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Memorandum

DATE: 19 April 2021
TO: Roland Sanford and Chris Lee, Solano County Water Agency (SCWA)
FROM: Tim Salamunovich, TRPA Fish Biologists
RE: Results of the October 2020 Western Solano County Streams Fish Surveys

Introduction

Prior to 1999, Solano Irrigation District (SID) conducted annual maintenance for the Putah South Canal (PSC) that included flushing water from the canal into western Solano County creeks via canal wasteways. In late December 1998 and early January 1999 this practice resulted in the release and deposition of fine sediment in the Suisun Creek stream channel. Most deposition was in the one-mile reach between the PSC and the Morrison Lane Bridge (Figure 1) and was largely concentrated in the first 600 feet of stream below the canal (Thomas R. Payne & Associates 1999a). Ten days of intensive clean-up effort using a suction dredge followed by five weeks of prolonged high stream flows transported the fine sediment depositions from the area. A resurvey of the affected area of Suisun Creek and additional areas downstream in mid-March 1999 did not find any significant fine sediment deposits remaining (Thomas R. Payne & Associates 1999b). Re-survey of the Suisun Creek below the PSC in late October 2000 found few fine sediment deposits (Thomas R. Payne & Associates 2000). In 1999 SID discontinued flushing sediment from the PSC wasteways as part of their standard maintenance operations.

Fish surveys in Suisun, Green Valley, and Ledge wood creeks were conducted in 1999, 2000, and 2001 to augment the sediment surveys and to provide additional information on the distribution and abundance of fish within these basins that intersect the PSC, two of which (Suisun and Green Valley) had been subjected to annual canal wasteway release prior to 1999 (Thomas R. Payne and Associates 1999c, 2000, and 2001). All three creeks had continuous stream flow at the time of these summer and fall surveys. Fish populations throughout the basins were composed almost entirely of native species. In Suisun Creek, native California roach (*Hesperoleucus symmetricus*), Sacramento pikeminnow (*Ptychocheilus grandis*), and sculpin (*Cottus* sp.) dominated the fish fauna at all the sites, with only two non-native green sunfish (*Lepomis cyanellus*) captured. A total of nineteen rainbow trout/steelhead (*Oncorhynchus mykiss*) were captured during the five Suisun Creek surveys.

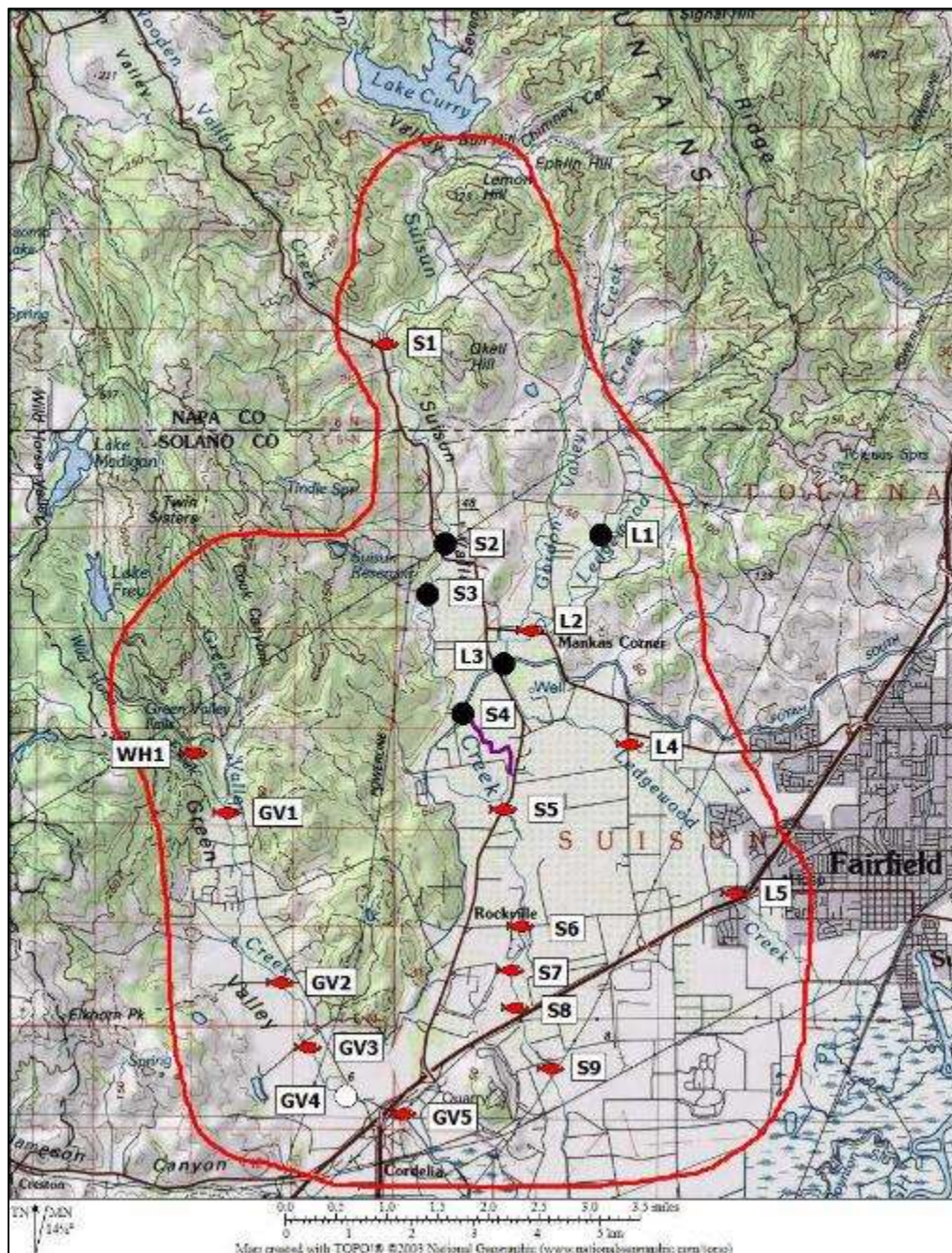


Figure 1. Western Solano County stream sites surveyed 12-15 October 2020: WHC1=Wild Horse at Green Valley Water Treatment Plant; GV1=Green Valley at Country Club; GV2=Green Valley at Mason Rd; GV3=Green Valley at Reservoir Ln; GV4=Green Valley at Turner Ct; GV5=Green Valley at Commerce Ct; S1=Suisun at Wooden Valley X Rd; S2=Suisun at upper Suisun Valley Rd; S3=Suisun at Caymus/Vezer; S4=Suisun at PSC; S5=Suisun at lower Suisun Valley Rd; S6=Suisun at Rockville Rd; S7=Suisun at Solano College; S8=Suisun at Suisun Pkwy; S9=Suisun at Cordelia Rd; L1=Ledgewood at Clayton Rd; L2=Ledgewood at Mankas Corners; L3=Ledgewood at PSC; L4=Ledgewood at Abernathy Rd; L5= Ledgewood at Rockville Rd; L6= Ledgewood at Auto Mall Pkwy; Sampling conducted at flowing (red fish) sites. No sampling at dry (black dot) or excessively deep (white dot) sites. Purple line shows Suisun Creek reach between the PSC and Morrison Lane.



In four electrofishing surveys along Green Valley Creek, no non-native fish were captured and fish populations were dominated by native California roach and sculpin. One hundred and fifty *O. mykiss* were captured during the 1999-2001 Green Valley surveys.

In three electrofishing surveys at several LedgeWood Creek sites, the fish populations were dominated by the native minnow, hitch (*Lavinia exilicauda*), Sacramento sucker (*Catostomus occidentalis*) and threespine stickleback (*Gasterosteus aculeatus*). No *O. mykiss* were captured during any of the LedgeWood surveys. Only a few non-native green sunfish (n=14), largemouth bass (*Micropterus salmoides*; n=1), and mosquitofish (*Gambusia affinis*; n=1) were captured.

After a fifteen-year hiatus, fish surveys restarted in late August 2016 after five consecutive years of below normal to critical water years (Normandeau Associates 2017). Streamflow in both Suisun and LedgeWood creeks was intermittent, and no trout were captured in either basin. Fewer trout were found in the Green Valley basin in 2016 compared to the prior surveys. The 2016 fish monitoring showed higher percentages of non-native fish, especially bluegill sunfish, in the intermittent reaches of Suisun Creek. Despite the local changes in fish fauna noted in 2016, native species still dominated the fish fauna in the Suisun, Green Valley, and LedgeWood basins. Sculpin, roach, pikeminnow, and sucker remained abundant and widely distributed in both the Suisun and Green Valley basins.

Surveys were repeated in the summer of 2017 following a wet winter (Normandeau Associates 2018). Continuous streamflow conditions were present in both Suisun and Green Valley creeks, with intermittent flows in LedgeWood Creek. Despite the return of continuous streamflow in August 2017, no rainbow trout were captured at any of the seven Suisun Creek survey sites. The August 2017 surveys found fewer alien fish in the non-tidal areas of Suisun Creek compared to 2016. The 2017 surveys found healthy trout populations in the upper Green Valley basin, especially in White Horse Creek and in Green Valley Creek near the confluence of the two creeks. The 2017 fish monitoring indicated that native California species continue to dominate the aquatic habitat in the Suisun, Green Valley, and LedgeWood basins.

Fish surveys were conducted in the three western Solano County stream basins during the summer of 2018, a below normal water year (Normandeau Associates 2019). Despite continuous streamflow during the August 2018 surveys, no rainbow trout were captured in Suisun Creek survey sites. The 2018 surveys found healthy trout populations in the upper Green Valley basin,



especially in White Horse Creek and in Green Valley Creek near the confluence of the two creeks. The 2018 fish monitoring indicated that native California species continue to dominate the populations of all three western Solano County basins.

Fish surveys were conducted in the three western Solano County stream basins during the summer of 2019, a wet water year (TRPA Fish Biologists 2020). Despite continuous streamflow during the October 2019 surveys, only one rainbow trout was captured at the nine Suisun Creek sites sampled. The 2019 surveys continued to find healthy trout populations in the upper Green Valley basin, especially in White Horse Creek and in Green Valley Creek near the confluence of the two creeks. The 2019 fish monitoring indicated that native California species continue to dominate the populations of all three western Solano County basins.

This report will present the results of the latest surveys conducted in the fall of 2020, following a dry water year in the Sacramento Valley according to the Sacramento Valley 40-30-30 Hydrologic Classification Index (DWR California Data Exchange Center, Water Supply Index WSIHIST).

Methods

Fish surveys were conducted using a portable backpack electrofisher to stun and capture fish at sites distributed along Suisun, Green Valley, and Ledge wood creeks where access could be arranged and where suitable habitat conditions existed (i.e., flowing water or isolated pools that could be safely waded). Captured fish were held in a bucket equipped with a small aerator until completion of the survey, at which time they were identified and measured to the nearest millimeter fork length (FL) (or total length [TL] for stickleback and sculpin).

Trout were weighed to the nearest 0.1 gram on an electronic scale. Prior to handling, trout were anesthetized in a weak CO₂ solution using commercially available effervescent pain-relief tablets (two tablets: $\frac{3}{4}$ gallons of clean river water). In addition, $\frac{1}{4}$ teaspoon (1.25 ml) API® Stress Coat+ was added to the anesthetic water bucket. Stress Coat is reported to protect and heal fish by replacing electrolyte loss and by the formation of a synthetic slime coating on the skin of fish and by replacing the natural secretion of slime that is typically interrupted by handling.

Fulton's Condition Factor (K) was calculated for trout using the formula of Bagenal and Tesch (1978). The condition factor compares the length and weight relationship of individual fish to assess their physical condition (Everhart et al. 1975). Higher condition factors indicate heavier fish



for a given length. A value of 1.0 is generally considered normal for a healthy trout. After processing, all fish were released back to the site of capture. Trout were held for an extended period in a bucket of aerated water and allowed to fully recover prior to release back to the site of capture.

The length of sample reaches at each site varied based upon the length of individual habitat units (i.e., pool, riffle, run). Generally, several hundred feet of stream was sampled at each site with continuous flow and typically this included a minimum of three riffle-pool sequences. In those cases where only intermittent pool habitat was present, one or two intermittent pools were sampled.

It should be noted that surveys provide data on the relative abundance of fishes at each study site and should not be construed as suitable for determining population estimates. It was not possible to capture every fish within the study reaches, and capture success varied among the various species and life stages at a particular site as well as between sites based largely on water salinity, conductivity, turbidity, and instream cover.

Some water quality parameters were measured at the time of the fish surveys and included water (and air) temperature, conductivity, pH, and salinity. Dissolved oxygen concentrations were not recorded during the surveys due to meter malfunction.

Results

Suisun Creek

Nine sites distributed along a 9.7-mile-long reach of Suisun Creek were visited on 13-14 October 2020 and included sites where access could be obtained from Wooden Valley Cross Road (in Napa County) downstream to Cordelia Road (Figure 1).

The City of Vallejo typically maintains a continuous release of water of two to three cubic feet per second (cfs) from Lake Curry into upper Suisun Creek (BOR 2003). During the early October 2019 survey, a release of one cfs was being provided from Lake Curry (John Palesi, City of Vallejo Water Department, personal communication, 7 December 2020 email). Continuous stream flow was noted at five of the nine Suisun Creek sites during the October 2020 surveys (Plate 1) and flow was visually estimated to range from 0.1 to 0.5 cfs at the sites (Table 1). Somewhere in the vicinity of the Napa-Solano County line Suisun Creek stream flow appeared to go subsurface and the sites



Plate 1. Photographs of full flow conditions in Suisun Creek in mid-October 2020. A: Cordelia Road Site; B: Suisun Parkway Site; C: Solano College Site; D: Rockville Road Site; E: Wooden Valley Cross Road Site (note irrigation pump pipe bank).



Table 1. Survey site location (from downstream to upstream), site length, sample date, survey time, stream flow estimate, air temperature, water temperature, conductivity, and salinity at time of survey for the Suisun, Green Valley, and Ledge wood creeks study sites during the 12-15 October 2020 fish monitoring surveys.

Site	Date	Time	Length (ft)	Flow ^{1/} (cfs)	Temperature (°C) Air Water		Conductivity (μS/cm)	Salinity (ppt)	pH
<u>Suisun Creek</u>									
Cordelia Road	10/13/20	1045	347	0.5	23.9	17.2	493.0	0.3	7.7
Suisun Parkway	10/13/20	1303	464	0.5	31.1	17.8	377.6	0.2	7.7
Solano College	10/14/20	1131	348	0.5	23.9	17.8	310.2	0.2	7.5
Rockville Road	10/14/20	1607	455	0.1	27.8	19.3	327.1	0.2	8.3
Lower Suisun Valley Road ^{2/}	10/14/20	0933	80	0.0	21.7	17.1	413.2	0.2	7.3
Putah South Canal	10/13/20	0830		dry					
Caymus/Vezer	10/13/20	0900		dry					
Upper Suisun Valley Road	10/13/20	0735		dry					
Wooden Valley Cross Road	10/13/20	1554	390	0.5	25.0	16.8	395.8	0.2	7.4
<u>Green Valley Creek</u>									
Commerce Court	10/12/20	1552	463	0.5	30.0	20.0	490.0	0.3	8.0
Turner Court ^{3/}	10/12/20	1427		0.5					
Reservoir Lane	10/12/20	1253	545	0.5	24.4	15.8	289.2	0.2	7.9
Mason Road	10/12/20	1033	306	0.5	20.6	16.1	288.8	0.2	7.4
GV Country Club	10/12/20	0823	608	0.1	13.9	15.3	140.5	0.1	7.7
White Horse at GVWWTP	10/15/20	1039	806	1.0	23.3	17.3	137.4	0.1	7.9
<u>Ledgewood Creek</u>									
Auto Mall Parkway	10/14/20	1438	252	0.5	33.8	18.7	780	0.4	7.9
Rockville Road	10/14/20	1303	281	0.5	27.8	17.7	734	0.4	8.0
Abernathy Road	10/13/20	1415		dry					
Putah South Canal	10/13/20	0845		dry					
Mankas Corners	10/14/20	0815	566	0.1	18.3	16.0	672	0.4	7.8
Clayton Road	10/14/20	0950		dry					

^{1/} visual flow estimate

^{2/} intermittent, subsurface flow; two isolated pools beneath bridge

^{3/} six-foot tall beaver dam created deep pool habitat too deep to electrofish



Between the upper Suisun Valley Road and the Putah South Canal crossing flow went subsurface through the extensive gravel bed habitat (Plate 2). At the lower Suisun Valley Road area intermittent pool habitat was present and fish sampling was conducted in the isolated pools fed by subsurface flow (Plate 2A).

Water temperatures at the Suisun Creek sites ranged from 16.8° to 19.3°C to (62.2° to 66.7°F; Table 1). The October 2020 water temperatures were higher than those noted during the previous October 2019 survey when Suisun Creek water temperatures ranged from 14.5° to 17.8°C to (58.1° to 64.0°F) [TRPA Fish Biologists 2020].



Plate 2. Photographs of intermittent flow or dry channel conditions in Suisun Creek in mid-October 2020. A: intermittent pool downstream of lower Suisun Valley Road; B: dry channel at the PSC Site; C: dry channel at the Caymus/Vezer Site; D: dry channel at the upper Suisun Valley Road Site.



The October 2020 surveys at the six Suisun Creek sites captured a total of 975 fish from nine species (Table 2). Native California fish from seven species made up 92.2 percent of the total catch in Suisun Creek. California roach were caught at all six Suisun Creek sites surveyed and were the most abundant fish at all six sites in the October survey (Table 2). This native minnow made up 50 percent of the total catch in Suisun Creek. The native Sacramento sucker, which were also captured at all sample locations, and contributed about 15 percent of the total Suisun Creek catch. Other widely distributed native species included prickly sculpin (*Cottus asper*), pikeminnow, and threespine stickleback, which together made up another 25 percent of the catch. Tule perch (*Hysterocarpus traskii*) were only captured in the two lower basin sites and made up less than two percent of the total catch. Only one rainbow trout/steelhead (258 mm FL) was captured at the most downstream Cordelia Road Site during the October survey (Plate 3). This was only the second documented capture of a trout in Suisun Creek in the last four years of sampling (2016-2020). Photos of some of the non-trout fish species captured in Suisun Creek during the October 2020 surveys can be found in Plate 4.



Plate 3. Photograph of 258 mm FL rainbow trout/steelhead captured at the Cordelia Road Site of Suisun Creek, 13 October 2020.



Table 2. Capture data for the fish monitoring surveys on Suisun, Green Valley, and Ledge wood creeks, 12-15 October 2020.

	Suisun Creek						Green Valley Creek					Ledge wood Creek			Total
	CORD	PRKWY	SCC	RKV	LSVR	WVX	COM	RES	MAS	GVCC	WHC	AUTO	RKV	MNKS	
Native Fishes															
Rainbow trout	1 (258 FL)							1 (299 FL)	2 (100-188 FL)		32 (54-181 FL)				36
Sacramento pikeminnow	14 (86-140 FL)	30 (77-300 FL)	2 (138-140 FL)	5 (122-212 FL)	3 (89-133 FL)	11 (64-158 FL)		2 (108-133 FL)				1 (142 FL)	2 (86-121 FL)		70
California roach	108 (39-117 FL)	120 (30-124 FL)	53 (37-75 FL)	76 (30-127 FL)	55 (38-100 FL)	74 (36-111 FL)	52 (50-112 FL)	141 (31-104 FL)	116 (28-97 FL)	131 (25-105 FL)	87 (35-85 FL)	25 (44-97 FL)	32 (54-118 FL)	78 (36-102 FL)	1,148
Sacramento sucker	6 (145-210 FL)	68 (101-215 FL)	4 (138-184 FL)	8 (136-199 FL)	10 (132-183 FL)	49 (92-152 FL)		19 (138-179 FL)	8 (98-147 FL)	30 (80-169 FL)		17 (124-203 FL)	9 (104-153 FL)	10 (54-173 FL)	238
Threespine stickleback	19 (32-55 TL)	18 (26-50 TL)	6 (39-47 TL)	20 (29-42 TL)	11 (35-49 TL)	5 (40-46 TL)	3 (25-42 TL)			1 (51 TL)		9 (32-46 TL)	2 (39-42 TL)	1 (44 TL)	95
Prickly sculpin	21 (43-69 TL)	13 (37-80 TL)	19 (35-68 TL)	30 (35-83 TL)	6 (42-62 TL)	16 (46-64 TL)	25 (47-83 TL)	1 (41 TL)	3 (41-55 TL)		59 (31-85 TL)			1 (112 TL)	194
Tule perch	5 (72-122 FL)	13 (66-106 FL)					8 (89-105 FL)								26
Exotic Fishes															
Goldfish							1 (184 FL)								1
Golden shiner							1 (98 FL)					1 (111 FL)			2
Mississippi silverside							71 (41-75 FL)								71
Western mosquitofish	2 (26-28 TL)	1 (28 TL)		25 (15-49 TL)	6 (16-38 TL)		89 (16-47 TL)	2 (22-29 TL)	3 (16-27 TL)			21 (15-40 TL)	8 (17-31 TL)	1 (25 TL)	158
Bluegill sunfish	1 (88 FL)	12 (76-125 FL)	6 (97-122 FL)	1 (140 FL)	2 (103-105 FL)	20 (63-88 FL)	1 (121 FL)								43
Green sunfish													1 (160 FL)	5 (103-166 FL)	6
Total # Individuals	177	275	90	165	93	175	251	166	132	162	178	74	54	96	2,088
# native fish	174	262	84	139	85	155	88	164	129	162	178	52	45	90	1,807
# exotic fish	3	13	6	26	8	20	163	2	3	0	0	22	9	6	281
Total # species	9	8	6	7	7	6	9	6	5	3	3	6	6	6	13
# native species	7	6	5	5	5	5	4	5	4	3	3	4	4	4	7
# exotic species	2	2	1	2	2	1	5	1	1	0	0	2	2	2	6
Shannon's Diversity (ln)	1.319	1.573	1.224	1.492	1.350	1.462	1.509	0.555	0.519	0.515	1.024	1.435	1.210	0.701	1.594
Evenness (H'/Hmax)	0.600	0.757	0.683	0.767	0.694	0.816	0.687	0.310	0.322	0.469	0.932	0.801	0.675	0.391	0.621

CORD = Cordelia Rd.; PRKWY = Suisun Prkwy; SCC = Solano Community College; RKV = Rockville Rd.; LSVR = Lower Suisun Valley Rd.; WVX = Wooden Valley Cross Rd.; COM = Commerce Ct.; RES = Reservoir Ln.; MAS = Mason Rd.; GVCC = Green Valley Country Club; WHC = White Horse Creek at Green Valley Water Treatment Plant; AUTO = Auto Mall Prkwy; MNKS = Mankas Corners.



Plate 4. Photographs of native fishes captured in Suisun Creek in mid-October 2020. A: 212 mm FL Sacramento pikeminnow; B: 96 mm FL California roach; Site; C: 166 mm FL Sacramento sucker; D: 42 mm TL threespine stickleback; E: 122 mm FL tule perch; F: 66 mm TL prickly sculpin.



Bluegill sunfish (*Lepomis macrochirus*) was the most abundant non-native fish noted in the October 2020 Suisun Creek surveys (plate 5). This exotic sunfish occurred at all six sample sites and made up almost five percent of the total Suisun Creek catch (Table 2). Western mosquitofish (*Gambusia affinis*) was the only other non-native fish captured in the October 2020 Suisun Creek surveys. This small exotic fish was found at four of the six Suisun Creek sites and made up less than four percent of the total Suisun basin catch.



Plate 5. Photograph of 103 mm FL non-native bluegill sunfish captured in Suisun Creek in mid-October 2020.

The October 2020 survey was similar to prior surveys in that roach, pikeminnow, sucker, and sculpin dominated the catches and were present throughout the basin. Tule perch were also captured, but only in the lower basin, as was the case in prior surveys. While three of four recent prior surveys (2016-2018) did not document any rainbow trout at any of the survey sites, the single rainbow trout captured in both the October 2019 and October 2020 Suisun Creek surveys, does suggest the continued presence of salmonids in the watershed.



In the five Suisun Creek surveys conducted in 1999-2001, only two green sunfish (less than 0.1 percent of the captures) and no bluegill were captured. When the surveys resumed in 2016 after multiple consecutive dry and critical water years, non-native bluegill sunfish made up over almost 20% of the fish. While non-native fish, again mostly bluegill sunfish ($n=42$), were found in the October 2020 survey, they were not abundant and made up less than five percent of the total catch in Suisun Creek. These results suggest that non-native fish seem to thrive in when dry condition prevail for extended consecutive years.

Green Valley Creek Basin

Five sites in the Green Valley Creek basin distributed along 5.2 miles from the City of Vallejo's Green Valley Water Treatment Plant (GVWTP) on Wild Horse Creek downstream to Green Valley Creek at Commerce Court in Cordelia (just upstream of the tidal zone) were sampled on 12-15 October 2020 (Figure 1). The GVWTP Site is located about 0.6 miles upstream of its confluence with Green Valley Creek and 1.7 miles downstream of Lake Frey. One of our usual Green Valley sample sites at the Turner Court footbridge could not be sampled due to a large beaver dam about 350 feet downstream that created a large deep pool habitat that could not be waded (Plate 6). The dam looks to be a partial barrier to upstream and downstream salmonid migration except at the highest stream flows, which are limited in most years. This beaver dam is likely an impediment to steelhead migration.

Most of the streamflow in lower Green Valley Creek appears to derive from Wild Horse Creek, where two City of Vallejo-owned domestic water supply reservoirs, Lake Frey and Lake Madigan, are located in the upper basin (Figure 1). The City of Vallejo was reportedly releasing 0.33 cfs from Lake Frey Dam during the October 2020 sampling (John Palesi, City of Vallejo Water Department, personal communication, 7 December 2020 email). During our surveys, continuous flow, estimated to be one-half to one cfs, was present at all five sites (Table 1). It is assumed that tributary and groundwater accretion supplemented the Lake Frey releases. During the four 1999-2001 surveys, one site in Wild Horse Creek and two sites in Green Valley Creek downstream of the Wild Horse confluence to Reservoir Lane were sampled and continuous flow was present throughout this study area (Thomas R. Payne and Associates 1999c, 2000, and 2001). Continuous streamflow was also noted throughout Green Valley Creek



Plate 6. Photographs of flow conditions in Green Valley Creek in mid-October 2020. A: full flow at Commerce Court Site; B: deep pool at Turner Court Site; C & D: six-foot high beaver dam at Turner Court Site (note deep pool upstream of dam). E: full flow at GV Water Treatment Plant Site. No photos of the Mason, Reservoir, or Country Club Sites.



to the tidal zone during the summers of 2016 through 2018 and the fall of 2019 (Normandeau Associates 2017, 2018, 2019; TRPA Fish Biologists 2020).

The early October 2020 water temperatures at the six Green Valley basin sites averaged 16.9°C (62.4°F) and ranged from 15.3° to 20.0°C (59.5° to 68.0° F; Table 1). The early fall water temperatures noted in 2020 were slightly higher than those noted for the Fall 2019 surveys and significantly cooler than those recorded during the previous summer surveys.

The mid-October fish surveys at the five Green Valley basin sites captured a total of 889 fish from twelve species, with native resident fish making up over 81 percent of the total catch (Table 2). Native California roach were caught at all five survey sites and made up over 59 percent of the total Green Valley basin fish captures. Prickly sculpin, another native species caught at four of the survey sites, made up almost ten percent of the captures. Sucker were captured at four sites and contributed over six percent of the total catch. Pikeminnow, tule perch, and stickleback were captured but only made up less than two percent of the total catch. A total of 35 *O. mykiss* were captured (almost four percent of the total catch), with all captures from three upstream sites and most from the GVVTP site on Wild Horse Creek (Plate 7). No trout were captured at the Green Valley Country Club Site during the October 2020 surveys. This is the first time no trout were seen at this site since sampling at this site began in 2016.



Plate 7. Photographs of rainbow trout/steelhead captured in Green Valley Creek in mid-October 2020. A: 75 mm FL rainbow trout/steelhead; B: 181 mm FL rainbow trout/steelhead.



The *O. mykiss* captured in the Green Valley basin during the October 2020 represented multiple size/age classes, which were visually assigned using length frequency (Figure 2). Young-of-the-year trout less than 100 mm in fork length (FL) dominated the trout population, similar to what was noted the previous three years surveys (2017-2019). Age 1 (100-149 mm FL), Age 2 (150-199) and Ages 3+ (>200 mm FL) sized trout were also present. If this age assignment is accurate, then there may be some portion of the trout population that is resident or non-migratory, since the migratory form of rainbow trout (i.e., steelhead) in the Central California Coast Distinct Population Segment typically migrate to the ocean as one or two year old fish (Moyle et al. 2008). More precise age discrimination using scale analysis, or otolith analysis to determine maternal life history would be needed to confirm this assessment.

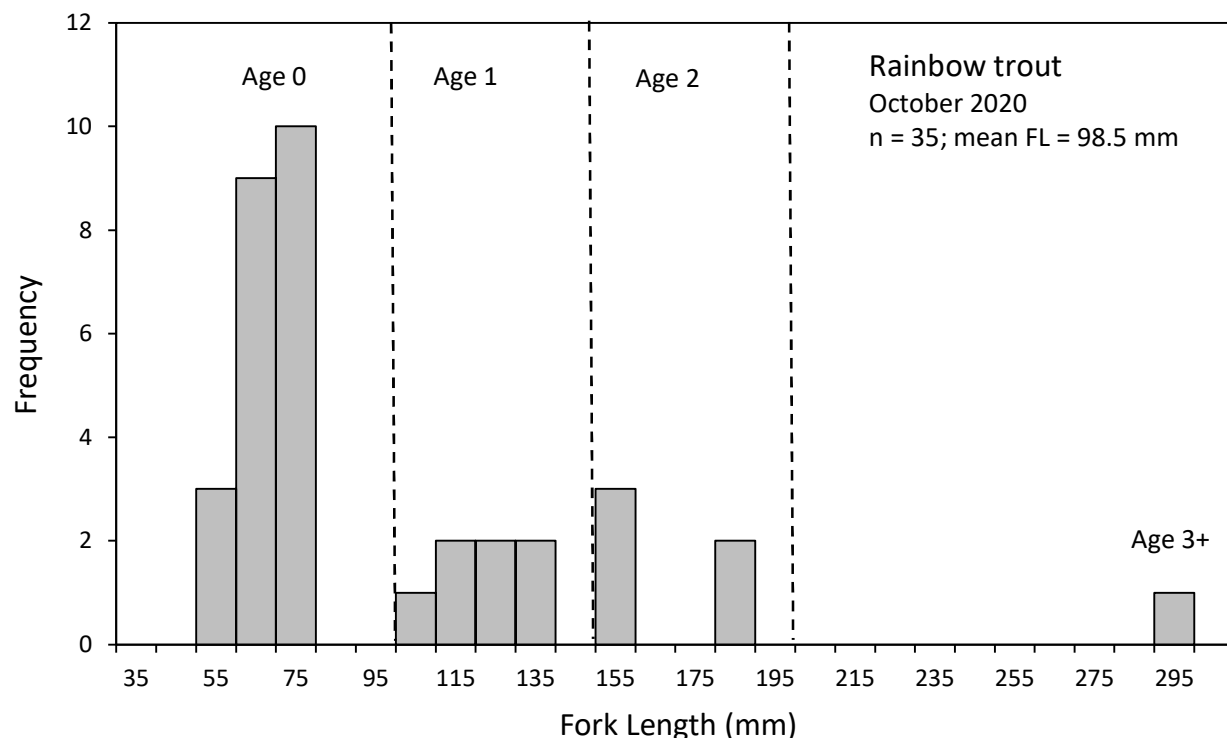


Figure 2. Length frequency for *O. mykiss* captured in Green Valley Creek basin, 12-15 October 2020.

The mean condition factor for the Green Valley rainbow trout was 1.05. It was noted during the time of sampling at the GVWTP Site on Wild Horse Creek, where most of the trout were captured, that there were a few trout that appeared to have an unusually low weight to length



relation. Examination of the condition factor frequencies showed that over 25 percent of the *O. mykiss* had conditions factors less than 0.9 (Figure 3), which may be indicative of trout populations in with low weights and foraging issues.

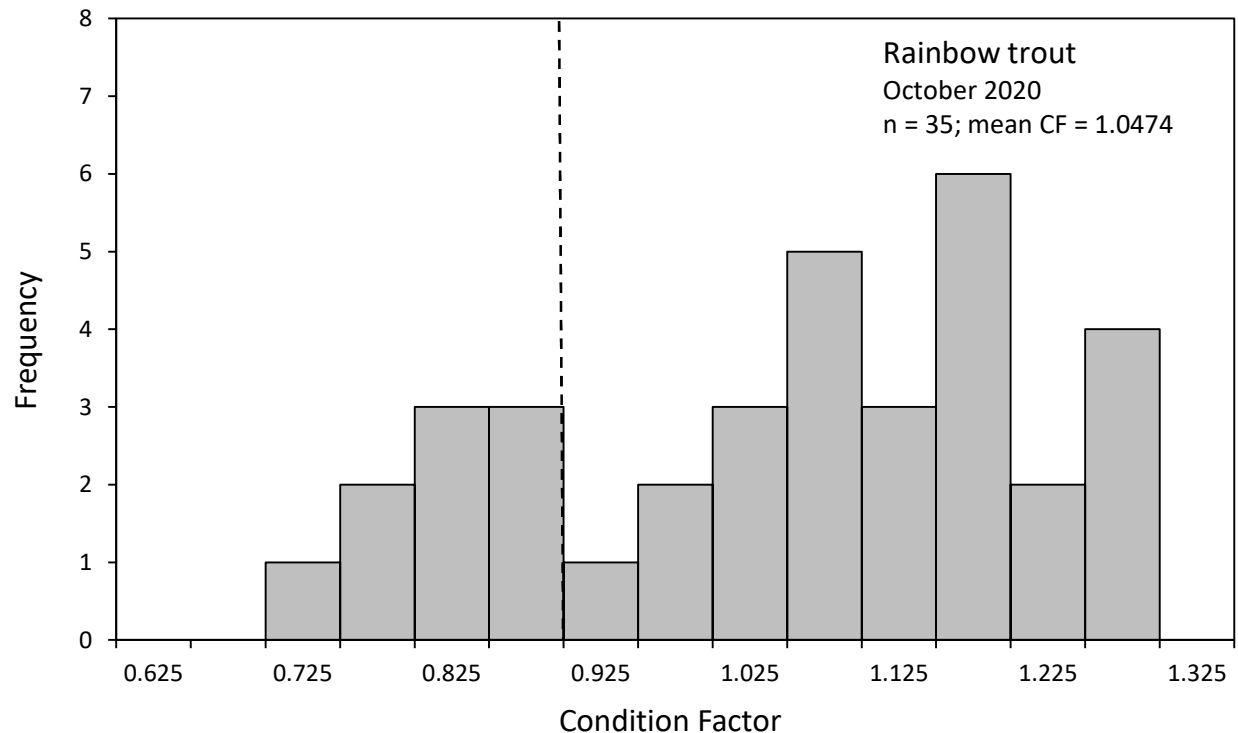


Figure 3. Condition factor frequency for *O. mykiss* captured in Green Valley Creek basin, 12-15 October 2020. Dotted line denotes 0.9 threshold.

We re-examined past data from 2017-2019 (i.e., since the GVWTP Site has been surveyed), and found that the 2020 data is the first year showing unusually high numbers of trout with condition factors less than 0.9 (Table 3). This indicates some trout are in less than “good condition” compared to previous survey periods.

Table 3. Breakdown of number of *O. mykiss* captured in Green Valley Creek basin 2017-2020 and showing numbers with condition factors (CF) less than various values (percentages shown in parentheses).

Year	Total Trout	CF <1.0	CF <0.9	CF <0.8
2017	38	0	0	0
2018	106	5 (4.7%)	0	0
2019	45	14 (31.1%)	2 (4.4%)	0
2020	35	12 (34.3%)	9 (25.7%)	3 (8.6%)



Most of the non-native fish noted during the October 2020 Green Valley basin fish surveys were captured at the Commerce Court Site, the most downstream Green Valley Creek sample site located near tidewater (Table 2). At this site, non-native fish (mostly mosquitofish and Mississippi silversides [*Menidia audens*]) made up almost 65% of the total catch. Silversides is now one of the most abundant and widespread species in the Sacramento-San Joaquin Delta (Mahardja et al. 2016). Other exotics captured in mid-October 2020 included two minnows, goldfish (*Carassius auratus*), and golden shiner (*Notemigonus crysoleucas*), and bluegill sunfish. At the four upstream sites, exotic fish were much less abundant and made up less than 2 percent of the total catch at any of the four sites.

The October 2020 Green Valley Creek survey was similar to the 1999-2001 and 2016-2019 surveys when California roach and sculpin also dominated the fish populations. During the four surveys conducted prior to 2002 (when no sampling was conducted downstream of the Reservoir Lane Site) no exotic species were captured in Green Valley Creek. In the August 2016 through 2019 surveys non-native fish made up three to eleven percent of the total captures in each year, though this increase in alien fish in these recent surveys is likely explained by additional sample sites located further downstream in the tidally influenced portions of Green Valley Creek that were not sampled in the earlier surveys. In the 1999-2001 surveys no sites downstream of Reservoir Lane were sampled.

The *O. mykiss* capture pattern and abundance noted in October 2020 was nearly identical with that noted in both the early August 2017 and October 2019, both of which followed a wet winter (Normandeau Associates 2018; TRPA Fish Biologists 2020). The main differences for the October 2020 trout patterns from previous surveys was the absence of any *O. mykiss* at the Green Valley Country Club Site (the first time this has occurred since sampling began in 2016) and the higher numbers of trout with lower condition factors at the Wild Horse Creek site.

The October 2020 surveys also suggest that while multiple size classes of trout in the Age 0 to Age 3 intervals are present in the Green Valley basin, these cool-water dependent salmonids are limited to the upper basin in the vicinity of Wild Horse Creek. This distribution for *O. mykiss* was also noted in the 1999-201 summer surveys of Green Valley basin, when Wild Horse Creek was also surveyed (Thomas R. Payne and Associates 1999c, 2000, and 2001).



Ledgewood Creek

Three sites along a 4.7-mile-long reach of Ledgewood Creek from Mankas Corners downstream to Auto Mall Parkway were sampled on 14 October 2020 and included Mankas Corners, Rockville Road, and Auto Mall Parkway (Figure 1). Stream flow in this reach was intermittent (Plate 8). Three Ledgewood Creek sites were visited but not sampled (Clayton Road, the Putah South Canal crossing, and Abernathy Road), as they were completely dry stream channels. Streamflow was present at the other three sites and the Auto Mall Parkway site appeared to be tidally influenced. During the three Ledgewood Creek surveys conducted during 2000-2001, continuous flow was present in the 2.4-mile-long reach between Mankas Corners and Abernathy Road (Figure 1).

The mid-October 2020 water temperatures at the three flowing Ledgewood Creek sites ranged from 16.0° to 18.7°C (60.8° to 65.7°F; Table 1). These temperatures were slightly higher than those noted during the only other previous fall survey conducted in early October 2019 (TRPA Fish Biologists 2020).

The October fish surveys at the three Ledgewood Creek sites captured a total of 224 fish from eight species, five of which were native fish species (Table 2). Native fish made up 83.5 percent of the total fish catch at the Ledgewood sites during the October 2020 survey. California roach dominated the Ledgewood fish populations and made-up 60 percent of the total catch. Sucker contributed another 16 percent of the total catch, while stickleback made up 11 percent. Pikeminnow, stickleback, and prickly sculpin (Plate 9A) were also captured. No trout were captured during the 2020 survey. Exotic mosquitofish, green sunfish (Plate 9B), and golden shiner were captured during the October 2020 survey.

During the 2000-2001 electrofishing surveys at several Ledgewood Creek sites, the fish populations were dominated by native hitch, sucker and stickleback (Thomas R. Payne and Associates 2000 and 2001). In the 2016 through 2020 surveys California roach, sucker, and stickleback were abundant (Normandeau Associates 2017, 2018, 2019; TRPA Fish Biologists 2020), and only one hitch has been captured (August 2018). *O. mykiss* have never been captured in Ledgewood Creek during any of these surveys. The most notable differences in both the 2016 through 2020 fish monitoring surveys of Ledgewood Creek compared to prior



Plate 8. Photographs of flow conditions in LedgeWood Creek in mid-October 2020. A: full flow at the Auto mall Parkway Site; B: full flow at the Rockville Road Site; C: dry channel at the Abernathy Road Site; D: dry channel at the PSC Site; E: full flow at the Mankas Corners Site; F: dry channel at the Clayton Road Site.

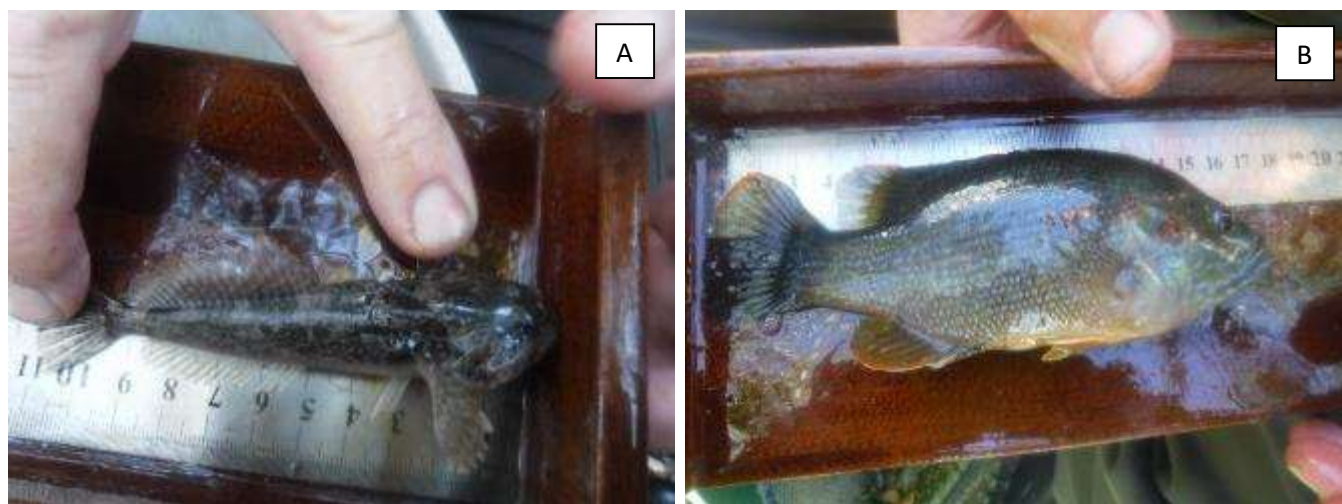


Plate 9. Photographs of fish captured in Ledgewood Creek in mid-October 2020. A: 160 mm TL native prickly sculpin; B: 112 mm FL non-native green sunfish.

surveys continue to be the recent absence of hitch, a native minnow, which dominated the earlier surveys, and the new dominance of roach, which were extremely rare in the earlier 2000-2001 surveys.

Conclusion

The October 2020 surveys, which followed a regional dry water year, documented extensive areas of intermittent or subsurface streamflow conditions in both Suisun and Ledgewood creeks. The extensive areas of dry channel along the middle Suisun basin noted during the October 2020 were the most noted during recent surveys and were comparable to conditions noted in August 2016 following five consecutive years of critical to below normal water years in the basin. Despite the intermittent flows noted in Suisun Creek during the 2020 surveys, rainbow trout were captured for the second time since the most recent surveys began in 2016.

Large areas of both Suisun and Ledgewood basins are under crop and vineyard production that require summer and fall irrigation. Wine grape acreage in Suisun Valley has increased by 375% since 1982 (Suisun Valley Vintners and Growers Association 2017). This increase in local agriculture acreage appears to have altered the hydrology of the stream and contributed to the occasional intermittent streamflow, even following wet winters, through direct instream or groundwater pumping. When periods of persistent below normal rainfall conditions return,



intermittent streamflow conditions will likely become more widespread in the Suisun Creek basin, concentrating trout production to upstream areas in the basin.

The 2020 surveys documented the continued existence of trout populations in the upper Green Valley basin, especially in White Horse Creek. Two potentially concerning issues suggested from the 2020 survey include the lack of *O. mykiss* captures at the Green Valley Country Club site and the higher numbers of trout at the Wild Horse Creek site exhibiting lower condition factors than past surveys. Both these areas provide the best over summer rearing habitat in the basin based on the combination of suitable water temperature, instream and overhead cover, stream habitat diversity, gradient, and lack of streamside and development and represents the most reliable indication on the status of trout in the Green Valley Creek. Future surveys may help determine if these unusual observations are indicative of long-term problems or are temporary concerns that disappear or correct over time.

Another potential issue identified during the 2020 surveys was the large beaver dam located in lower Green Valley Creek and its potential impacts on anadromous *O. mykiss* in the basin. This impediment to migratory fish should be evaluated by CDFW biologists to determine if, and how, it needs remediation actions.

Despite the apparent changes in local fish fauna over the past seventeen years, the October 2020 fish monitoring indicate that native California species continue to dominate the aquatic habitat in the Suisun, Green Valley, and Ledge wood basins. Roach, sculpin, pikeminnow, and sucker remain abundant and widely distributed in both the Suisun and Green Valley basins. Populations of *O. mykiss* are present in Wild Horse Creek and in Green Valley Creek as far downstream as Mason Road. The October 2020 capture of a rainbow trout/steelhead in lower Suisun Creek is the second instance of *O. mykiss* in Suisun Creek basin during the past two years of sampling and suggest habitat conditions in the basin still remain capable of supporting trout production.

The dominance of roach in the 2016-2020 Ledge wood Creek fish surveys is likely a result of the intermittent flow patterns noted in this basin. Moyle (2002) noted that California roach tend to be the dominant fish species in warm, intermittent streams. It is not clear why hitch, which were the dominant fish in the 2000-2001 Ledge wood surveys, are now scarce, since this



species can tolerate elevated water temperatures and salinities (Moyle 2002). Perhaps hitch have been unable to adapt to the intermittent flow conditions that now are present in the basin.

Early estimates for designating WY 2021 as a critical water year may modify fish species distribution and abundance in western Solano County streams later this fall. Repetition of surveys in 2021 and beyond may provide additional information on the resilience of native fish species and their ability to respond to temporal changes in basin hydrology.

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