

Second confirmed presence of Green Sturgeon in the Stanislaus River

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RESEARCH NOTE

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Green Sturgeon (*Acipsenser medirostris*) are anadromous fish found on both sides of the Pacific Ocean, from Mexico to Alaska (U.S.) on the eastern side, as well as Russia, Japan, and Korea (Moyle 2002). The North American population has been separated into a northern and southern distinct population segment (sDPS), each spawning in different rivers in Northern California and Southern Oregon (NMFS 2018). The sDPS of Green Sturgeon was listed as threatened by the National Marine Fisheries Service (NMFS) in 2006 (NMFS 2018). The sDPS has only been documented spawning in the Sacramento River, Feather, and Yuba rivers (Seesholtz et al. 2014, CDFW 2018, Poytress et al. 2015). Prior to 2018, there were only unconfirmed angler reports of sDPS Green Sturgeon in the San Joaquin Basin upstream of Stockton (NMFS 2018). Recently, individual fish have been found in the San Joaquin River (SJR) at river kilometer (rkm) 90, upstream of the Merced Confluence (Root et al. 2020) and the Stanislaus River (rkm 86) near Knights

Ferry (Anderson et al. 2018)

Critical habitat for the sDPS of Green Sturgeon was identified by NMFS in 2009, which includes the Sacramento River, lower Feather River, lower Yuba River, the Sacramento-San Joaquin Delta, and Suisun, San Pablo and San Francisco Bays, nearshore Pacific Ocean waters from Monterey Bay to Puget Sound (NMFS 2009). When determining critical habitat, NMFS considered data from tagging and tracking studies, genetic analysis, field observations, records of fisheries harvest and incidental capture in water diversion activities, and opportunistic sightings. Critical habitat for sDPS Green Sturgeon does not include the San Joaquin River or any of its tributaries, the Stanislaus, Tuolumne or Merced River. Although NMFS considered many different sources, very little data is collected on Green Sturgeon in the San Joaquin Basin. There are no monitoring studies or programs for Green Sturgeon in the San Joaquin River or tributaries (Heublein et al. 2017) and the California Department of Fish and Wildlife (CDFW) Sturgeon Report card does not include location codes for any of the San Joaquin tributaries (Hause et al. 2022). Studies targeting other species such as White Sturgeon (*Acipenser transmontanus*) or juvenile salmonids could potentially document Green Sturgeon, but thus far none have been reported (Faukner and Jackson 2013, 2014; Faukner et al. 2015; Heironimus et al. 2015, 2016; Heironimus and Jackson 2017; TID and MID 2022).

The Stanislaus River is one of three tributaries within the San Joaquin River watershed that flows from the Sierra Nevada to the San Joaquin River in the eastern part of the Central Valley, draining a watershed of approximately 2,330 km² (900 mi²) (SWRCB 2018). The Stanislaus River enters the SJR at rkm 120.7. Stanislaus River waterflow, magnitude and patterns are maintained and operated by U.S. Bureau of Reclamations at New Melones Dam and must adhere to multiple constraints, including water right requirements, flood control operations, contractual obligations, and federal requirements under the federal Endangered Species Act (USBOR 2020). Goodwin Dam is located at 94.9 rkm from the confluence of the SJR and is a barrier preventing further upstream migration.

On 6 July 2022, La Grange CDFW staff were notified by a local fisherman of a possible sturgeon sighting on the Stanislaus River below Knights Ferry. The potential sturgeon was said to be holding in a deep pool near Horseshoe Recreation Area located at 80.5 rkm. CDFW confirmed the presence of a sturgeon holding at this location on 18 July 2022 via footage captured with a Go Pro and an ARIS (Adaptive Resolution Monitoring Sonar) but were not able to identify the species of the sturgeon ([Fig. 1](#)). The sturgeon appeared to be confined in the pool between impassable shallow riffles. After evaluating temperature and streamflow data, we determined that environmental conditions were not detrimental to the health of the sturgeon in this stretch of the river, therefore a rescue event was not necessary. Visual sightings were made weekly by La Grange CDFW escapement crews from 4 October 2022 until the capture and tagging event on 3 November 2022 confirming that it was still present. Go Pro footage in early October 2022 confirmed the sturgeon to be a Green Sturgeon.

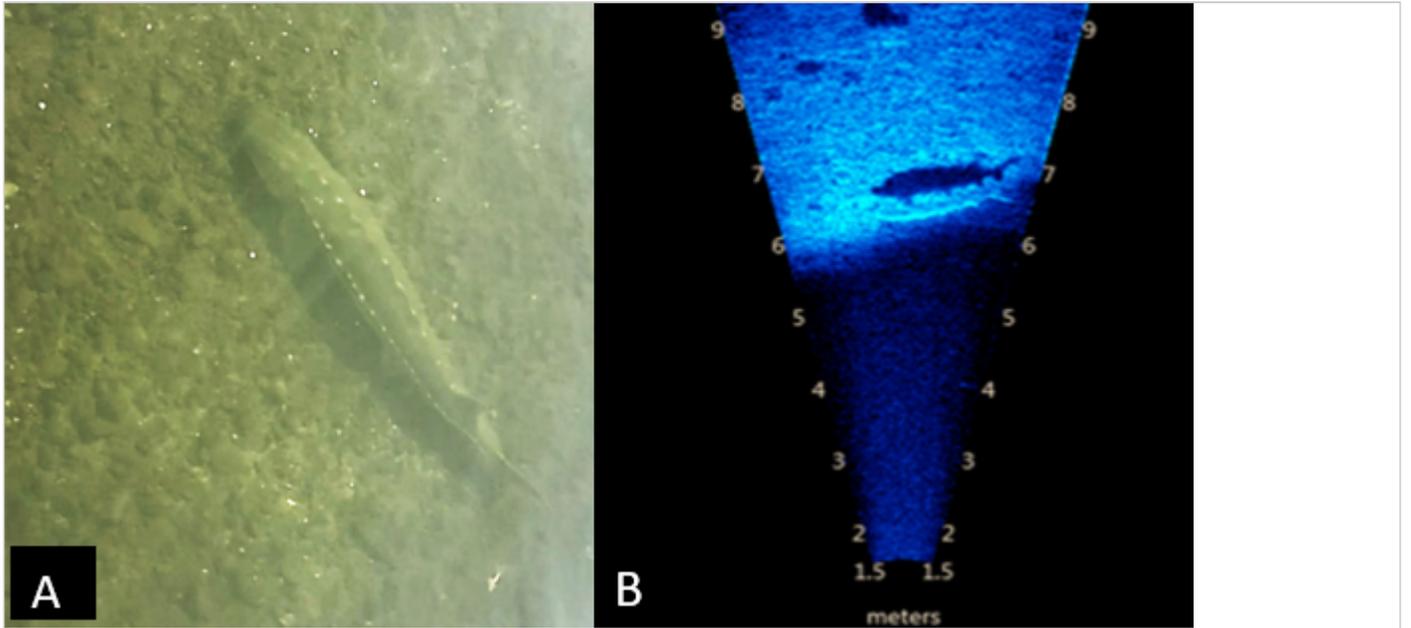


Figure 1. GoPro Image (A) and ARIS sonar image (B) from 18 July 2023.

On 3 November 2022, CDFW staff members deployed two 100 ft (30.5 m) trammel nets by boat, in the pool parallel with streamflow, one in the center of the pool, and the other near the tail out. Trammel nets were anchored at river bottom. A block net was deployed perpendicular with streamflow at the tail out of the pool to prevent the sturgeon from migrating downstream during the capture event. Nets were checked every twenty minutes to prevent stress induction on any fish species captured. The Green Sturgeon was captured within one hour of sampling effort and appeared to be in healthy condition. The fork length measured 157 cm while the total length was 176 cm, with a girth behind the pelvic fin of 56 cm. In addition, a fin clip sample was collected for genetic analysis; however, it has not been analyzed to date. The water temperature in this pool at the time of capture was 13.5°C.

The Green Sturgeon was placed ventral side up in a V-shaped cradle with the anterior end submerged, allowing water to flow freely through the gills and transition into a relaxed state. The sturgeon was then surgically implanted with a EMCO V16 (69 kHz) acoustic transmitter and Passive Integrated Transponder tag (Biomark, HDX23, 23 mm) in the peritoneal cavity adjacent to the midline of the fish between the third and fourth scute (Miller et al. 2020). The VEMCO size V16 acoustic tag implanted in the Green Sturgeon has a ten-year battery life and a pulse repetition interval between 90 and 120 seconds, allowing it to be detected amongst the existing array of VEMCO 69 kHz receivers. Two sutures were used to close the incision ([Fig. 2](#)). The sturgeon remained in healthy condition throughout the surgery. Following the surgery, the Green Sturgeon was placed dorsal side up and gently restrained by the caudal peduncle until full recovery. CDFW continued to monitor the Green Sturgeon's location via acoustic telemetry monitoring and visual sightings.



Figure 2. Green Sturgeon in a V-shaped cradle during surgical implant process.

CDFW and the U.S. Fish and Wildlife Service (USFWS) operate and maintain an existing array of VEMCO 69 kHz acoustic telemetry receivers placed at several fixed locations ranging from the Benicia and Antioch Bridge in the San Francisco Bay, upstream through the main stem of the SJR, and throughout the tributaries ([Fig. 3](#)). CDFW deployed an additional receiver upstream of the capture location on 3

November 2022 to monitor potential upstream migration. A non-stationary VR2W receiver was utilized for the periodic monitoring of the sturgeon post tagging event. VR2W receivers are traditionally deployed in a fixed location for extended periods of time; however, we used it by deploying it in the pool weekly after the tagging event for ten-minute increments to confirm the presence or absence of the tagged Green Sturgeon.



A visual timeline and chart including all aspects associated with monitoring the Green Sturgeon is provided below (Fig. 4). The chart represents temperature versus streamflow data from the Orange Blossom California Data Exchange Center (CDEC) gauge from 1 June 2022 to 31 January 2023, with distinct vertical markers for each observation, tagging, and migration event. The light green shaded portion of the chart indicates the time period that we confirmed the Green Sturgeon continued holding in the same pool, throughout the fall pulse flows for adult chinook salmon attraction released on the Stanislaus River. Acoustic telemetry data downloaded from the 69 kHz receivers revealed that the Green Sturgeon migrated downstream where it was detected at the Stanislaus River upstream (SR US) receiver

on 1 January 2023 after Stanislaus River streamflow's spiked to approximately 4500 CFS due to winter storm precipitation. The Green Sturgeon continued outmigration into the SJR on 2 January 2023 where it was detected by two other receivers located between the SJR and Stanislaus River confluence and the Bay Delta region on 3 January 2023. The next detection of the Green Sturgeon in the SJR was at Antioch Bridge on 8 January 2023, followed by detections at the Benicia Bridge receiver array the following two days. The Green Sturgeon was detected at the Golden Gate Bridge receiver array on 14 January 2023, which is indicative of imminent ocean entry. This outmigration period is indicated by the light-yellow shaded portion of the chart ([Fig. 4](#)) and a summary of detection data for each receiver can be found in [Table 1](#).



Figure 4. Temperature versus streamflow chart (horizontal dashed lines) using Stanislaus River CDEC gauge at Orange Blossom (rkm 77), in addition to timeline for observation, capture, and monitoring period (solid vertical markers).

Table 1. Green Sturgeon detections dates, receiver names, and descriptions by river kilometer measured from the confluence of the SJR in the Sacramento-San Joaquin Delta (rkm = river kilometer)

Date	Receiver Name	Description
7/1/22	Public Sighting	Initial sighting of Green Sturgeon
7/16/22	ARIS Observation	First official observation at ARIS
10/29/22	Tagging	Tagging event for monitoring
12/28/22 - 1/12/23	Downstream Migration	Period of downstream migration
1/1/23	Golden Gate Bridge	Indicative of imminent ocean entry

Detection Location	Date	Receiver Abbreviation	Receiver Location Description	rkm
Stanislaus River, rkm 121 ^a	12/1/2022	Mobile VR2W Stan HR	Horseshoe Rec Area	80.1
Stanislaus River, rkm 121 ^a	12/21/2022	Mobile VR2W Stan HR	Horseshoe Rec Area	80.1
Stanislaus River, rkm 121 ^a	1/1/2023	SR US CDFW	Stanislaus River Upstream	50.2
San Joaquin River	1/2/2023	SJR DS SR	SJR Downstream Stanislaus River	119.1
San Joaquin River	1/3/2023	SJR HH	San Joaquin River Honey Hole	104.6
San Joaquin River	1/3/2023	SJR G2	San Joaquin River "Gate 2"	99
Bay Area ^b	1/8/2023	Antioch Bridge - North	Antioch Bridge	—
Bay Area ^b	1/9/2023	BeniciaBr4	Benicia Bridge	—
Bay Area ^b	1/10/2023	BeniciaBr4	Benicia Bridge	—
Bay Area ^b	1/14/2023	GG	Golden Gate	—

^a rkm designation marks the river kilometer mile of the confluence of the Stanislaus River with the San Joaquin River

^b No river kilometer is provided because these receivers are located in the Bay Area region, beyond the mouth of the San Joaquin River (rkm 0)

This monitoring effort documents the third confirmed presence of a Green Sturgeon in the SJR Basin, and second within the Stanislaus River. While this study only confirms the presence and movement pattern of one individual fish over a short period of time, it does provide evidence that Green Sturgeon do utilize the SJR tributaries. Although the SJR and its tributaries are not listed as critical habitat for the sDPS Green Sturgeon (NMFS 2009), sporadic evidence of Green Sturgeon presence in the Stanislaus River suggests the need for further investigation regarding the distribution and migration patterns of this species in this area.

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