

Memorandum

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Subject: Summary of 2019 Fish Rescue Operations at Tisdale Weir

Background

The Tisdale Bypass is a passive flood control structure located at river kilometer (Rkm) 286 or river mile (RM) 177.7 as measured from the Golden Gate Bridge (**Figure 1**). When Sacramento River flows exceed a stage height of 45.5 feet above mean sea level or a flow of approximately 595 cubic meters per second (21,012 cfs), the Tisdale Weir overtops, and floodwaters enter the Tisdale Bypass. The Tisdale Bypass conveys flows east for approximately seven km (four miles) into the Sutter Bypass. Of all Sacramento River flood control structures, the Tisdale Weir spills with the greatest frequency and longest duration.

Adult Chinook salmon (*Oncorhynchus tshawytscha*), steelhead (*Oncorhynchus mykiss*), and sDPS green sturgeon (*Acipenser medirostris*), and other fish species often become isolated and subsequently stranded behind the Tisdale Weir when migrating up the Sutter Bypass and then into the Tisdale Bypass as they attempt to return to the Sacramento River at Tisdale Weir. When flows recede below the top of the Tisdale Weir, fish become stranded in the Tisdale Weir splash basin and in inundated areas downstream of the weir. Juvenile salmonids migrating downstream in the Sacramento River may follow floodwater flows overtopping the Tisdale Weir. When flows over the

weir decrease or end and connectivity between the Tisdale and Sutter bypasses is lost, juvenile salmonids and can become stranded in the weir stilling basin and inundated areas downstream.

The 2019 water year was classified as a wet year, and the resulting runoff caused Sacramento River flows to overtop Tisdale Weir five times between 11 January and 28 February 2019. The first four overtopping events were of short duration (two to seven days) with short intervals between events (**Figure 2**). Thus, the water depth within the Tisdale Weir stilling basin and inundated area downstream of the weir remained too deep to conduct efficient rescue operations after the end of each of these events; Sacramento River flows were forecast to overtop for a fifth time by the end of February. The fifth overtopping event which began 28 February and ended 22 April, lasted 62 days with a maximum flow over the weir of 31,935 cubic feet per second on 1 March.



Figure 1. Tisdale Weir Site and Vicinity.

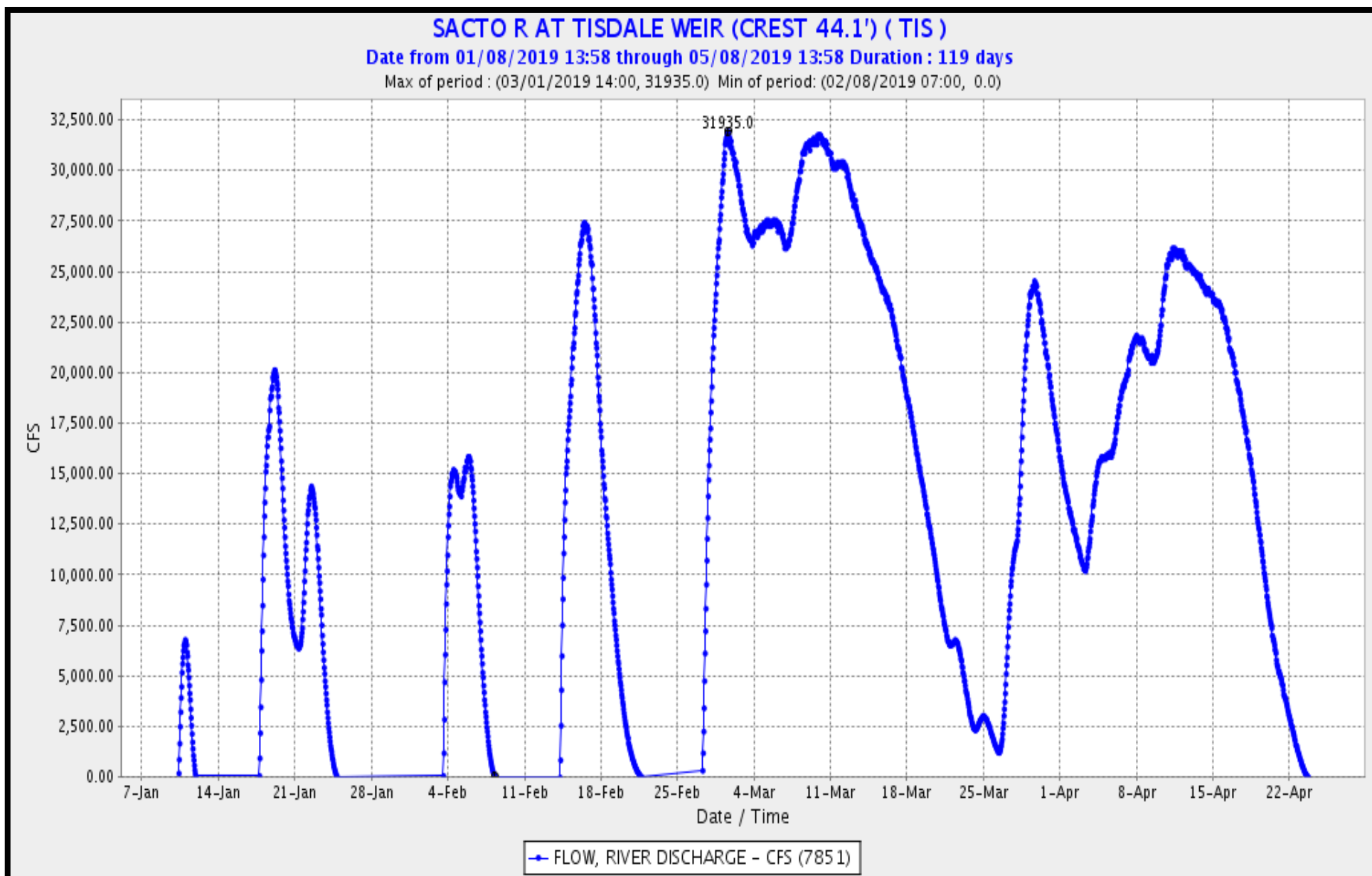


Figure 2. Hydrograph of Tisdale Weir overtopping events, 2019 water year.

Methods

CDFW staff began daily monitoring of conditions at the Tisdale Weir when the California Data Exchange Center (CDEC) National Weather Service River Forecast Center forecasted the Sacramento River stage height below the top of the weir at an elevation of 45.5 feet mean sea level (msl). Daily assessments of conditions included water depth, clarity, water temperature, observations of fish species composition and numbers, and potential safety issues regarding fish rescue operations. CDFW staff conducted initial rescue operations at the Tisdale Weir on 24-25 April 2019 targeting adult sturgeon when water levels within the stilling basin and inundated area immediately downstream were shallow enough to seine effectively. Rescue operations initially targeted adult sturgeon because they are highly susceptible to poaching once stranded in the stilling basin.

Adult sturgeon were captured using large dip nets, crowder racks, and a 100-ft long by 12-ft tall 6-in mesh heavy duty beach seine. Adult sturgeon were placed in a specially designed “sturgeon stretcher” with their ventral surface facing up to reduce handling stress and facilitate tagging. Sturgeon were internally tagged with 69 kHz acoustic transmitters and passive integrated transponder (PIT) tags and measured for fork and total length before release into the Sacramento River at the Tisdale Launch Ramp. To determine post-rescue survival and continuance of spawning migration, tag identification numbers of sturgeon tagged with 69 kHz acoustic transmitters were queried in the Biotelemetry Autonomous and Real Time Database (BARD) or searched for in the Rio Vista Bridge receiver download from 13 September 2019.

Subsequent rescue efforts for other fish species were conducted 3, 8 and 15 May using a combination of 1/8-inch and 1/4-inch mesh beach seines, dip nets, and backpack electro-fishers. Captured fish which were placed in aerated coolers prior to work-up. All fish were identified to species, enumerated, and transported to the Sacramento River at the Tisdale Boat Launch for release. Adult Chinook salmon (*Oncorhynchus tshawytscha*) were measured for fork length and tagged with external anchor (Floy) tags and adult and juvenile steelhead (*O. mykiss*) were measured for fork length and internally tagged with integrated passive transponder (PIT) tags to monitor post-rescue survival and migration patterns. Tissue samples (approximately 2 x 2 mm dorsal lobe caudal fin clips) were collected from adult Chinook salmon for genetic analysis to provide ESU determination. Juvenile Chinook salmon were measured for fork length to determine Evolutionary Significant Unit (ESU) or race designation (Greene 1992).

Results

A total of 1,272 fish comprised of 11 native and eight nonnative species was rescued

during the fish rescue operations (**Table 1**). Among these were federal and state listed species including Sacramento River winter-run Chinook salmon (federal and State endangered), Central Valley spring-run Chinook salmon (federal and State threatened), Central Valley steelhead (federal threatened), and sDPS green sturgeon (federal threatened). Twelve of the 20 adult green sturgeon rescued were implanted with 69 kHz acoustic tags; all 20 adult green sturgeon and the one white sturgeon were implanted with PIT tags. Three Central Valley spring-run Chinook salmon and two Sacramento River winter-run Chinook salmon adult carcasses were salvaged during rescue operations conducted on 3 and 8 May; they likely perished from poor water quality. One adult Chinook salmon carcass was too decomposed to determine ESU through genetic analysis.

Table 1. Fish species rescued from the Tisdale Weir splash basin and downstream inundated area, 24, 25 April; 3, 8, and 15 May 2019.

Species common name	Scientific name	Life Stage	Number rescued
Green sturgeon*	<i>Acipenser medirostris</i>	Adult	20
White sturgeon*	<i>Acipenser transmontanus</i>	Adult	1
Winter-run Chinook salmon*	<i>Oncorhynchus tshawytscha</i>	Adult	3 ^a
Spring-run Chinook salmon*	<i>Oncorhynchus tshawytscha</i>	Adult	2 ^a , 2 ^b
Spring-run Chinook salmon*	<i>Oncorhynchus tshawytscha</i>	Juvenile	3 ^a , 6 ^b
Fall-run Chinook salmon*	<i>Oncorhynchus tshawytscha</i>	Juvenile	66
Central Valley steelhead*	<i>Oncorhynchus mykiss</i>	Juvenile	1 ^b
Pacific lamprey*	<i>Lampetra tridentata</i>	Adult	1
Sacramento pikeminnow*	<i>Ptychocheilus grandis</i>	Adult and juvenile	66
Sacramento splittail*	<i>Pogonichthys macrolepidotus</i>	Adult	5
Hardhead*	<i>Mylopharodon conocephalus</i>	Adult	2
Sacramento sucker*	<i>Catostomus occidentalis</i>	Adult	317
Sacramento blackfish*	<i>Orthodon microlepidotus</i>	Adult	1
Tule perch*	<i>Hysterocarpus traskii</i>	Adult	1
Striped bass	<i>Morone saxatilis</i>	Adult	283
American shad	<i>Alosa sapidissima</i>	Adult	511
Spotted bass	<i>Micropterus punctulatus</i>	Adult	2
Smallmouth bass	<i>Micropterus dolomieu</i>	Adult	4
Black crappie	<i>Pomoxis nigromaculatus</i>	Adult	2
Redear sunfish	<i>Lepomis microlophus</i>	Adult	3
White catfish	<i>Ameiurus catus</i>	Adult	1
Bigscale logperch	<i>Percina macrolepida</i>	Adult	1

* Native species

^a Adipose fin clipped; hatchery origin; ^b Adipose fin intact; wild origin

Discussion

Rescue operations at Tisdale Weir prevented 1,272 fish, including federal and State listed species, from perishing from factors such as lack of water, poor water quality, predation, or poaching. However, adult Chinook salmon and sturgeon stranded downstream of Tisdale Weir and returned to the Sacramento River were still subjected to migration delays. Post-rescue detection data from listed fish species tagged during rescue operations provides an indication of post-rescue survival and movement patterns, including potential spawning success. Of the 12 adult sDPS green sturgeon tagged with acoustic transmitters during the rescue operations, post-rescue detection data provides evidence to suggest 100 percent survival (**Table 2**). Assuming 100 percent survival of the eight green sturgeon not tagged with acoustic transmitters, the rescue of 20 adult sDPS green sturgeon represents 5.7 percent of the annual spawning population given that the most current estimate is 348 individuals (average of annual sDPS green sturgeon spawning runs; 2010-2015; Mora et al 2018).

Eight of the adult sDPS green sturgeon implanted with acoustic transmitters were subsequently detected between Sacramento River Rkm 424 (Glenn Colusa Irrigation District) and Rkm 494 (China Bend). Southern DPS green sturgeon spawning has been routinely documented within this 70 km reach (Poytress et al. 2015). Both types of sDPS green sturgeon post-spawning behaviour documented in Sacramento River spawning populations were observed in the tagged fish as determined by detection data from receivers deployed between the Butte City Bridge (Rkm 363) and China Bend. Two green sturgeon were detected moving downstream after spending 4-6 weeks in the spawning reach, while six remained within the spawning reach until late fall or early winter. Two green sturgeon aborted their spawning migration as they were detected at the Rio Vista Bridge receiver array maintained by CDFW for the juvenile sturgeon tagging and monitoring project (96 Rkm). One green sturgeon was detected only at the Butte Bridge 3-4 December 2019. Based on this one detection, it would appear that the tag was not transmitting as programmed, and it is possible that this fish migrated upstream to the spawning reach. **Table 2** presents detection dates and post-rescue migration data for the 12 green sturgeon tagged with acoustic transmitters.

Capturing fish from the weir stilling basin and inundated area downstream of the weir is problematic due to the quantity of large woody debris, cobble substrate, and emergent vegetation, and it is likely that a number of fish escaped capture and subsequently perished from one or more of the aforementioned factors. Migration delays can affect gamete viability. A female sDPS green sturgeon rescued from the Tisdale Weir 14 April 2011 contained eggs which showed early stages of atresia (Thomas et al. 2013).

Capture and handling stress could also result in post-rescue mortality disease resulting from slime coat and scale loss, particularly to adult salmonids (Donaldson et al. 2010). The Tisdale Weir Rehabilitation and Fish Passage Project should provide volitional passage back to the Sacramento River when weir overtopping events cease. However, the estimated project completion date of June 30, 2027 means that there will likely be several more stranding events necessitating fish rescue operations.

While rescue of listed fish species is considered high priority, considerable human resources were expended to conduct fish rescues at Tisdale Weir. Staff involvement over the five days of rescue operations included four to five Environmental Scientists and five to seven scientific aides spending eight to 10 hours per rescue event which necessitated overtime pay and backlogging of regularly assigned tasks. In addition, CDFW Wildlife Officers were required to increase patrols at Tisdale Weir prior to rescue efforts to deter potential poaching events.

Table 2. Post rescue detections of sDPS green sturgeon rescued from Tisdale Weir; 25-26 April and 3 May 2019.

Date tagged	Tag ID	Post-rescue detection dates and migration comments
4/25/2019	A69-9001-15834	Detected in Sacramento River green sturgeon spawning reach 5/08 through 6/11/2019
4/25/2019	A69-9001-15835	Detected in Sacramento River green sturgeon spawning reach 5/03 through 6/19/2019
4/25/2019	A69-9001-15837	Detected in Sacramento River green sturgeon spawning reach 5/01 through 12/07/2019
4/25/2019	A69-9001-15838	Detected in Sacramento River green sturgeon spawning reach 5/01 through 1/30/2020
4/25/2019	A69-9001-15839	Detected in Sacramento River green sturgeon spawning reach 5/09 through 12/08/2019
4/26/2019	A69-9001-15840	Detected in Sacramento River green sturgeon spawning reach 5/11 through 5/16/2019
4/26/2019	A69-9001-15843	Detected in Sacramento River green sturgeon spawning reach 5/01 through 12/09/2019
5/03/2019	A69-9001-15846	Detected in Sacramento River at Rio Vista Bridge 5/08/2019
4/26/2019	A69-9001-15847	Detected in Sacramento River green sturgeon spawning reach 5/05 through 12/10/2019
4/26/2019	A69-9001-15848	Detected in Sacramento River at Rio Vista Bridge 5/02/2019
4/26/2019	A69-9001-15849	Detected in Sacramento River at Rio Vista Bridge 5/03/2019

Date tagged	Tag ID	Post-rescue detection dates and migration comments
4/26/2019	A69-9001-15850	Detected in Sacramento River at Butte City Bridge 12/03/2019

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