

# Memorandum

**Date:** November 18, 2019

**To:** Morgan Kilgour  
Senior Environmental Scientist; Supervisor  
Department of Fish and Wildlife  
North Central Region  
1701 Nimbus Road, Suite A  
Rancho Cordova, CA 95670

**Cc:** CDFW North Central Region Fish Files

**From:** Marc Beccio; Environmental Scientist  
Department of Fish and Wildlife  
1701 Nimbus Road, Suite A  
Rancho Cordova, CA 95670

**Subject:** 2019 Yuba River Sturgeon Spawning Study

## Purpose

The report documents findings of the second year of a California Department of Fish and Wildlife (CDFW) study to determine if southern Distinct Population Segment (sDPS) green sturgeon (*Acipenser medirostris*) and/or white sturgeon (*Acipenser transmontanus*) spawn in the Yuba River, and, if so, what are the temporal, spatial, and habitat requirements associated with sturgeon spawning events.

## Background

Southern DPS green sturgeon and white sturgeon populations have been severely reduced because of dams, diversions, habitat degradation, and both legal and illegal harvest. The Sacramento River system is the only river system supporting spawning of the federal threatened sDPS green sturgeon and is the primary river system supporting spawning of white sturgeon. Green sturgeon spawning has been documented in a 93 km section of the Sacramento River from Hamilton City (river kilometer [RK] 332.5) upstream to Cottonwood (RK 426) (Poytress et al. 2013) and in the Feather River in the vicinity of the Thermalito Bay Outlet in mid-June 2011 (Seesholtz et al. 2015). The majority of white sturgeon are thought to spawn in the middle Sacramento River between Knights Landing (RK 142) and Colusa (RK 237) (Schaffter 1997).

Because green sturgeon are federally listed as threatened, it is crucial to identify and support additional spawning populations. One of the Demographic Recovery Criteria points in the *Recovery Plan for Southern Distinct Population Segment of the North American Green Sturgeon (Acipenser medirostris)* is that “SDPS green sturgeon spawn successfully within two rivers in their historical range...”

Both green sturgeon and white sturgeon have been observed in the Yuba River. Southern DPS green sturgeon were observed in the Yuba River in 2011, 2016, and 2017; all three years with above average precipitation. In early May 2011, CDFW staff observed at least one green sturgeon below the Daguerre Point Dam (DPD) Pool (personal communication with C. McKibbin). Cramer Fish Sciences conducted underwater video surveys 24-26 May 2011 and determined that there were at least four green sturgeon holding in the pool below the Daguerre Point Dam (Cramer Fish Sciences 2011). In July of 2016, CDFW divers conducted a visual survey of the pool below the Daguerre Point Dam and observed at least eight adult SDPS green sturgeon holding in the pool (personal communication with M. Healy). CDFW conducted the initial sturgeon spawning survey in the Yuba River in 2017 but did not collect any sturgeon eggs, although staff observed green sturgeon in the pool below Daguerre Point Dam during egg mat deployment and retrieval site visits (CDFW 2017). In 2018, CDFW documented spawning of green sturgeon for the first time by collecting approximately 270 sturgeon eggs. Of these, 33 eggs were vouchered for species verification and developmental staging to determine a spawning date (CDFW 2018).

Suitable sturgeon spawning habitat typically consists of pools or deep runs with depths ranging from 1.8 to 11.2 meters and flow velocities of  $\geq 1.0$  meter per second with substrates consisting of gravel, cobble, and boulder (Poytress 2013, Schaffter 1997). Although DPD blocks upstream passage, the DPD plunge pool appears to be suitable sturgeon spawning habitat based on the combination of depth, flow turbulence, and substrate composition. Coupled with visual observations of sDPS green sturgeon in the pool in 2011, 2016 and 2017, and collection of green sturgeon eggs in 2018, CDFW staff again focused sturgeon egg mat sampling in this habitat unit (**Figure 1**).

## Methods

Egg mats were constructed by securing a furnace filter insert to a 76x107x5-cm rectangular steel frame rigged with a 9.5 mm diameter braided polypropylene rope attachment bridle. A 9.5 mm diameter buoy line of sufficient length (depending on depth) and a 10-inch diameter inflatable buoy were used to mark the egg mat location from the surface and facilitate retrieval. Factors considered for mat deployment sites included presence of sDPS green sturgeon as determined by visual observation or DIDSON imagery and depth, flow, and substrate regimes as reported in the literature. Once a suitable sampling site was selected, the mat was deployed by gradually lowering it to the river bottom from the bow of the boat while holding the boat stationary in the current. When the egg mat reached the river bottom, the buoy was deployed and observed for several minutes to ensure the egg mat remained in place. Deployment date, water depth, and water temperature were recorded at mat deployment site. Yuba River flow during site visits was obtained from the United States Geological Survey

gage near Marysville (CDEC 2019). Egg mats were retrieved by slowly hauling in the float line to avoid dislodging adhered sturgeon eggs and gently lifting the mat into the boat. Two to three CDFW staff conducted a thorough visual inspection of each egg mat to check for sturgeon eggs prior to re-deployment.

Sampling was initiated on 16 April 2019 and terminated on 19 August 2019 for a sampling period of 125 days. Site visits to check egg mats were conducted on 16 April; 7, 21 24, 28 and 31 May; 4, 7, 12, 14, 17, 25, and 28 June; 2, 9, 12, 16, 19, 23, and 29 July; 2, 6, 9, 14 and 19 August. Egg mats were numbered as mats 1 through 6 from north to south. CDFW staff deployed six egg mats at the Daguerre Point Dam pool site for the first week of the study. On the next site visit conducted 7 May 2019, staff were unable to retrieve four of six egg mats which were buried by mobilized substrate after flows increased from 6,750 cfs on 16 April to nearly 10,000 cfs on 26 April. The four buried mats were replaced on 17 May and a seventh mat was added to the array as well.

## Results

No green sturgeon eggs were collected during the 2019 sampling season, however; one early-stage juvenile green sturgeon with a fork length of approximately 40 mm was observed and captured by hand in edgewater habitat approximately 200 m downstream of Daguerre Point Dam on 19 August 2019 (**Figures 2 and 3**). CDFW staff made visual observations of between one and at least 10 adult green sturgeon holding in the pool below the Daguerre Point Dam during each site visit. Several adult green sturgeon were also observed in shallow pool and run habitat between the confluence of the Feather River and Daguerre Point Dam during site visits conducted in late June and early July. Other fish species observed in the Daguerre Point Dam pool during site visits included adult Central Valley spring-run Chinook salmon (*Oncorhynchus tshawytscha*), adult steelhead or rainbow trout (*O. mykiss*), Sacramento sucker (*Catostomus occidentalis*), Sacramento pikeminnow, (*Ptychocheilus grandis*), prickly sculpin (*Cottus asper*), riffle sculpin (*Cottus gulosus*), American shad (*Alosa sapidissima*), and striped bass (*Morone saxatilis*). Benthic macroinvertebrates such as stonefly nymphs (*Calinuria californica* and *Hesperoperla pacifica*), caddisfly larvae (Hydropsychidae, Glossosomatidae, and mayfly larvae, Baetidae and Heptageniidae) were commonly observed on the egg mats.

Yuba River flows during the sampling period ranged from a high of 279 cubic meters per second ( $\text{m}^3/\text{s}$ ) on 26 April to a low of 41 ( $\text{m}^3/\text{s}$ ) on 30 July 2019 (**Figure 4**). Water temperatures over the duration of the study ranged from a low of 10° C to 15.7° C (**Table 1**). Water depth and substrate composition at Daguerre Point Dam sampling site were also within ranges reported in the literature for green sturgeon spawning habitat. Although flow velocity measurements were not taken, estimated surface velocities where egg mats were deployed ranged of 0.3 to 1 meter per second, which were similar to velocities estimated during the 2017 and 2018 sampling seasons and to velocities in the literature (Poytress *et. al.* 2015, Seesholtz *et. al.* 2015).



**Figure 1.** Yuba River and Daguerre Point Dam. Egg mat sampling was conducted in the pool immediately downstream of the dam.



**Figure 2.** Daguerre Point Dam Pool egg mat locations. Mats are approximately three-four meters upstream of buoys.

**Table 1.** Deployment and retrieval dates, total sampling days; and number of sturgeon eggs sampled, 2018 Yuba River Sturgeon Spawning Study.

<b>Deployment date</b>	<b>Retrieval date</b>	<b>Total sampling days</b>	<b>Water temp (° C)</b>	<b>Mat depth range (m)</b>	<b>Flow range (m<sup>3</sup>/s)</b>	<b>Number of sturgeon eggs; notes</b>
4/16	5/07	21	10.0 – 10.3	3 – 4	178 – 191	None; four mats buried in substrate; need to replace; observed one adult green sturgeon.
5/07	5/17	10	10.3	3 – 4	191 – 192	None; deployed five new mats; seven in total now deployed; observed one adult green sturgeon
5/17	5/21	4	10.0	3 – 4	192 – 161	None; observed 5-6 adult green sturgeon
5/21	5/24	3	10.0 – 10.3	3 – 4	161 – 166	None; observed 5-6 adult green sturgeon
5/24	5/28	4	10.3 – 11.7	3 – 4	166 – 164	None; observed 5-6 adult green sturgeon
5/28	5/31	3	11.7 – 12.2	3 – 4.5	164 – 187	None; observed 5-6 adult green sturgeon
5/31	6/04	4	12.2 – 13.5	3 – 4	187 – 215	None; observed 5-6 adult green sturgeon
6/04	6/07	3	13.5 – 12.7	2.5 – 3	215 – 220	None; observed 5-6 adult green sturgeon
6/07	6/12	5	12.7 – 13.6	2.5 – 6	220 – 173	None; observed 5-6 adult green sturgeon
6/12	6/14	2	13.6 – 13.8	2.5 – 6	173 - 155	None; observed 5-6 adult green sturgeon

<b>Deployment date</b>	<b>Retrieval date</b>	<b>Total sampling days</b>	<b>Water temp (° C)</b>	<b>Mat depth range (m)</b>	<b>Flow range (m<sup>3</sup>/s)</b>	<b>Number of sturgeon eggs; notes</b>
6/14	6/17	3	13.6 – 14.2	2.5 – 3.5	155 – 136	None; observed 10-plus adult green sturgeon
6/17	6/21	4	14.2 – 14.5	3 – 3.5	136 - 128	None; observed 10-plus adult green sturgeon
6/21	6/25	4	14.5 – 14.2	3 – 3.5	128 - 103	None; lost one mat; observed 10-plus adult green sturgeon
6/25	6/28	3	14.2 – 13.1	3 – 3.5	103 – 85	None; observed 10-plus adult green sturgeon
6/28	7/02	4	13.1	3 – 3.5	85 – 67	None; observed 10-plus adult green sturgeon
7/02	7/09	7	13.1 – 12.9	3 – 3.5	67 – 66	None; observed 10-plus adult green sturgeon
7/09	7/12	3	12.9 – 13.7	2.5 – 4.5	66 – 51	None; observed 10-plus adult green sturgeon
7/12	7/16	4	13.7	2.5 – 4.5	51 – 43	None; observed 10-plus adult green sturgeon
7/16	7/19	3	13.7 – 14.4	2.5 – 3.5	43 - 42	None; observed 10-plus adult green sturgeon
7/19	7/23	4	14.4 – 14.7	3 – 3.5	42	None; observed 10-plus adult green sturgeon
7/23	7/29	6	14.7 – 14.5	3.5 – 4	42	None; observed 10-plus adult green sturgeon
7/29	8/02	4	14.5 – 13.3	3 – 4	42	None; observed 10-plus adult green sturgeon
8/02	8/06	4	13.3 – 15.7	Not recorded	42	None; observed 10-plus adult green sturgeon

<b>Deployment date</b>	<b>Retrieval date</b>	<b>Total sampling days</b>	<b>Water temp (° C)</b>	<b>Mat depth range (m)</b>	<b>Flow range (m<sup>3</sup>/s)</b>	<b>Number of sturgeon eggs; notes</b>
8/06	8/09	3	15.7 – 13.6	2.5 – 4.5	42 - 50	None; observed 10-plus adult green sturgeon
8/09	8/14	5	13.6 – 13.1	2.5 – 4.5	50 – 52	None; observed 10-plus adult green sturgeon
8/14	8/19	5	13.1 – 12.8	2.5 – 4.5	52 – 53	None; captured one early stage juvenile green sturgeon by hand in glide – edgewater habitat approximately 200 downstream of DPD; estimated fork length 40 mm; observed 10-plus adult green sturgeon





**Figure 3.** Early stage juvenile green sturgeon captured 19 August 2019 approximately 200 m downstream of Daguerre Point Dam.

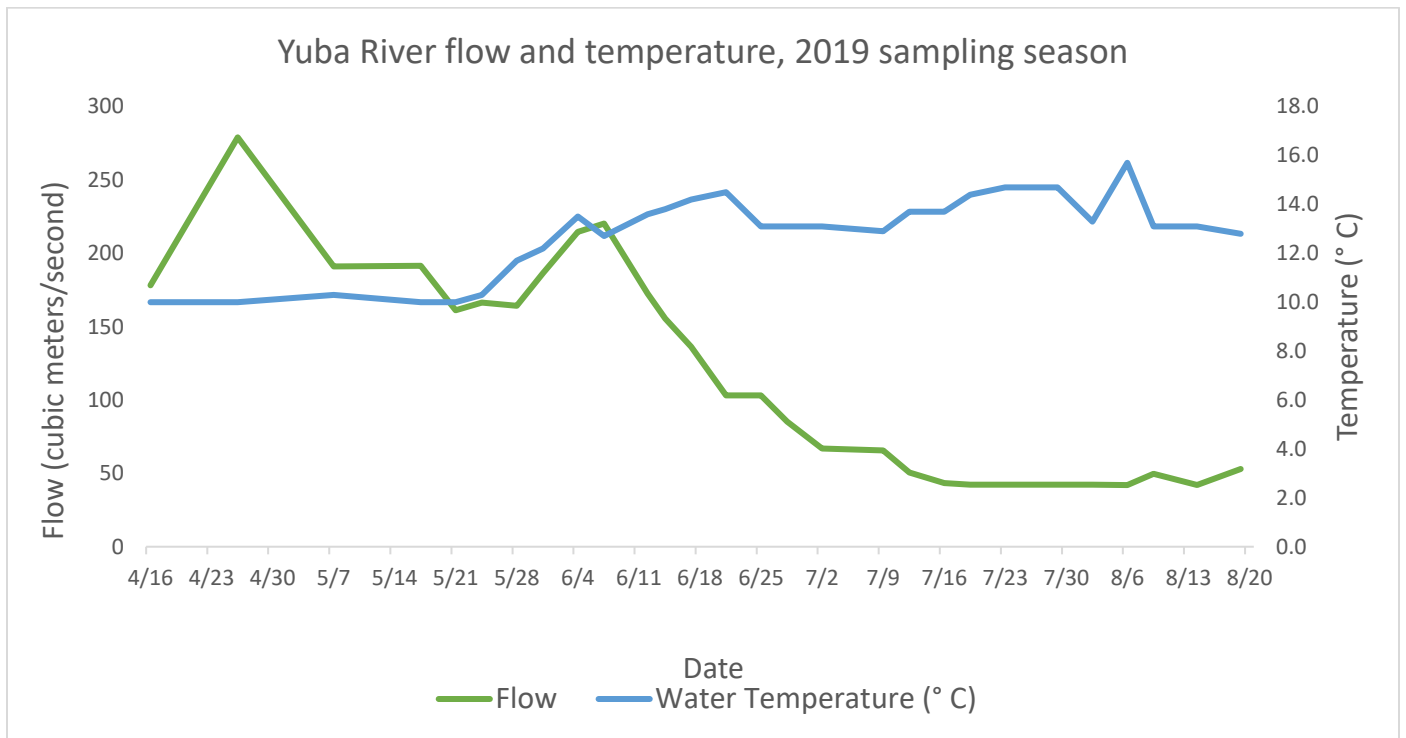


Figure 4. Yuba River flow at Marysville, 16 April through 19 August 2019 (CEDC 2019) and water temperature (measured) at Daguerre Point Dam.

## Discussion

Although no green sturgeon eggs were collected during the 2019 sampling season, the capture of an early-stage juvenile green sturgeon 19 August provides evidence that green sturgeon spawned in the Yuba River for a second consecutive year. The patchiness of egg distribution of spawning sturgeon (Carrofino *et. al.* 2010) or loss of four egg mats during a flow increase after the initial deployment may explain why green sturgeon eggs were not collected on the egg mats during the 2019 sampling season. Green sturgeon eggs were collected at the DPD site during the 2018 sampling season approximately one week after a flow increase of 8.5 m<sup>3</sup>/s (CDFW2018), therefore the flow increase that resulted in the loss of the egg mats may have also triggered spawning. Although sturgeon spawning surveys were not conducted in the Yuba River in 2016, adult green sturgeon presence in the Daguerre Point Dam pool was documented by members of the CDFW dive team (personal communication with M. Healy). CDFW initiated sturgeon spawning surveys in the Yuba River at Daguerre Point Dam in 2017, and although green sturgeon were observed at the sampling site during most site visits, no sturgeon eggs were collected. This highlights that patchiness of distribution is likely why green sturgeon eggs were not collected on the egg mats during the 2017 sampling season. Therefore, it is possible that green sturgeon spawned in the Yuba River over four consecutive years (2016 through 2019). An abundance of several species of fish known to prey on fish eggs including steelhead/rainbow trout, Sacramento sucker, Sacramento pikeminnow, prickly and riffle sculpin, and striped bass occur in the Daguerre Point Dam pool. The dam concentrates predatory fish in the pool and has the potential to contribute to high predation rates on sturgeon eggs and newly emerging larvae as current fish passage structures likely are limited to salmonids.

Removal of the Daguerre Point Dam would provide access to additional upstream habitat in the lower Yuba River for sDPS green sturgeon and would also likely decrease predator densities during spawning events.

## References

- Carroffino D. C., T. M. Sutton, R. F. Elliott, and M. C. Donofrio. 2010. Early life stage mortality rates of lake sturgeon in the Peshtigo river, Wisconsin. *N Am J Fish Management* 30:295–304.
- CDEC. 2019. Yuba River mean daily flow at Marysville. Available at: <http://cdec.water.ca.gov/dynamicapp/QueryDaily?s=MRY&d=now>. Accessed November 2019.
- Cramer Fish Sciences. 2011. Memo: Green Sturgeon Observations at Daguerre Point Dam, Yuba River, CA.
- Deng X., Van Eenennaam J.P., Doroshov S. I. 2002. Comparison of early life stages and growth of Green and White Sturgeon. In: Van Winkle W et al., editors. 2002. *Biology, management, and protection of North American sturgeon*. American Fisheries Society, Symposium 28, Bethesda, Maryland. p. 237-248.

Heublein, J. C., J. T. Kelly, C. E. Crocker, A. P. Klimley, S. T. Lindley. 2009. Migration of green sturgeon (*Acipenser medirostris*), in the Sacramento River. *Env. Biol. Fish.* 84: 245-258.

Kynard, B., E. Parker, and T. Parker. 2005. Behavior of early life intervals of Klamath River green sturgeon (*Acipenser medirostris*) with a note on body color. *Env. Biol. Fish.* 72:85-97.

Klimley, A. P., E. D. Chapman, J. J. Cech, D. E. Cocherell, N. A. Fangué, M. Gingras, Z. Jackson, E. A. Miller, E. A. Mora, J. B. Polleto. 2015. Sturgeon in the Sacramento-San Joaquin watershed: new insights to support conservation and management. *San Francisco Estuary and Watershed Science* 13(4).

Poytress, W. R., Gruber, J. J., Van Eenennaam, J. P. 2015. Spatial and temporal distribution of spawning events for Sacramento River green sturgeon. *Trans. Am. Fish. Soc.* 144(6): 1129-1142.

Seesholtz, A.M., Manuel, M. J., Van Eenennaam, J. P. 2014. First documented spawning and associated habitat conditions for green sturgeon in the Feather River, California. *Environ. Biol. Fishes* 98(3): 905-912.

Shaffter, R. G. 1997. White sturgeon spawning migrations and locations of spawning habitats in the Sacramento River, California. *California Fish and Game*: 83: 1-20.