began operations in 2003. They identified the period extending from August through March as encompassing the majority of the upstream migration and holding of adult steelhead in the lower Yuba River. Because steelhead have not been acoustically tagged (as were spring-run Chinook salmon), additional information regarding holding areas is not available.

Adult Spawning and Embryo Incubation

Steelhead spawning has been reported to primarily occur in the lower Yuba River upstream of Daguerre Point Dam (SWRI et al. 2000; YCWA et al. 2007). Kozlowski (2004) states that field observations during winter and spring 2000 (YCWA unpublished data) indicated that the majority of steelhead spawning in the lower Yuba River occurred from Long Bar upstream to the Narrows with the highest concentration of redds observed upstream of the Highway 20 Bridge. RMT (2013) reported that steelhead redds show a distinctive pattern spatially throughout the lower Yuba River, with the majority of redds in the Timbuctoo Bend and Parks Bar reaches of the lower Yuba River. In the lower Yuba River, steelhead have been observed to spawn in side channel areas as well as in mainstem areas (YCWA unpublished data).

Juvenile Rearing and Outmigration

In the lower Yuba River, juvenile steelhead exhibit variable durations of rearing. Some juvenile *O. mykiss* may rear in the lower Yuba River for short periods (up to a few months) and others may spend from one to three years rearing in the river.

Based on the combined results from electrofishing and snorkeling surveys conducted during the late 1980s, CDFG (1991) reported that juvenile steelhead were observed in all river reaches downstream of the Englebright Dam and, in addition to Chinook salmon, were the only fish species observed in the Narrows Reach. They also indicated that most juvenile steelhead rearing occurred above Daguerre Point Dam. SWRI et al. (2000) summarized data collection in the lower Yuba River obtained from 1992 through 2000. They reported the primary rearing habitat for juvenile *O. mykiss* is upstream of Daguerre Point Dam, with decreasing abundance downstream of Daguerre Point Dam. SWRI et al. (2000) suggested that higher abundances of juvenile *O. mykiss* above Daguerre Point Dam may have been due to larger numbers of spawners, greater amounts of more complex, high quality cover, and lower densities of predators such as striped bass and American shad, which reportedly were restricted to areas below Daguerre Point Dam. The habitat enhancement strategy developed by YWA (2020) considers

the observations that rearing juvenile steelhead are most abundant proximate to their spawning areas, which occur upstream of Daguerre Point Dam.

Smolt Emigration

Although not numerous, captures of (over-summer) holdover juvenile *O. mykiss* generally ranging from about 60 to 140 mm fork length (FL) were observed in the rotary screw trap (RST) captures primarily from October through mid-April (RMT 2013). These fish likely reared in the river over the previous summer, representing an extended juvenile rearing strategy characteristic of holdover juvenile *O. mykiss*. Juvenile *O. mykiss* that exhibit extended rearing in the lower Yuba River are assumed to undergo the smoltification process and volitionally emigrate from the river and are referred to as yearling and smolts.

Smolt-sized *O. mykiss* constitute a highly variable percentage of the annual emigrant populations. RMT (2013) reported that in general, the higher the annual mean flow and the lower the annual mean temperature at the Marysville Gage, the greater the proportion of smolt-sized juvenile *O. mykiss* in the annual emigrant population.

NMFS Recovery Plan for Central Valley Chinook Salmon and Steelhead

As described above, NMFS's (2014) Final Recovery Plan for Central Valley Chinook Salmon and Steelhead establishes three population levels to help guide recovery efforts for existing populations, referred to as Core 1, 2, and 3 populations. The NMFS Recovery Plan (pg. 77) identifies the lower Yuba River steelhead population below Englebright Dam as a Core 2 population. NMFS (2014) Recovery Plan states that "*Implementation of the flow schedules specified in the Fisheries Agreement of the Yuba Accord is expected to address the flow-related major stressors including flow-dependent habitat availability, flow-related habitat complexity and diversity, and water temperatures.*"

Southern DPS of North American Green Sturgeon

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. 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 (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 lower Yuba River to extend from the confluence with the lower Feather River upstream to Daguerre Point Dam.

Green sturgeon are slow-growing fish, typically reaching maturity around age 15 and living 60 to 70 years (NMFS 2020; CDFW 2019). Limited information regarding green sturgeon

distribution, movement, and behavioral patterns, as well as lifestage-specific habitat utilization preferences, is available for the Yuba, Feather and Sacramento rivers. Green sturgeon in the Sacramento River have been documented and studied more widely than they have in either the Feather or the Yuba rivers.

Since the 1970s, numerous surveys of the lower 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. Over the many years of these surveys and monitoring of the lower Yuba River, only a few confirmed observations of an adult green sturgeon occurred prior to 2011. During 2016, CDFW personnel conducted some observational snorkeling in the plunge pool located immediately below Daguerre Point Dam. During the course of the snorkeling, observations of a few green sturgeon were made in the plunge pool and video documented.

YCWA (2013) examined the potential occurrence of green sturgeon in the lowermost 24 miles of the Yuba River based on detections of acoustically-tagged green sturgeon in the Yuba River. None of the 217 green sturgeon acoustically-tagged and tracked by the California Fish Tracking Consortium in the Central Valley were detected in the Yuba River. One fish tagged by DWR in the Feather River was detected once on September 6, 2011 in the Yuba River by CDFW's lowermost acoustic receiver located at the confluence of the Yuba and Feather rivers. That fish also was detected upstream in the Feather River earlier on the same day and downstream in the Sacramento River on the evening of September 6, 2011. Therefore, the fish apparently only entered the mouth of the lower Yuba River for a very brief period of time before continuing its downstream migration in the Feather and Sacramento rivers. A few adult green sturgeon also have been observed in the lower Yuba River immediately downstream of Daguerre Point Dam as recently as 2018 (NMFS 2018).

The lifestage-specific periodicities for green sturgeon in the lower Yuba River are summarized in Table 3.2.5-4.

Table 3.2.5-4. Lifestage-specific periodicities for green sturgeon in the lower Yuba River (shaded boxes indicate temporal utilization of the Yuba River) (RMT 2013; YCWA 2017).

Lifestage	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
Adult Immigration and Holding				■	■	■	■	■																
Spawning and Embryo Incubation					■	■	■	■	■	■	■	■	■	■										
Post-Spawning Holding					■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		
Juvenile Rearing and Outmigration	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■

Adult Immigration and Holding

According to Erickson and Webb (2007), water temperature seems to be an important cue signaling adults to migrate into river systems. Adult green sturgeon enter San Francisco Bay in late winter through early spring, and spawn in the Sacramento River primarily from April through early July (Heublein et al. 2009; Poytress et al. 2011, 2015). For the Sacramento River,

NMFS (2009) reports that adult green sturgeon prefer deep holes (≥ 5 m depth) at the mouths of tributary streams, where they spawn and rest on the bottom. Post-spawn adult fish may hold for several months in the Sacramento River and out-migrate in the fall or winter, or move out of the river quickly during the spring and summer months, with the holding behavior most commonly observed (Heublein et al. 2009; Mora 2016). No definitive information regarding green sturgeon adult immigration and holding is available for the lower Yuba River.

Spawning and Embryo Incubation

Unlike salmon, green sturgeon may spawn several times during their long lives, returning to their natal rivers every 3–5 years (NMFS 2020). Little is known about where green sturgeon spawning occurs in the Central Valley, or how successful they are when they spawn (CDFW 2019). Eggs are likely broadcast and externally fertilized in relatively fast water and probably in depths greater than three meters (Moyle 2002). In 2018, CDFW biologists documented green sturgeon spawning in the lower Yuba River for the first time, finding approximately 270 green sturgeon eggs on an egg mat deployed immediately below Daguerre Point Dam. Green sturgeon larvae hatch from fertilized eggs after approximately 169 hours of incubation at a water temperature of 59°F (Van Eenennaam et al. 2001; Deng et al. 2002), which is similar to the sympatric white sturgeon development rate (176 hours). Van Eenennaam et al. (2005) indicated that an optimum range of water temperatures for egg development was between 57.2°F and 62.6°F. Water temperatures above 68°F are reportedly lethal to green sturgeon embryos (Cech et al. 2000; Beamesderfer and Webb 2002).

Post-Spawning Holding

Green sturgeon larvae do not exhibit the initial pelagic swim–up behavior characteristic of other *Acipenseridae*. They are strongly oriented to the bottom and exhibit nocturnal activity patterns (NMFS 2009a). After 6 days, the larvae exhibit nocturnal swim-up activity (Deng et al. 2002) and nocturnal downstream migrational movements (Kynard et al. 2005). After approximately 10 days, larvae begin feeding and growing rapidly. Under laboratory conditions, green sturgeon larvae cling to the bottom during the day, and move into the water column at night (Van Eenennaam et al. 2001).

Juvenile Rearing and Outmigration

Juvenile green sturgeon spend from 1 to 4 years in fresh and estuarine waters, and disperse into salt water at lengths of 300 to 750 mm (USACE 2007). As reported in USACE (2007), metamorphosis to the juvenile stage is complete at 45 days, and juveniles continue to grow rapidly, reaching 300 mm in one year. Green sturgeon juveniles tested under laboratory conditions had optimal bioenergetic performance (i.e., growth, food conversion, swimming ability) between 59°F and 66.2°F under either full or reduced rations (Mayfield and Cech 2004). The lack of a significant proportion of juveniles shorter than approximately 200 mm in Delta captures indicates that juvenile green sturgeon likely hold in the mainstem Sacramento River, as suggested by Kynard et al. (2005).

NMFS Recovery Plan for the Southern DPS of North American Green Sturgeon

The NMFS (2018) Recovery Plan states that since the listing of the Southern DPS in 2009, spawning has been documented in the lower Yuba River (Seesholtz et al. 2015; Beccio 2018), but many significant threats have not been addressed. Because Daguerre Point Dam is

recognized by NMFS as limiting the distribution of green sturgeon in the lower Yuba River (74 FR 52300, October 9, 2009; Mora et al. 2009), the recovery plan includes actions to restore habitat for green sturgeon below Englebright Dam and to provide volitional passage at the USACE's Daguerre Point Dam on the lower Yuba River.

3.2.5.1.3 Available Information regarding ESA-listed Species in the Lower Yuba River

The most recent summary of information regarding spring-run Chinook salmon, steelhead and green sturgeon in the lower Yuba River is YCWA's 2017 Application for New License, as amended, for the Yuba River Development Project (YCWA 2017). As discussed in YCWA's Applicant-Prepared Draft Biological Assessment (BA), a description of existing information regarding salmonid populations in the lower Yuba River is contained in Attachment 7-8A to Technical Memorandum 7-8, *ESA/CESA-Listed Salmonids Downstream of Englebright Dam*, which can be found on YCWA's website (https://www.yubawater.org/DocumentCenter/View/1419/TM-7-8-PDF). Technical Memorandum 7-8 summarized the available literature for spring-run Chinook salmon where specifically identified, Chinook salmon in general where runs are not specifically identified, and *O. mykiss*. The technical memorandum describes available field studies and data collection reports, other relevant documents, and ongoing data collection, monitoring and evaluation activities including the Yuba Accord M&E Program and other data collection and monitoring programs. Technical Memorandum 7-8 summarily describes 21 available field studies and data collection reports, 20 other relevant documents (e.g., plans, policies, historical accounts and regulatory compliance), 14 data collection, monitoring and evaluation activities for the M&E Program, and 4 other data collection and monitoring programs. Provided below is a summary of new or updated information.

Spring-run Chinook Salmon

Acoustic Tagging

As described in YCWA's Applicant-Prepared Draft BA (pages BA5-13 through BA5-17, BA5-46, and BA5-54 to BA5-56), the RMT conducted a 3-year acoustic telemetry study of adult spring-run Chinook salmon tagged downstream of Daguerre Point Dam during the phenotypic adult upstream migration period, which provided new information to better understand adult spring-run Chinook salmon temporal and spatial distributions in the lower Yuba River. Together with the results from the VAKI Riverwatcher™ monitoring, the acoustic telemetry study found that past characterizations of temporal and spatial distributions to be largely unsupported, as phenotypic adult spring-run Chinook salmon were observed to exhibit a much more diverse pattern of movement, and holding locations in the lower Yuba River were more expansive than has been previously reported (RMT 2013).

Examination of the 2009, 2010 and 2011 acoustically-tagged spring-run Chinook salmon data revealed a consistent pattern in fish movement. In general, acoustically-tagged spring-run Chinook salmon exhibited an extended holding period, followed by a rapid movement into upstream areas (i.e., upper Timbuctoo Reach, Narrows Reach, and Englebright Reach) during September. Then, a period encompassing approximately one week was observed when fish held at one specific location, followed by rapid downstream movement. The approximate 1-week

period appeared to be indicative of spawning events, which ended by the first week in October. These observations, combined with early redd detections and initial carcasses appearing in the carcass surveys (see below), suggest that the spring-run Chinook salmon spawning period in the lower Yuba River may be of shorter duration than previously reported, extending from September 1 through mid-October (RMT 2013).

The acoustically-tagged phenotypic spring-run Chinook salmon spent variable and extended periods of time holding below Daguerre Point Dam after being tagged and prior to passing upstream of Daguerre Point Dam, with a range of 0 to 116 days. Based on all 67 acoustically-tagged spring-run Chinook salmon that passed upstream of Daguerre Point Dam, the average holding time before passing upstream of Daguerre Point Dam was about 50 days.

Consideration of holding duration downstream of Daguerre Point Dam supports the observation that the ratios of flows and water temperatures in the lower Yuba River, relative to the lower Feather River, 6 weeks prior to passage of spring-run Chinook salmon at Daguerre Point Dam may be influencing the attraction of adipose fin-clipped spring-run Chinook salmon of FRFH-origin into the lower Yuba River (YCWA 2017).

Straying into the Lower Yuba River

As described in YCWA's Applicant-Prepared Draft BA (pages BA5-53 to BA5-57), some information indicating the extent to which adipose-clipped Chinook salmon originating from the Feather River Fish Hatchery (FRFH) return to the lower Yuba River is available from coded wire tag (CWT) analysis. For all CWT hatchery-origin fish returning to the Yuba River from out-of-basin sources, 97 percent were from the FRFH. However, this information does not indicate the percentage of hatchery contribution from the FRFH to the phenotypic spring-run Chinook salmon run in the lower Yuba River because, among other reasons, samples were collected during the fall and represent a mixture of phenotypic spring- and fall-run Chinook salmon spawning in the lower Yuba River (RMT 2013).

To assess the amount of straying of FRFH Chinook salmon into the lower Yuba River, the estimated numbers of spring-run Chinook salmon of hatchery (i.e., ad-clipped fish) and potentially non-hatchery origin (i.e., not ad-clipped fish) passing upstream of Daguerre Point Dam for 12 years of available VAKI Riverwatcher™ data were used to evaluate straying into the lower Yuba River. YCWA (2017) used annual series of daily counts of Chinook salmon with adipose fins clipped and with adipose fins intact that passed upstream of Daguerre Point Dam from March 1, 2004 through February 28, 2016 that were obtained from the VAKI Riverwatcher™ data. The estimated numbers of adipose fin-clipped spring-run Chinook salmon that passed upstream of Daguerre Point Dam from 2004 through February 2016 that were derived from the VAKI Riverwatcher™ data are an indicator of the minimum number of Chinook salmon of hatchery origin (most likely of FRFH origin) that strayed into the lower Yuba River. While all phenotypic spring-run Chinook salmon juveniles are adipose fin-clipped at the FRFH before release, only approximately 25% of fall-run Chinook salmon are adipose fin-clipped at the FRFH. Therefore, some returning non-adipose fin clipped Chinook salmon passing through the VAKI could be FRFH Fall-run Chinook salmon.

To evaluate the influence of "attraction" flows and water temperatures on the straying of adipose fin-clipped adult phenotypic spring-run Chinook salmon into the lower Yuba River, variables

related to flows and water temperatures in the lower Yuba River and the lower Feather River were developed and statistically related to the weekly proportions of adipose fin-clipped phenotypic spring-run Chinook salmon (relative to all spring-run Chinook salmon) passing upstream of Daguerre Point Dam. Details of the analytical evaluation are provided in YCWA (2017).

The analysis showed that an estimated 65 percent of the variation in the proportion of adipose fin-clipped phenotypic spring-run Chinook salmon passing upstream of Daguerre Point Dam can be accounted for by the ratio, at the confluence between the Yuba and Feather rivers, of lower Yuba River flow relative to lower Feather River flow, and the ratio of lower Yuba River water temperature relative to lower Feather River water temperature, 6 weeks prior to the time of passage at Daguerre Point Dam. In other words, the higher the Yuba River flows relative to Feather River flows, combined with the lower the Yuba River water temperatures relative to Feather River water temperatures, the higher the percentage of fin-clipped Chinook salmon passing upstream of Daguerre Point Dam 6 weeks later (YCWA 2017).

Genetic Considerations

Lower Yuba River spring-run Chinook salmon genetic considerations are discussed on pages BA5-56 through BA5-58 of YCWA's (2017) Applicant-Prepared Draft BA and summarized here. Available information indicates that: 1) the phenotypic spring-run Chinook salmon in the lower Yuba River actually represents hybridization between spring- and fall-run Chinook salmon in the lower Yuba River, and hybridization with Feather River stocks including the FRFH spring-run Chinook salmon stock, which itself represents a hybridization between Feather River fall- and spring-run Chinook salmon populations; and 2) straying from FRFH origin "spring-run" Chinook salmon into the lower Yuba River occurs, and that this rate of straying is associated with the relative proportion of lower Yuba River flows and water temperatures to lower Feather River flows and water temperatures ("attraction flows and water temperatures"); and 3) the FRFH spring-run Chinook salmon is included in the ESU, in part because of the important role this stock may play in the recovery of spring-run Chinook salmon in the Feather River Basin, including the Yuba River (70 FR 37160). Although straying of FRFH "spring-run" Chinook salmon into the Yuba River has oftentimes been suggested to represent an adverse impact on Yuba River spring-run Chinook salmon stocks, it is questionable whether the phenotypic spring-run Chinook salmon in the lower Yuba River represents an independent population. The RMT (2013) reported that data obtained through the course of implementing the RMT's M&E Program demonstrate that phenotypically "spring-running" Chinook salmon in the lower Yuba River do not represent an independent population – rather, they represent an introgressive hybridization of the larger Feather-Yuba river regional population (YCWA 2017).

Poaching at Daguerre Point Dam and the Lower Yuba River

While poaching has previously been reported as a stressor, it was unclear whether, or to what extent, poaching affected the spring-run Chinook salmon population in the lower Yuba River. During the Yuba River Development Project relicensing process, YCWA met with CDFW Wardens to discuss whether poaching has been observed on the lower Yuba River and specifically at Daguerre Point Dam. The Wardens stated that they regularly observe fishing line gear and other evidence of illegal fishing at Daguerre Point Dam and described poaching as a growing problem on the lower Yuba River - specifically in the plunge pool immediately

downstream of Daguerre Point Dam, where spring-run Chinook salmon hold during the summer. The Wardens also reported that some fisherman drive boats and/or jet skis from the lower Feather River and come up the lower Yuba River to Daguerre Point Dam, where they illegally catch several Chinook salmon quickly and then go back to the lower Feather River, where they can claim the salmon as legally caught in the lower Feather River. Illegal fishing in the lower Yuba River is not confined to the vicinity of Daguerre Point Dam, and the CDFW Wardens have written citations for poaching throughout the lower Yuba River.

Steelhead

As described in YCWA's Applicant-Prepared Draft BA, many of the most important stressors specific to steelhead in the lower Yuba River correspond to the stressors described for spring-run Chinook salmon in the lower Yuba River, which included passage impediments and barriers, poaching, hatchery effects, fry and juvenile rearing physical habitat structure, predation, loss of riparian habitat and instream cover (e.g., riparian vegetation, instream woody material), loss of natural river morphology and function, and loss of floodplain habitat.

As with all naturally-spawning populations of steelhead in the Central Valley, Lindley et al. (2007) characterized the steelhead population in the lower Yuba River as data deficient and, therefore, did not characterize its viability. Data limitations, particularly regarding abundance and productivity, continue to render problematic quantitative estimation procedures to assess the viability of the steelhead population in the lower Yuba River. Continued monitoring of adult steelhead in the lower Yuba River is providing additional information that is needed to assess extinction risk based on Lindley et al. (2007) criteria regarding population size, population decline, occurrences of catastrophes within the last 10 years that could cause sudden shifts from a low risk state to a higher one, and the impacts of hatchery influence. Updated information regarding abundance and productivity, spatial structure, and diversity for the steelhead population in the lower Yuba River from Section 5 of YCWA's Applicant-Prepared Draft BA is summarized below.

Straying of Hatchery-Origin Steelhead into the Lower Yuba River

Hatchery-origin steelhead straying into the lower Yuba River and interbreeding with naturally-spawning Yuba River steelhead has been suggested to represent a threat to the genetic diversity and integrity of the naturally-spawning steelhead population in the lower Yuba River. Prior to YCWA's Yuba River Development Project relicensing, no data were available and no quantitative analyses had been conducted to address the extent of hatchery-origin steelhead straying into the lower Yuba River. As described in YCWA's Applicant-Prepared Draft BA, some information was available to assess the amount of straying of hatchery-origin (adipose fin-clipped) steelhead into the lower Yuba River from VAKI Riverwatcher™ data. Attempts were made to differentiate adult steelhead from other *O. mykiss* (i.e., juvenile steelhead and resident rainbow trout) recorded passing Daguerre Point Dam utilizing daily VAKI Riverwatcher™ data. Six years of data (biological years[6] 2010/2011 through 2015/2016[7])[8] were available identifying

[6] For assessment purposes, a "steelhead biological year" was identified as extending from August 1 through July 31 each year, because: 1) preliminary review of the VAKI Riverwatcher™ data indicated a general paucity of upstream migrant *O. mykiss*

adipose fin-clipped *O. mykiss* passing through the VAKI Riverwatcher™ system, during which extensive inoperable periods did not occur during the adult steelhead upstream migration period. Data reduction, limitations and applications are described in Section 5.2.7 (Viability) of the Applicant-Prepared Draft BA (YCWA 2017).

Analysis of the VAKI Riverwatcher™ data indicated that the percent contribution of hatchery-origin adult upstream migrating fish, represented by the percentage of adipose fin-clipped adult steelhead relative to the total number of adult upstream migrating steelhead because 100 percent of FRFH-origin steelhead have been marked since 1996, was approximately 42 percent for the 2010/2011 biological year, about 62 percent for the 2011/2012 biological year, about 38 percent for the 2012/2013 biological year, about 55 percent for the 2013/2014 biological year, about 42 percent for the 2014/2015 biological year, and about 40 percent for the available data (i.e., August 2015 through June 2016) of the 2015/2016 biological year.

Differentiation of Adult Steelhead VAKI Riverwatcher™ Counts

For the Yuba River Development Project relicensing, a multi-step process was developed to differentiate adult steelhead passing upstream of Daguerre Point Dam from resident rainbow trout or juvenile *O. mykiss*, which is described on pages BA5-134 to BA5-138 of YCWA's Applicant-Prepared Draft BA. The length-frequency distribution of all adipose fin-clipped steelhead observed at Daguerre Point Dam from March 1, 2009 through March 31, 2015 was used to differentiate between "juvenile" *O. mykiss* and "adult" steelhead. Modeled length-frequency distributions were fit to the observed data to determine a threshold length to separate both fish groups. Consequently, the recorded lengths of fish identified as *O. mykiss* passing through Daguerre Point Dam from January 1, 2004, through March 31, 2015, were classified as adult steelhead if the recorded length was 16 inches or higher. If the recorded lengths of fish identified as *O. mykiss* passing through Daguerre Point Dam were less than 16 inches, then the fish were considered to be "other" *O. mykiss* (e.g., juvenile or adult rainbow trout, or juvenile steelhead).

The daily counts of adult steelhead passing upstream of Daguerre Point Dam were not corrected for days when the VAKI Riverwatcher™ systems were not fully operational. The RMT determined it would be inappropriate to attempt to correct the adult steelhead counts due to: 1) the relatively low numbers of adult steelhead recorded during most of the steelhead biological years; and 2) the frequently extended durations when the VAKI Riverwatcher™ systems were not fully operational during the steelhead immigration season. The daily counts of adult steelhead passing upstream at Daguerre Point Dam were used to represent the abundance of steelhead, with the understanding that the resultant estimates are minimum numbers, and most of the survey years considerably underestimate the potential number of steelhead because the

during early summer; 2) the immigration of adult steelhead in the lower Yuba River has been reported to occur beginning during August (CALFED and YCWA 2005; McEwan and Jackson 1996); and 3) RMT (2010b) identified the steelhead upstream migration period as beginning during August in the lower Yuba River (RMT 2013).

[7] The steelhead 2015/2016 Biological Year was only evaluated through June 13, 2016, corresponding to the period of data availability.

[8] More recently, the VAKI RiverwatcherTM system on the north side of Daguerre Point Dam experienced two periods of inoperation from September 18, 2016 through February 28, 2017, and from August 15, 2017 through September 25, 2017.

annual estimates do not include periods of VAKI Riverwatcher™ system non-operation, and do not consider the fact that not all steelhead migrate past Daguerre Point Dam, due to some spawning occurring downstream of Daguerre Point Dam (RMT 2013).

Annual Time Series of Steelhead Passing Upstream of Daguerre Point Dam
YCWA's Applicant-Prepared Draft BA (page BA5-138 through BA5-18