The Summer Townet Survey
2021 Season Report

California Department of Fish and Wildlife

Bay Delta Region

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Contents

Introduction

Summer Townet Survey (STN) is a long-term monitoring effort that samples for young pelagic fishes in the upper San Francisco Estuary (SFE), from San Pablo Bay upstream through the Sacramento-San Joaquin Delta (referred to as the Bay-Delta). This survey has been conducted consistently since 1959 and is one of the longest running estuarine fish sampling efforts in the United States. The study targets small fish (12-55 mm FL) during June – August using a small trawl net to determine the relative abundance and distribution of local fish populations to understand the annual recruitment success of fish populations that spawn in the spring and rear during the summertime. The area sampled, Suisun Bay and Delta, is an important nursery for many species of young fish. Originally designed to determine the annual spawning success of juvenile Striped Bass (*Morone saxatilis*), the study has evolved to inform on the state and federally listed endangered Delta Smelt (*Hypomesus transpacificus*) and other members of the pelagic community, including invertebrates and zooplankton. Environmental data is collected during sampling to understand relationships of fish catch with water temperature, turbidity, salinity, and other measures of habitat conditions (e.g., harmful algal blooms). This study has been of immense value to resource management in the SFE, having informed response of fish abundance and distribution relative to freshwater Delta outflow, fish use of the low salinity zone (LSZ), decline of native fish and need for protection by State and Federal ESA listing, understanding recruitment of fish relative to loss by entrainment at water projects in the south Delta, and most recently management actions taken to improve conditions for Delta Smelt and their habitat. Summer Townet currently provides fish, zooplankton, and water quality information used to understand summer-fall flow actions (STN Bibliography), modified operation of Suisun Marsh Salinity Control Gates, North Delta Food Web Managed Flow Actions, and tidal wetland restoration identified in the Delta Smelt Resiliency Strategy, federal biological opinion and CDFW issued incidental take permit (ITP).

Since 1959, STN has sampled 32 fixed locations from eastern San Pablo Bay to Rio Vista on the Sacramento River, and to Stockton on the San Joaquin River and a single station in the lower Napa River. Most stations are set in the channels of rivers, with additional locations in the shallow waters of Suisun, Grizzly, and Honker bays, to capture the movement of young fish as their distribution expanded throughout the season. These original 'index' stations are used as to calculate relative abundance indices for Delta Smelt and Striped Bass. Presently, 40 stations (32 index and 8 non-index stations) are sampled every other week mid-June through early-August using a conical, fixed-frame net, which is pulled obliquely through the water column 2 to 3 times at each station. The repeated tows at each station are to provide a greater water volume sample relative to the larger water volumes that occur in various river sections and bays and improve detection of fish. At each station environmental variables are measured including water temperature (°C), water clarity (Secchi disk depth in cm & turbidity in NTU), and specific conductivity (µS/cm) to help explain trends in catch and annual recruitment. Presence of the blue-green algae *Microcystis* spp. is observed at the water surface at each station and a rank (1-5) assigned based on density.

2021 Overview

The CDFW STN began the 2021 season with survey 1 on June 7th and completed the 6th and final survey on August 19th. Similar to the previous year, the 2021 sampling season was conducted using health related safety restrictions related to the ongoing Covid-19 pandemic. In both 2020 and 2021, the STN survey was not able to sample at station 721 due to aquatic vegetation (Figure 1). Therefore, an alternative station was sampled, 722, located 2 km down river of station 721 (Figure 2), a station also sampled by the Spring Kodiak Trawl (SKT station 716). Relative abundance indices for Delta Smelt and age-0 Striped Bass were calculated and reported in separate memos, and can be accessed on the STN bibliography. The following seasonal report is meant as a supplement to the reported abundance indices, providing a summary of environmental trends, the abundance and spatial patterns for fish and invertebrate catch between June and August.

Figure 1.Vegetation at station 721 impeding our efforts to collect a bottom water sample using a Van Dorn. Due to the thick vegetation, we were unable to tow the net at station 721 during the entire 2021 season.

The 1959-2021 STN dataset was released to the public via the CDFW FTP website as an Access file, Excel file, and two CSV files on November 10th.

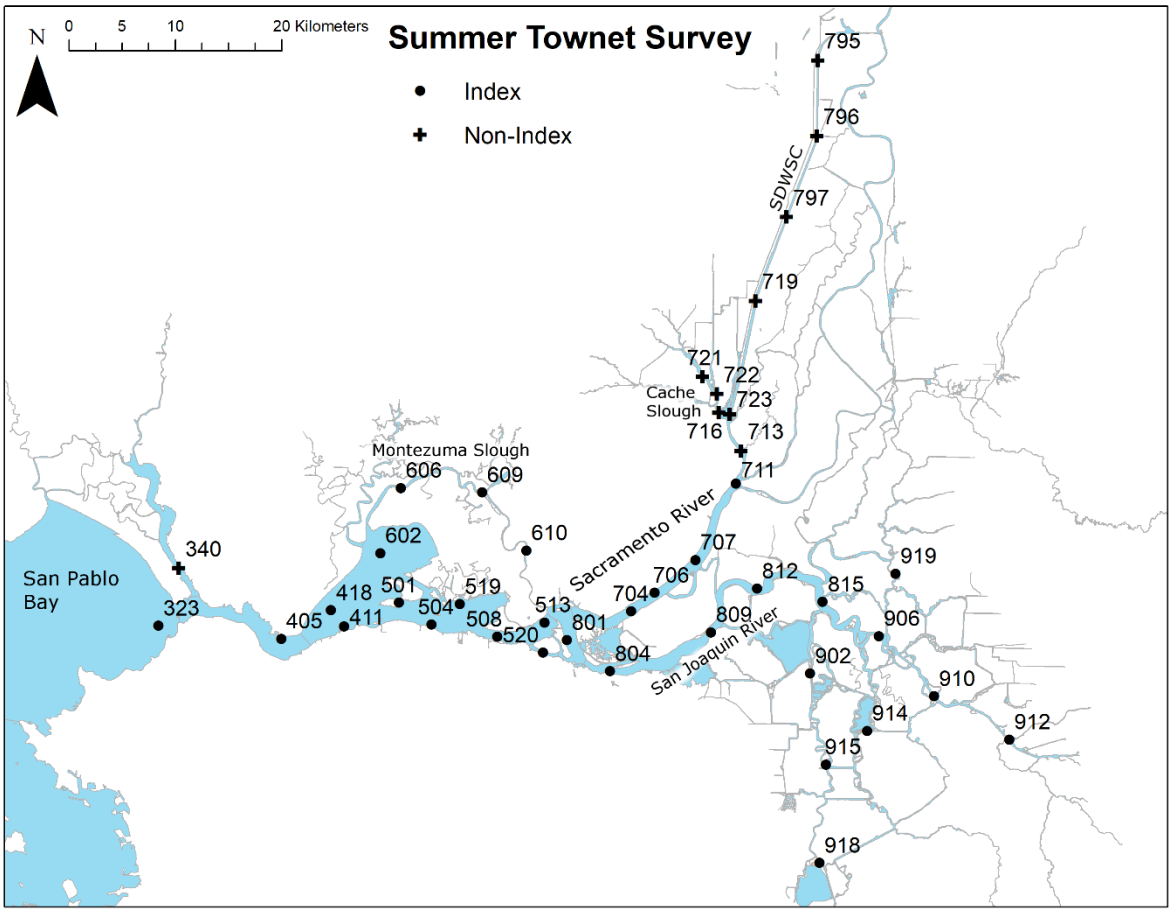

Figure 2. The Summer Townet Survey station map showing 31 index stations (circles) and 10 non-index stations (crosses). Note that station 721 was not sampled in 2021 and an alternative station, 722, downstream of 721, was selected to supplement sampling in Cache Slough.

Methods and Gear

At each STN station, the net is towed for 10 minutes obliquely through the water. Each index station receives 2 tows and a third tow if at least 1 fish was collected in one of the first 2 tows. In the North Delta non-index stations, a maximum of 2 tows is conducted to minimize the risk of Delta Smelt catch. The townet is an 5.60 m (18’ 6”) long cone (See Figure 3) with a 1.47 m (58”) diameter opening at the mouth and a 0.30 m (12”) diameter opening at the end of the cod end (narrow end). It consists of four major components: 1) the collar, 2) the main body (½” stretched knotted mesh), 3) the fyke (½” knotless mesh) and 4) the cod-end (bobbinet with 8 holes per inch). A flowmeter (General Oceanics, model # 2030, Figure 5 bottom.) is suspended in the center of the net mouth during the tow.

Following each tow, the net is emptied, and all fish and macro-invertebrates (caridean shrimp, crabs, and jellyfish spp.) are identified to species and enumerated. The first 50

Figure 3. The townet in the field ready for deployment. Note flowmeter in center of net mouth with CB net attached on top of the D-ring frame.

representatives of each fish species have fork lengths recorded in millimeter. Any fish that cannot be identified in the field, such as larval fish less than 25 mm FL, are preserved in ethanol or 10% buffered formalin to be identified later within a CDFW laboratory.

A clark-bumpus (CB) net is mounted at the top of the townet to collect meso-zooplankton, targeting zooplankton 0.5-3.0 mm long, including cladocerans, copepodids, and adult copepods. At each STN station, the CB sample is collected generally on the first concurrent fish net tow. Flowmeter counts for the CB net are recorded at the start and end of each tow to calculate volume sampled. The CB sample is preserved using a concentrated, buffered formalin with rose-Bengal dye which is then diluted to a 10% buffered formalin solution.

Abiotic variables and a *Microcystis* spp. ranking metric are measured prior to sampling at each STN station (Appendix 1).

Analysis and graphics were constructed using the program R. Boxplots accompanying the heat maps for all abiotic variables show the median as the horizontal line, the box outlines the 1st and 3rd quartile, and the vertical line and points show the range and outliers at each station. Fish and invertebrate catch is reported as catch-per-unit-effort (CPUE; catch/10,000 meters^3 water sampled). Regional CPUE and standard deviation, was calculated based on regions defined by the Summer Townet Survey index. Non-index stations in the North Delta were added to this analysis as a new 'North Delta' region.

Sampling Effort in 2021

Routine Sampling

In 2021, STN successfully visited and sampled each index station in all 6 surveys. Apart from station 721, all non-index stations were also successfully sampled including the 721-station replacement in Cache slough, station 722. Most surveys were completed within 4 days using 1 or 2 research vessels (Survey 1, June 7-10; Survey 2, June 21-23,25; Survey 3, July 6-9; Survey 4, July 19-23; Survey 5, Aug 2-5; Survey 6, Aug 16-19). The summary of tows for each station are presented in Table 1.

Table 1. Number of fish (and zooplankton) tows per station by survey and total tows over the 2021 STN season.

Station Code	Survey 1	Survey 2	Survey 3	Survey 4	Survey 5	Survey 6	Total Tows
323	3 (1)	3 (1)	3 (1)	3 (1)	3 (1)	3 (1)	18 (6)
340	2 (1)	2 (1)	2 (1)	3 (1)	3 (1)	3 (1)	15 (6)
405	2 (1)	3 (1)	3 (1)	3 (1)	3 (1)	3 (1)	17 (6)
411	2 (1)	2 (1)	3 (1)	2 (1)	3 (1)	3 (1)	15 (6)
418	3 (1)	3 (1)	3 (1)	3 (1)	3 (1)	2 (1)	17 (6)
501	2 (1)	3 (1)	3 (1)	2 (1)	2 (1)	3 (1)	15 (6)
504	3 (1)	3 (1)	3 (1)	3 (1)	3 (1)	3 (1)	18 (6)
508	3 (1)	3 (1)	3 (1)	3 (1)	2 (1)	3 (1)	17 (6)
513	3 (1)	3 (1)	3 (1)	3 (1)	3 (1)	2 (1)	17 (6)
519	2 (1)	2 (1)	3 (1)	2 (1)	3 (1)	3 (1)	15 (6)
520	2 (1)	3 (1)	3 (1)	3 (1)	2 (1)	2 (1)	15 (6)
602	3 (1)	3 (1)	3 (1)	3 (1)	3 (1)	3 (1)	18 (6)
606	3 (1)	3 (1)	3 (1)	3 (1)	3 (1)	3 (1)	18 (6)
609	3 (1)	3 (1)	3 (1)	3 (1)	3 (1)	3 (1)	18 (6)
610	3 (1)	3 (1)	3 (1)	3 (1)	3 (1)	3 (1)	18 (6)
704	3 (1)	3 (1)	3 (1)	3 (1)	3 (1)	3 (1)	18 (6)
706	3 (1)	3 (1)	3 (1)	3 (1)	3 (1)	3 (1)	18 (6)
707	3 (1)	3 (1)	3 (1)	3 (1)	3 (1)	3 (1)	18 (6)
711	2 (1)	2 (1)	2 (1)	3 (1)	2 (1)	2 (1)	13 (6)
713	2 (1)	2 (1)	2 (1)	2 (1)	2 (1)	2 (1)	12 (6)
716	2 (1)	2 (1)	2 (1)	2 (1)	2 (1)	2 (1)	12 (6)
719	3 (1)	2 (1)	2 (1)	2 (1)	2 (1)	2 (1)	13 (6)
722	2 (1)	2 (1)	2 (1)	2 (1)	2 (1)	2 (1)	12 (6)
723	2 (1)	2 (1)	2 (1)	2 (1)	2 (1)	2 (1)	12 (6)
795	3 (1)	2 (1)	2 (1)	2 (1)	2 (1)	2 (1)	13 (6)
796	3 (1)	2 (1)	2 (1)	2 (1)	2 (1)	2 (1)	13 (6)
797	3 (1)	2 (1)	2 (1)	2 (1)	2 (1)	2 (1)	13 (6)
801	3 (1)	3 (1)	3 (1)	3 (1)	3 (1)	2 (1)	17 (6)

804	3 (1)	3 (1)	2 (1)	2 (1)	2 (1)	2 (1)	14 (6)
809	3 (1)	3 (1)	3 (1)	3 (1)	3 (1)	3 (1)	18 (6)
812	3 (1)	3 (1)	2 (1)	3 (1)	3 (1)	2 (1)	16 (6)
815	3 (1)	3 (1)	2 (1)	2 (1)	2 (1)	3 (1)	15 (6)
902	3 (1)	3 (1)	3 (1)	3 (1)	3 (1)	3 (1)	18 (6)
906	3 (1)	3 (1)	3 (1)	3 (1)	2 (1)	3 (1)	17 (6)
910	3 (1)	3 (1)	2 (1)	2 (1)	2 (1)	3 (1)	15 (6)
912	2 (1)	3 (1)	3 (1)	2 (1)	2 (1)	3 (1)	15 (6)
914	2 (1)	3 (1)	3 (1)	2 (1)	2 (1)	3 (1)	15 (6)
915	3 (1)	3 (1)	3 (1)	3 (1)	2 (1)	2 (1)	16 (6)
918	3 (1)	3 (1)	3 (1)	3 (1)	2 (1)	3 (1)	17 (6)
919	3 (1)	2 (1)	2 (1)	2 (1)	2 (1)	2 (1)	13 (6)
All Stations	107 (40)	107 (40)	105 (40)	103 (40)	99 (40)	103 (40)	624 (240)

Non-routine Sampling

In addition to the routine monitoring, STN conducted additional sampling (below), starting in survey 3 of 2021 (Table 2), for the Suisun Marsh Salinity Control Gate (SMSCG) special study (Interagency Ecological Program, 2022). STN conducted additional zooplankton tows using a Mysid sled, as well as collected phytoplankton surface samples from the stations listed below.

Table 2. Additional sampling conducted for the Suisun Marsh Salinity Control Gate (SMSCG) study. A 0 indicates no sample collected and a 1 indicates that a sample was collected.

Survey	Station	SMSCG Phytoplankton (0,1)	SMSCG Zooplankton (0, 1)
3	602	1	0
3	606	1	0
3	609	1	0
3	610	1	0
3	704	1	0
3	706	1	0
3	801	1	0
3	EMP NZS42[1]	0	1
3	FMWT 605[1]	1	1
3	Mont[1]	1	1
4	602	1	0
4	606	1	0
4	609	1	0
4	610	1	0

4	704	1	0
4	706	1	0
4	801	1	0
4	F605[1]	1	1
4	Mont[1]	1	1
5	602	1	0
5	606	1	0
5	609	1	0
5	610	1	0
5	704	1	0
5	706	1	0
5	801	1	0
5	EMP NZS42[1]	1	1
5	FMW T605[1]	1	1
5	Mont	1	1
6	602	1	0
6	606	1	0
6	609	1	0
6	610	1	0
6	704	1	0
6	706	1	0
6	801	1	0
6	EMP NZS42[1]	0	1
6	FMWT 605[1]	1	1
6	Mont[1]	1	1

[1]-Indicates a station that is not a part of the regular STN sampling schedule.

Environmental Variables

The STN collects metrics for biotic and abiotic variables at each station. Summaries for temperature (C), salinity (ppt), water clarity (cm), turbidity (NTU), and *Microcystis* spp. (1-5 qualitative rankings) are described below with corresponding figures.

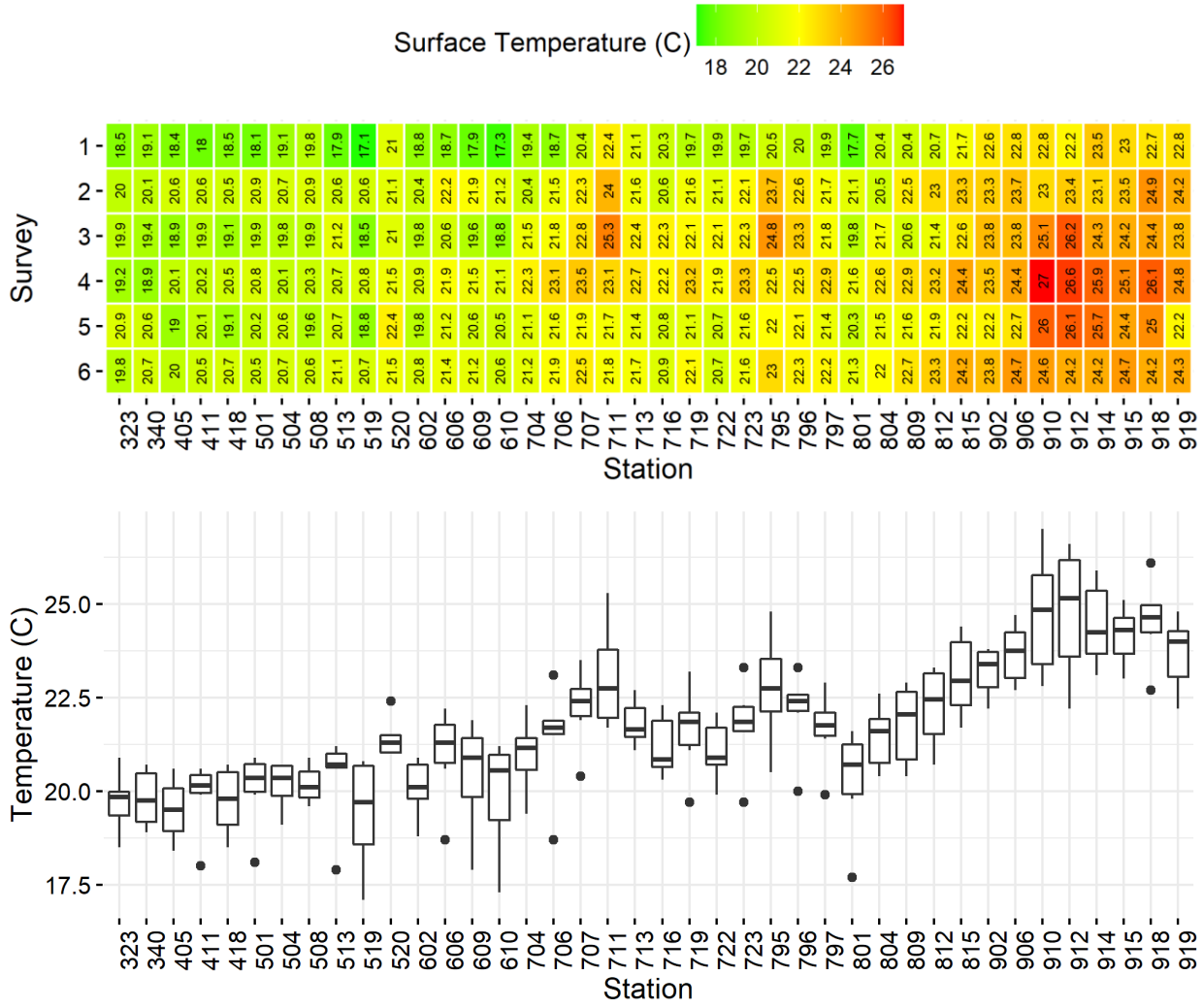

Figure 4. Surface temperature (C) at each STN station (index and non-index) by survey (top) and the distribution of temperature for each station across the season (bottom). Temperatures above 22 C are considered stressful (yellow) to Delta Smelt and have been linked to mortality above 25 C (red). Boxplots (bottom) show the median as a horizontal line, 1st and 3rd quartile by box, range by vertical line and outliers by points.

Temperatures (Figure 4) at the STN stations were generally cooler in June surveys (surveys 1-2) and warmest at the end of July and early August (Surveys 4-5). In addition to temporal changes in temperature, stations furthest from San Pablo Bay were generally warmer than stations closer to the cooler ocean temperatures. The warmest stations were 910 and 912, the eastern edge of the STN sampling range. Temperatures were at levels considered stressful to Delta Smelt in areas considered important for rearing, such as the lower Sacramento River

and Sacramento Deep Water Ship Channel (SDWSC). However, recorded temperatures across the season could be influenced by other factors such as the time of day, tide and weather during the sampling event and were not considered in this comparison among stations.

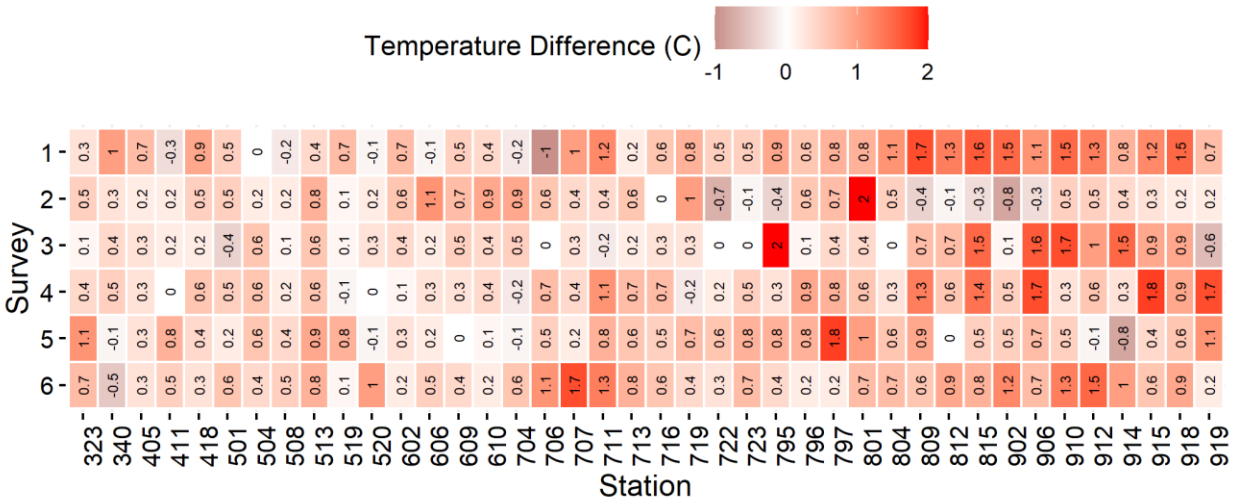

Figure 5. Temperature differences (C) between the surface and bottom at each STN station (index and non-index) by survey. Negative (brown) values are warmer bottom temperatures compared to the surface, red colors indicating greater temperatures at the surface and clear tiles indicate little to no difference in temperature.

Temperatures were usually warmer at surface waters compared to bottom water samples (Figure 5). The most extreme differences were observed in the SDWSC (795-797), but many stations in the lower San Joaquin River, East and South Delta indicated some differences in temperature between surface and bottom water. These temperatures do not necessarily indicate stratification at a station since these differences may not be consistent or prolonged across tides.

Salinity (Figure 6) in the Delta increased with proximity to San Pablo Bay. Salinity was more variable between Suisun Bay to the convergence of the San Joaquin and Sacramento rivers, reflecting tidal influences in this region. Most stations did not have extreme differences in salinity between the surface and bottom zones of the water column (Figure 7). However. in survey 1 and particularly in survey 2, there were distinct differences in salinity within the water column in Montezuma Slough, Suisun Bay, and the Confluence (including San Pablo Bay station 323). These comparisons do not account for tide occurring at the time of sampling.

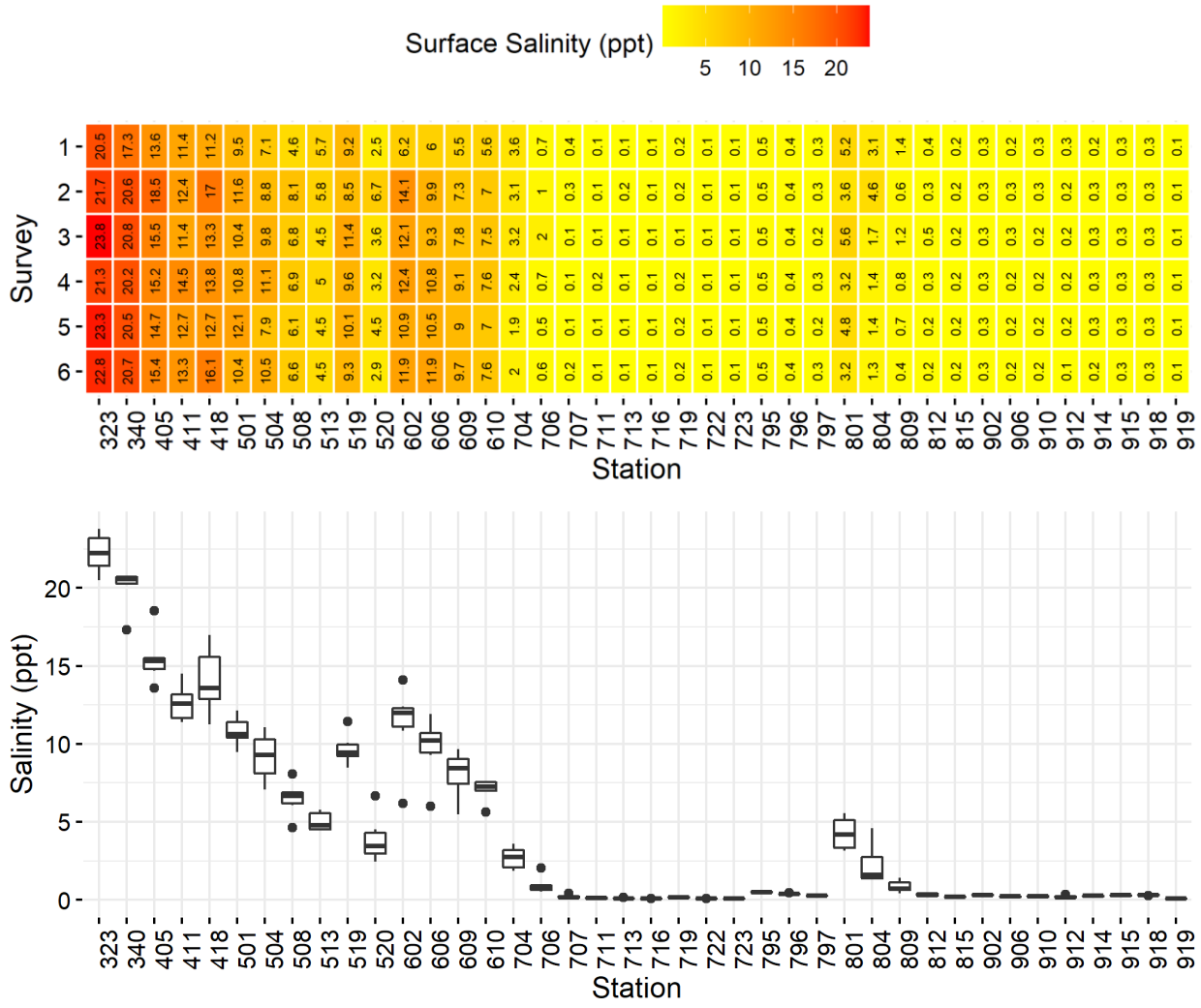

Figure 6. Surface salinity (ppt) at each STN station (index and non-index) by survey (top) and the distribution of salinity for each station across the season (bottom). Salinity (ppt) transformed from conductivity (µS/cm) measured at each STN station (index and non-index) in 2021 by survey (top). Red shading indicates sea water transitioning to yellow shading as salinity decreases into freshwater ranges (bottom).

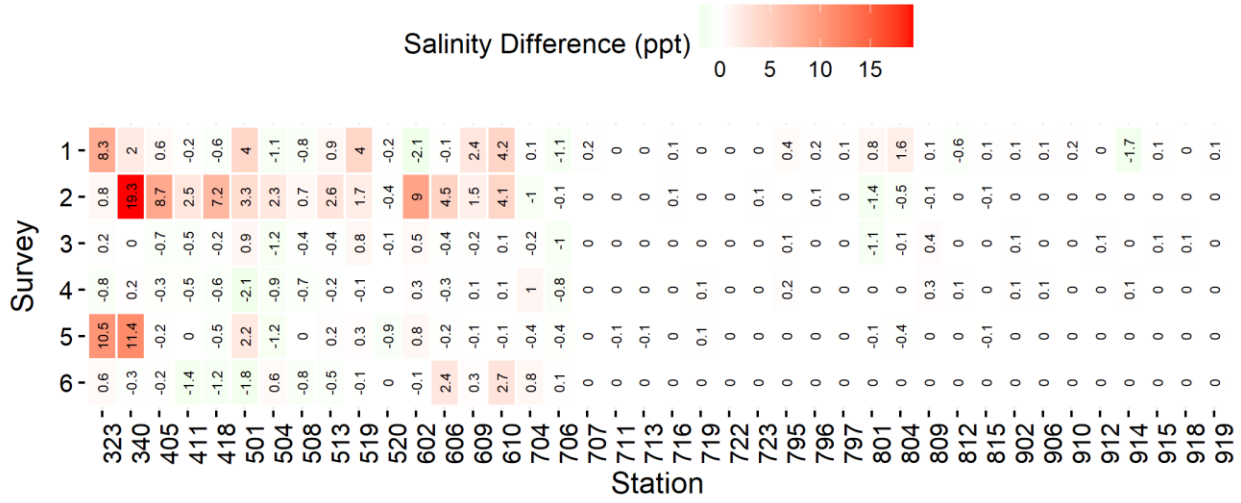

Figure 7. Salinity (ppt) differences within the water column between the surface and bottom. Negative (green) values indicate greater salinity lower in the water column while positive (red) values indicate greater salinity in the surface.

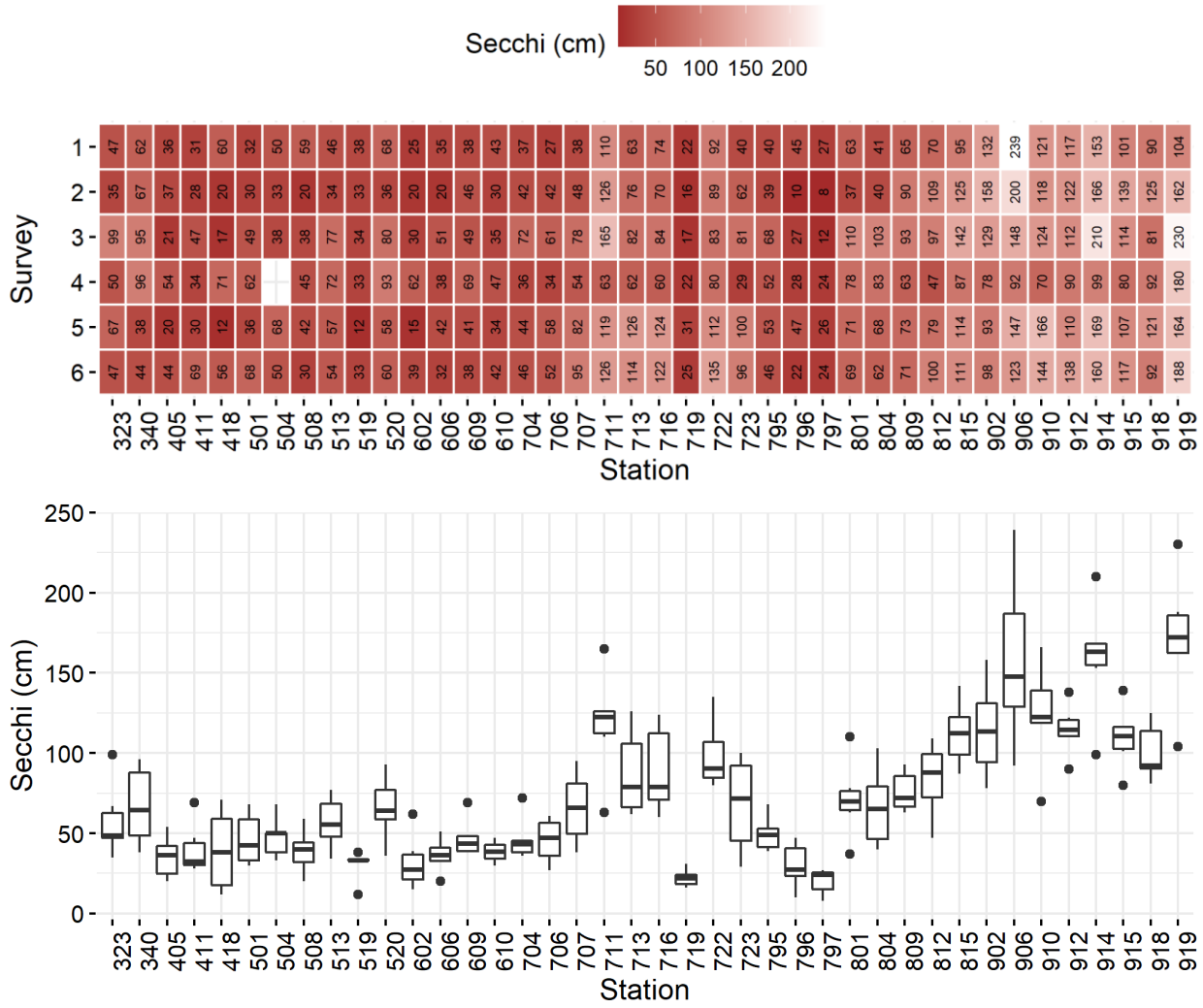

Figure 8. Water clarity, measured in cm by depth of Secchi disk, at each station by survey (top) and the distribution of secchi readings over the whole season (bottom).

Secchi depth (Figure 8) and turbidity (Figure 9) values had little variability at most stations over the 2021 season. However, across the sampling range, STN recorded greater water clarity in the south, and east Delta, as well as in the San Joaquin River stations. Water clarity also appeared to increase while traveling upriver from the Lower Sacramento River into Cache Slough. However, moving into the SDWSC water clarity sharply declines (stations 719, 795-797). This is reflected in surface turbidity as well, however several stations appear to be distinctly more turbid, particularly in the SDWSC such as 719, and 797.

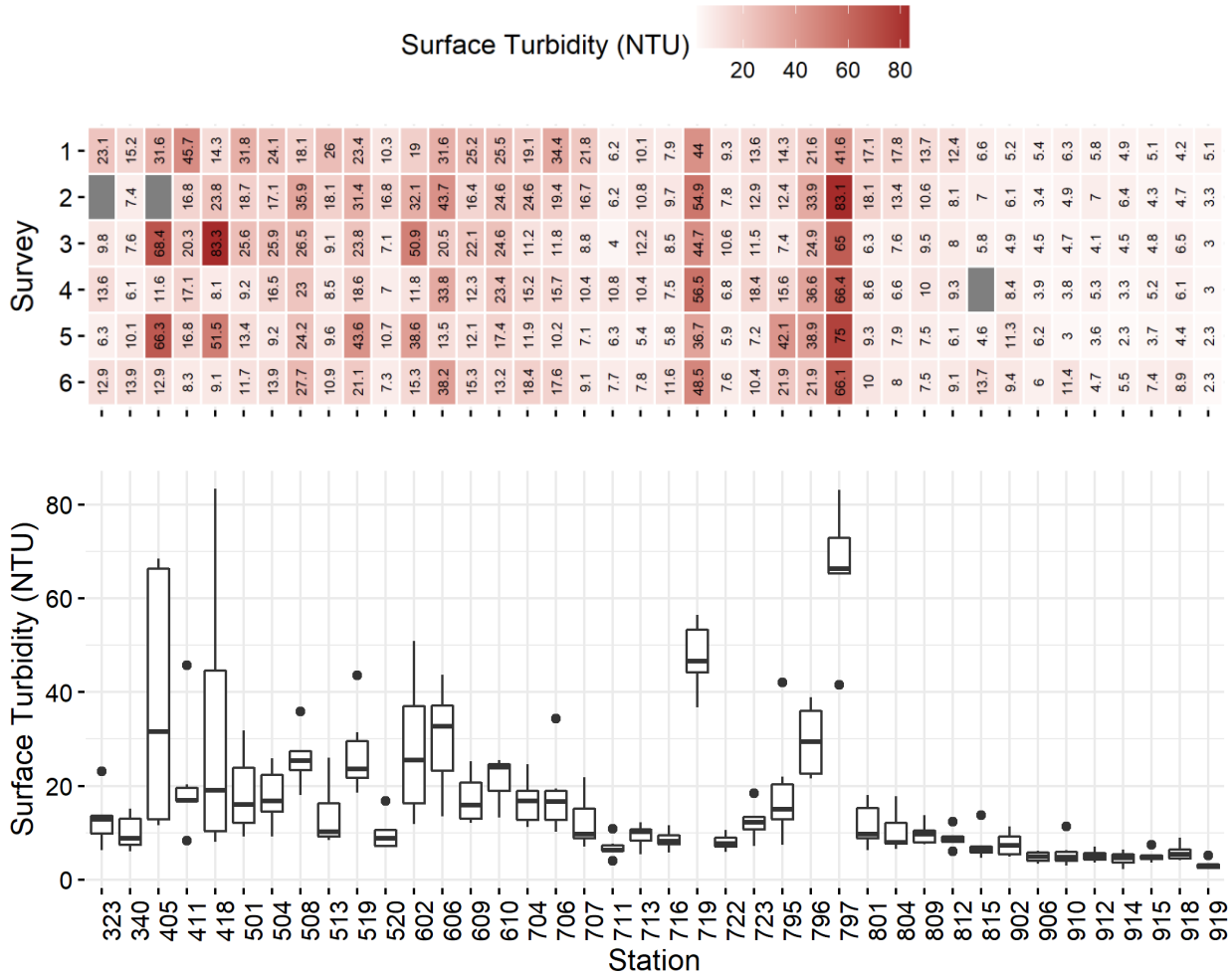

Figure 9. Surface turbidity (NTU) across station and survey (top) and the overall distribution at each survey (bottom). Grey tiles within the top plot represent missing turbidity readings.

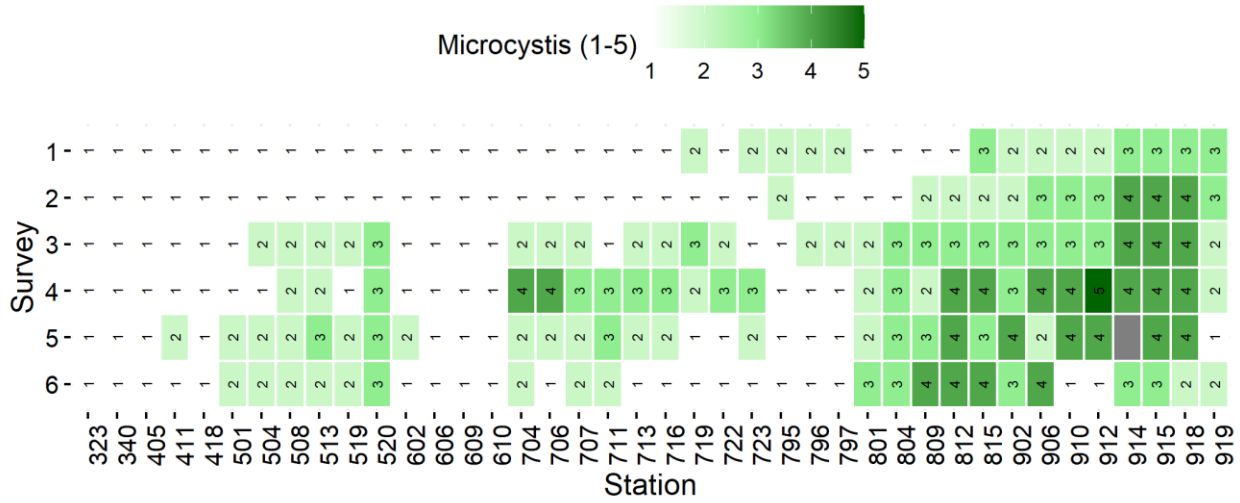

Figure 10. Ranking of Microcystis spp. presence at each station, over each survey. Range includes 1 as absence of Microcystis spp. (blue) and 5 is the highest presence of Microcystis spp. that can be reported (dark green).

Microcystis was recorded as early as Survey 1, within the South and East Delta, as well as the SDWSC. *Microcystis* presence increased over time, appearing to peak in July over most of the STN sampling range. The highest reported presence, rank 5, occurred in Survey 4 at Station 912 (Stockton). By the end of August, ranking of *Microcystis* presence appeared to decrease.

Catch Per Unit Effort

Fish

Overall fish catch decreased in 2021, compared to 2020. The most numerous species caught (Table 10) in 2021 were larval *Tridentiger* spp. goby species, Threadfin Shad (*Dorosoma petenense*), and age-0 Striped Bass. *Tridentiger* spp. larvae and Threadfin Shad were consistently caught in all six surveys, while Age-0 Striped Bass declined in catch significantly after surveys one and two. Both *Tridentiger* spp. and Threadfin Shad peaked in survey 4. However, despite the lower catches, the percent CPUE of species catch was similar in 2021 to 2020 values. For example, in 2021 *Tridentiger* spp., Threadfin Shad and age-0 Striped Bass represented 63.8, 11.2, and 4.6% of the total CPUE. While in 2020 they represented (in the same order) 67.0, 14.5, and 4.5% of the total CPUE. Notable increases in CPUE between 2020 and 2021 were increased Longfin Smelt (*Spirinchus thaleichthys*) catch (1.9% CPUE in 2021) and Yellowfin Goby (*Acanthogobius flavimanus)* (1.1% in 2021).

Table 3. Summer Townet Survey fish catch-per-unit-effort (CPUE; catch/10,000 meters^3 water sampled) in 2021 for each survey (total survey catch/total survey volume), the total CPUE (total seasonal catch/total seasonal volume water sampled) and the percent of seasonal CPUE represented by each taxonomic category

Common Name	Survey 1	Survey 2	Survey 3	Survey 4	Survey 5	Survey 6	Total CPUE	Percent CPUE
Tridentiger spp.	93.4	167.33	213.3	222.84	55.81	93.67	141.38	63.82
Threadfin Shad	28.26	7.65	12.43	52.58	35.78	13.83	24.88	11.23
Age-0 Striped Bass	42.3	10.07	2.22	1.38	0.66	0.11	10.18	4.60
Shimofuri Goby	0	0.1	8.29	23.47	7.99	5.73	7.37	3.33
Unknown Damaged Fish (UNID)[1]	8.89	11.48	7.88	8.82	2.08	1.19	6.86	3.10
Shokihaze Goby	0	0	0.91	20.39	11.93	7.78	6.55	2.96
American Shad	16.57	18.02	2.02	0	0.11	0.11	6.48	2.93
Northern Anchovy	1.97	1.31	4.65	9.03	7.66	6.59	5.08	2.29
Longfin Smelt	22.93	0.4	0.2	0	0	0	4.3	1.94
Yellowfin Goby	5.15	1.31	4.14	1.27	2.74	0.11	2.52	1.14
White Catfish	0.19	1.31	2.43	2.55	0	1.19	1.27	0.57
Plainfin Midshipman	0	0	0	0	5.47	2.05	1.18	0.53
Tridentiger/Striped Bass Larvae (UNID)[1]	5.52	0	0	0.11	0	0.43	1.1	0.50
Mississippi Silverside	1.31	0.91	0.3	0.32	2.3	0.43	0.93	0.42
Wakasagi	0.28	0.1	0.2	1.17	0.44	0.54	0.45	0.20
Herring (UNID)[1]	0.09	0	0.61	0	0.22	0	0.15	0.07
Rainwater Killifish	0	0.2	0.2	0	0.11	0.43	0.15	0.07
Splittail	0.75	0	0	0	0	0	0.14	0.06
Pacific Herring	0.37	0.2	0	0	0	0	0.1	0.05
Topsmelt	0	0.1	0	0.21	0.22	0	0.09	0.04
Bay Goby	0.37	0	0	0	0	0	0.07	0.03
Three Spine Stickleback	0.19	0	0.1	0	0	0	0.05	0.02
Unknown Fish (UNID)[1]	0	0	0.2	0.11	0	0	0.05	0.02
Cheekspot Goby	0	0	0	0	0	0.11	0.02	0.01
Gobies (UNID)[1]	0	0	0.1	0	0	0	0.02	0.01
Jacksmelt	0	0	0.1	0	0	0	0.02	0.01

Largemouth Bass	0	0.1	0	0	0	0	0.02	0.01
Lepomis (UNID)[1]	0	0	0	0.11	0	0	0.02	0.01
Pacific Lamprey	0	0	0	0.11	0	0	0.02	0.01
Prickly Sculpin	0.09	0	0	0	0	0	0.02	0.01
Staghorn Sculpin	0.09	0	0	0	0	0	0.02	0.01
Starry Flounder	0	0	0	0.11	0	0	0.02	0.01
Tule Perch	0	0	0	0.11	0	0	0.02	0.01

[1]-Unknown (UNID) is a category to describe when samples were lost, damaged or too underdeveloped to identify to species.

Invertebrates

The top three invertebrates caught by STN (Table 4) in 2021 were jellyfish *Maeotias marginata*, and shrimp *Exopalaemon modestus* (Siberian Prawn) and *Crangon spp*. The jellyfish *Maeotias* represented over half (51%) of the invertebrate catch recorded, followed by the invasive *E. modestus* shrimp (33%) then the native *Crangon* spp. (15%). This was a shift from 2020, when both *Maeotias* spp. and *E*. *modestus* had slightly higher total CPUE, but *Exopalaemon* represented 57% of the invertebrate catch. In addition, *Crangon* shrimp catch in the STN increased between 2020 to 2021 from 32.6 CPUE to 70.1 CPUE.

Table 4. Invertebrate catch-per-unit-effort (CPUE; catch/10,000 meters^3 water sampled) for each survey (total survey catch/total survey volume), the total CPUE (total seasonal catch/total seasonal volume water sampled) and the percent of seasonal CPUE represented by each taxonomic category.

Common Name	Survey 1	Survey 2	Survey 3	Survey 4	Survey 5	Survey 6	Total CPUE	Percent CPUE
Maeotias spp.	0	4.73	146.51	431.77	230.58	693.48	241.55	51.32
Siberian prawn	62.8	59.9	89.22	263.84	68.29	409.46	155.12	32.96
Crangon spp.	58.02	110.14	51.63	64.37	122.46	15.23	70.14	14.9
Palaemon	0	2.32	5.05	4.67	9.41	1.3	3.69	0.78
Jelly (UNID)	0	0	0	0.64	0	0	0.1	0.02
Unknown Invertebrate (UNID)	0	0.2	0	0	0	0	0.03	0.01

[1]-Unknown (UNID) is a category to describe when samples were lost or specimens were too damaged to identify to species.

Spatial Patterns

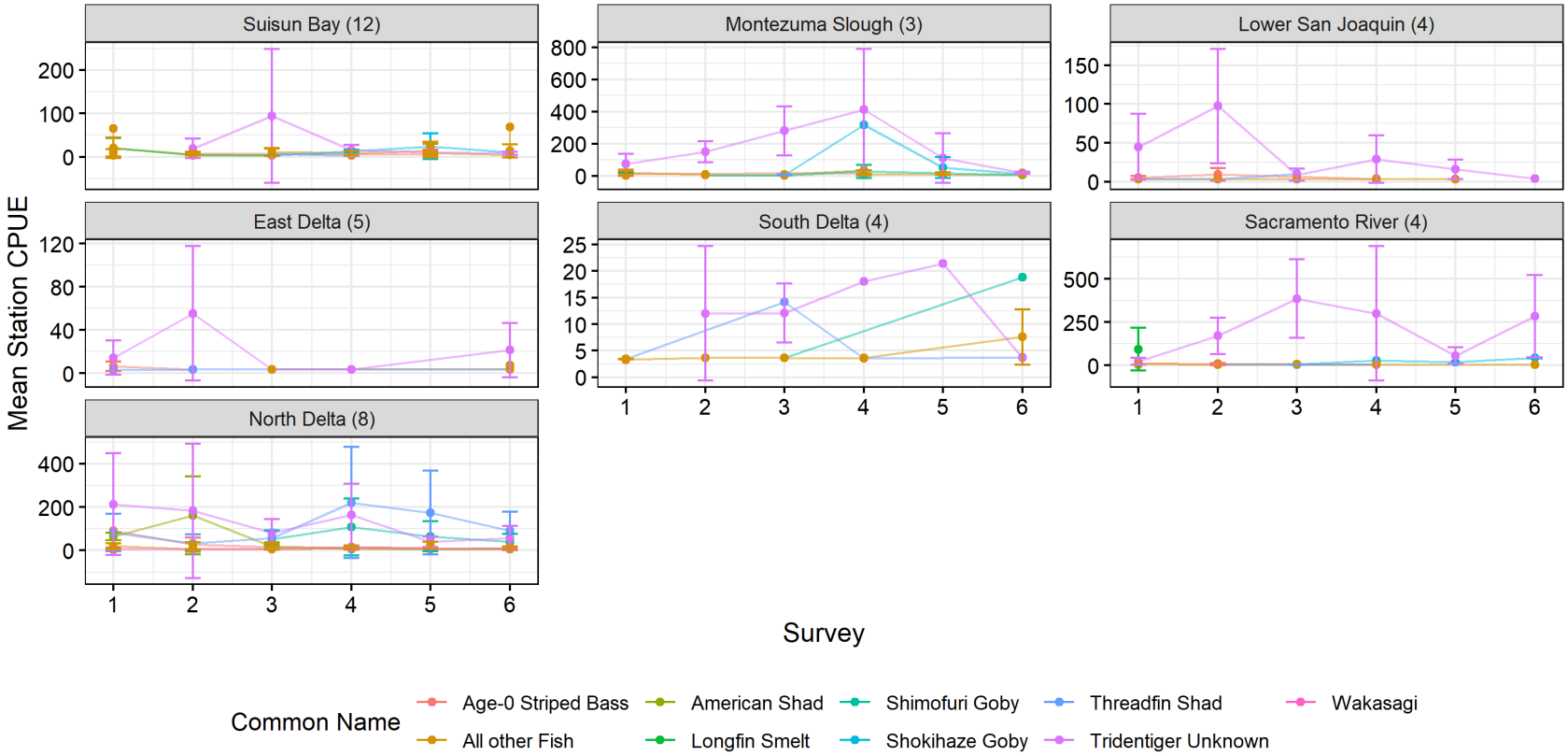

Figure 11. The Summer Townet Survey stations divided into 7 regions (Figure 12). Numbers following the regional name indicate the number of STN stations within each region (top). These regions were used to inform patterns in mean and standard deviation error bars for catch-per-unit-effort among stations of common fish in 2021. All 40 stations sampled during the 2021 season are included. Note that the range of CPUE (y-axis) varies with each region.

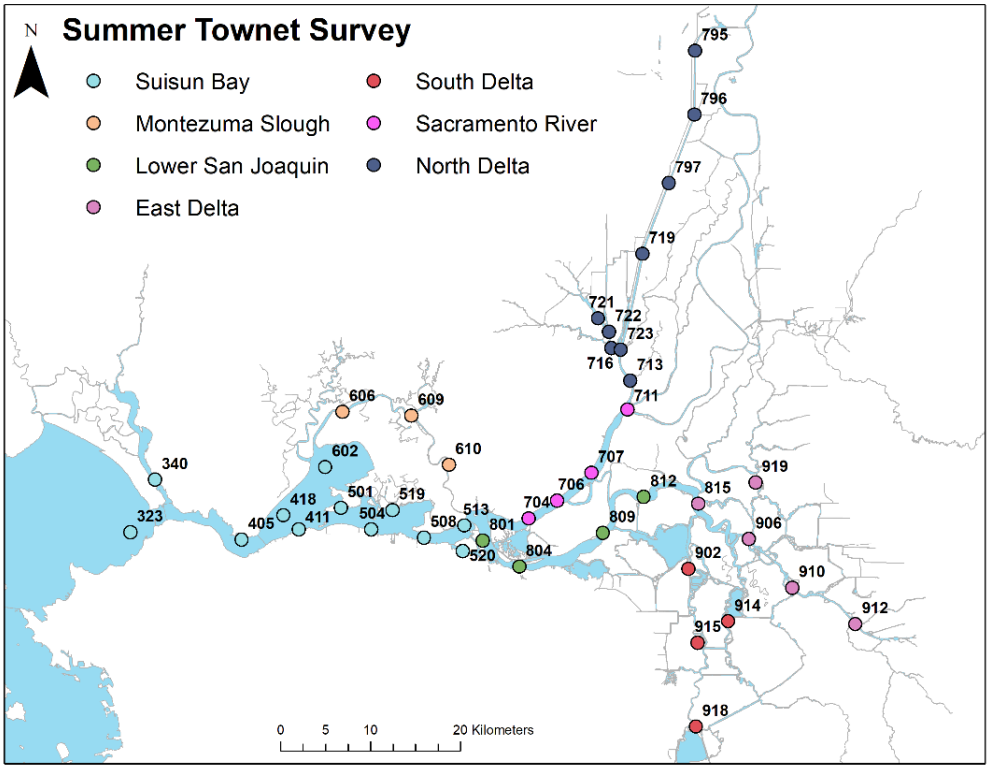

Figure 12. Regional assignments for all 40 of the Summer Townet Stations.

Summer Townet catch varied across the sampling range. The greatest catch was recorded in Montezuma Slough (Figure 11) and the lowest catch was generally observed in the South Delta. Each fish species varied in patterns in each region. *Tridentiger* spp. gobies gradually increased over time in Montezuma Slough, the Sacramento River, and the South Delta. Both Suisun Bay and East Delta had consistent catch except for a single high survey catch. *Tridentiger* spp. catch in the North Delta began with a high catch followed by a gradual decline. Threadfin shad were primarily observed in the North Delta and increased overtime as *Tridentiger* spp. catch declined in the region. Finally, age-0 Striped Bass catch was mainly observed in the North Delta in Survey 1. Most of the Striped Bass catch was observed in non-index stations not included in the Summer Townet age-0 Striped Bass index calculation. However, the inclusion of catch from non-index stations in 'alternative indices' can show different patterns in relative abundance patterns in the Bay-Delta region (White & Baxter, *In Prep*).

Length Frequency for Species of Special Interest in 2021

Fork length frequency histograms for the following fish were extracted from the [STN website](#) (11/17/2021). Most fish collected during summer were species that spawn in winter-spring, thus highest catches occur for young fishes ranging 20-50 mm. Most species caught fall within this range, typically catching young-of-year fish. A subset of these fish is presented below using length frequency histograms.

American Shad

American shad (*Alosa sappidissima*) larvae were detected in Surveys 1-3 (Figure13). Most American Shad caught by STN in survey 1 were larvae or early-juveniles. By survey 2, we saw our largest American Shad length at 55mm FL. By Survey 3 American shad catch had dropped off, likely due to their anadromous migration to cooler waters outside of STN's sampling range.

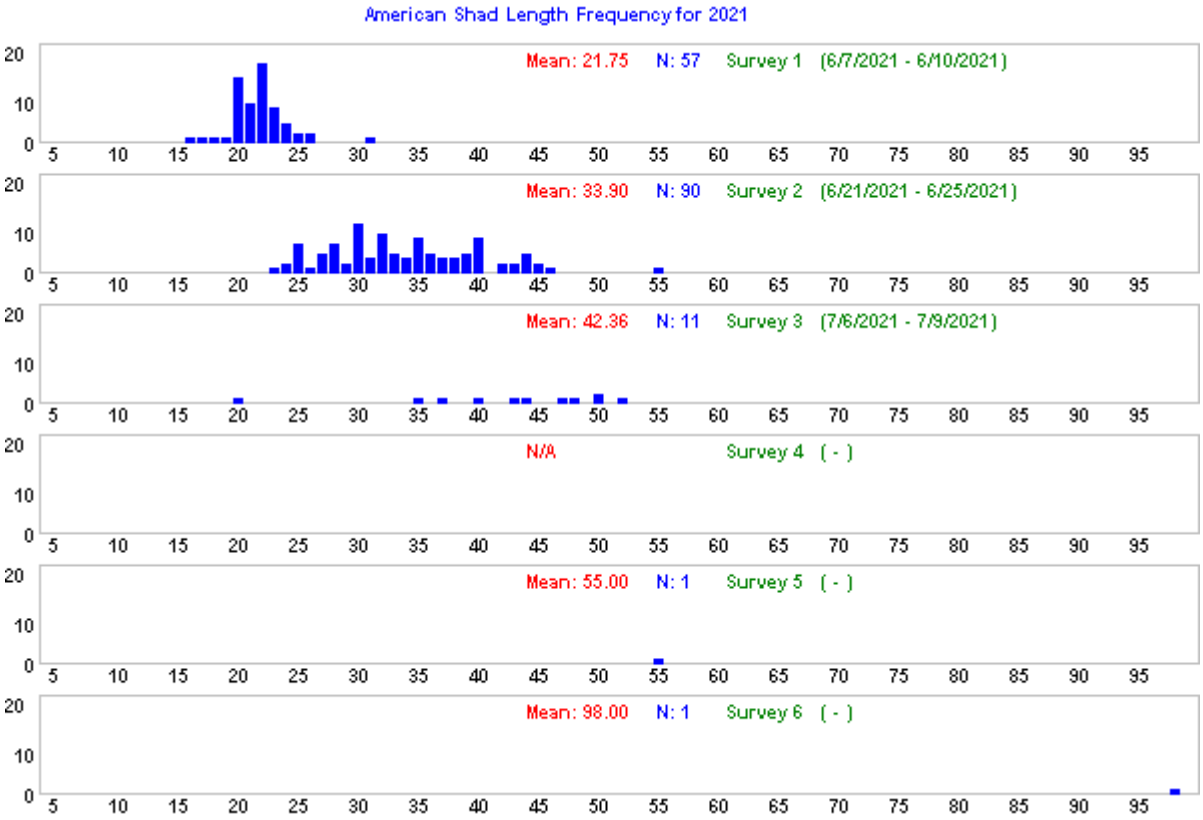

Figure 13. Summer Townet Survey American Shad length frequency histograms for surveys 1-6 in 2021.

Delta Smelt

No Delta Smelt were caught during the 2021 STN survey season. These fish are critically endangered and have not been caught in this survey since 2017.

Longfin Smelt

Longfin smelt were only caught in the first 3 surveys, mainly in survey 1 (Figure 14). All longfin smelt caught were young-of-year ("age-0"). Like American Shad, Longfin Smelt catches decline in the sampling range of STN as water temperatures increase and fish move to cooler waters.

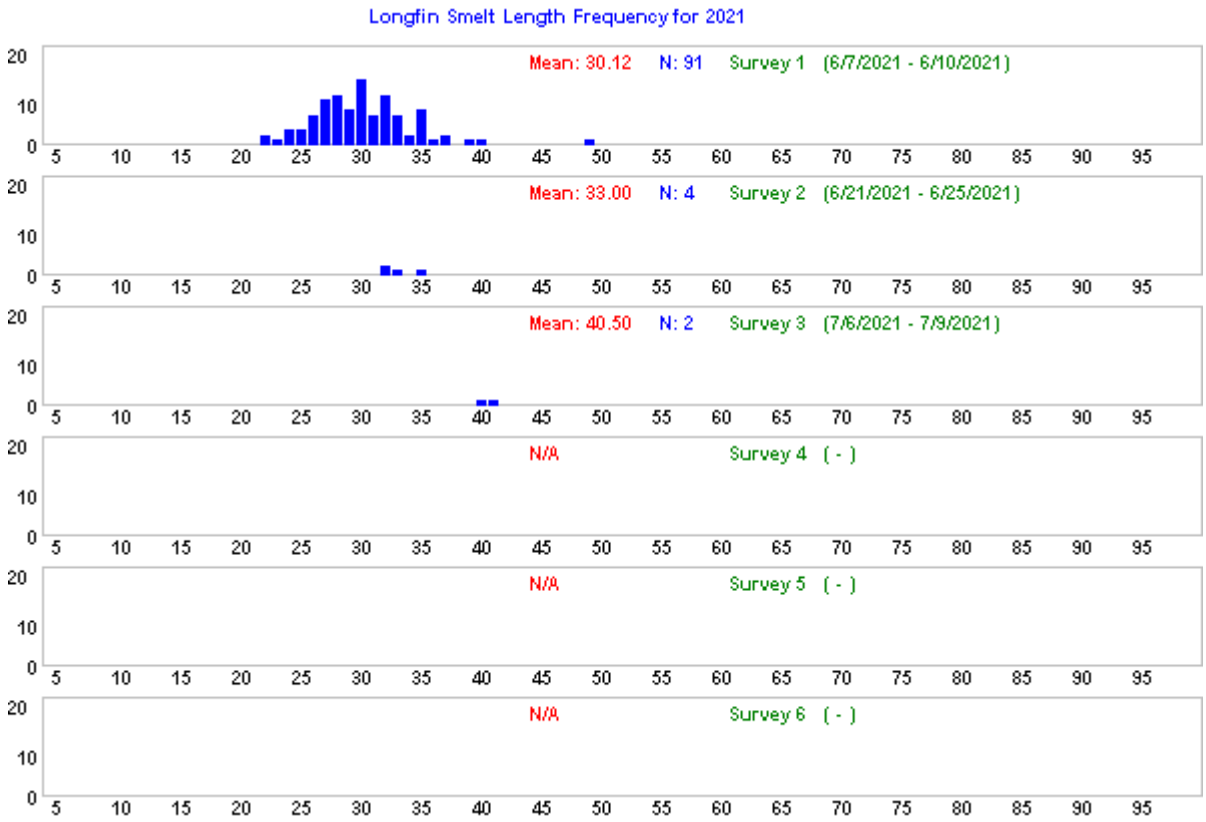

Figure 14. Summer Townet Survey Longfin Smelt length frequency histograms for surveys 1-6 in 2021.

Splittail

Splittail were only recorded in survey 1 and were young-of-year (Figure 15). This catch was higher than 2020, but much lower than both the number and distribution of splittail sizes in 2019.

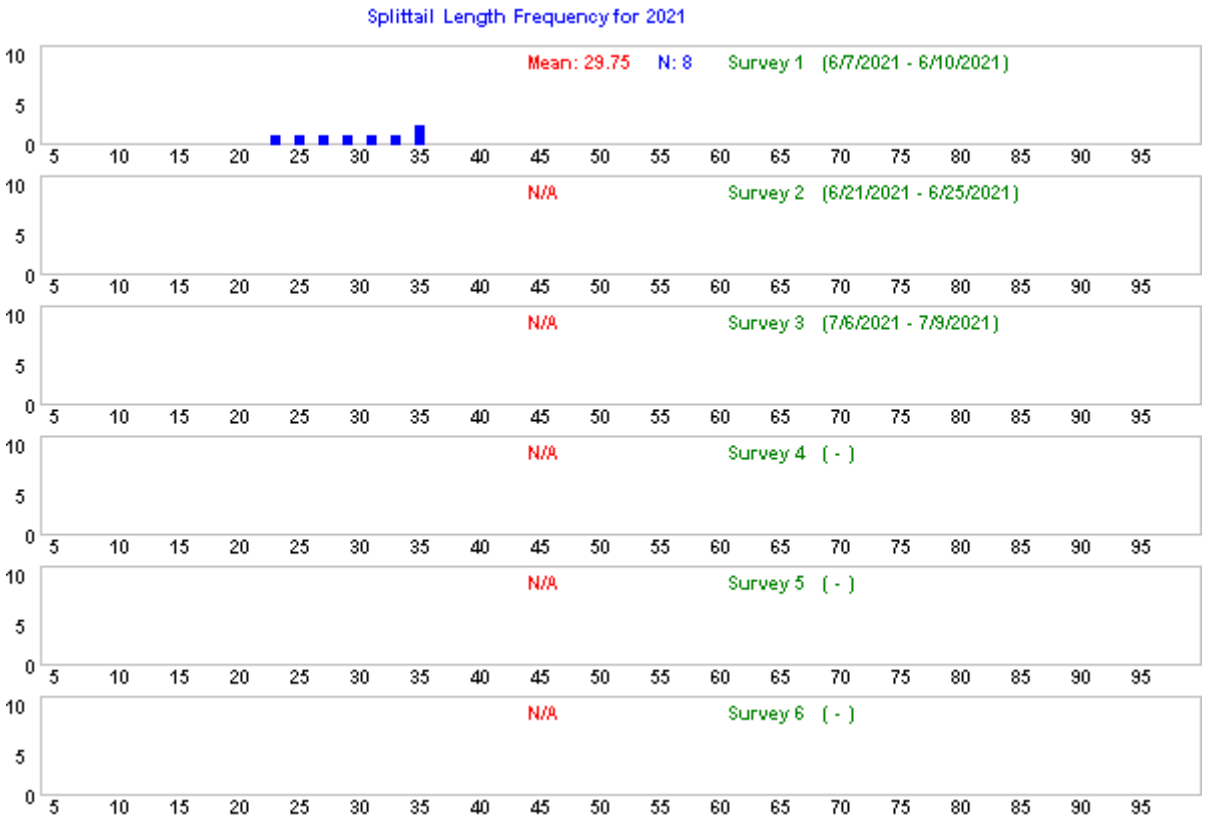

Figure 15. Summer Townet Survey Splittail length frequency histograms for surveys 1-6 in 2021.

Striped Bass

Striped Bass catch was high in survey 1, with multiple cohorts possible (peaks within the length frequency; Figure 16). Fewer Striped Bass were caught in survey 2, however there continues to be some separation in size indicating different cohorts.

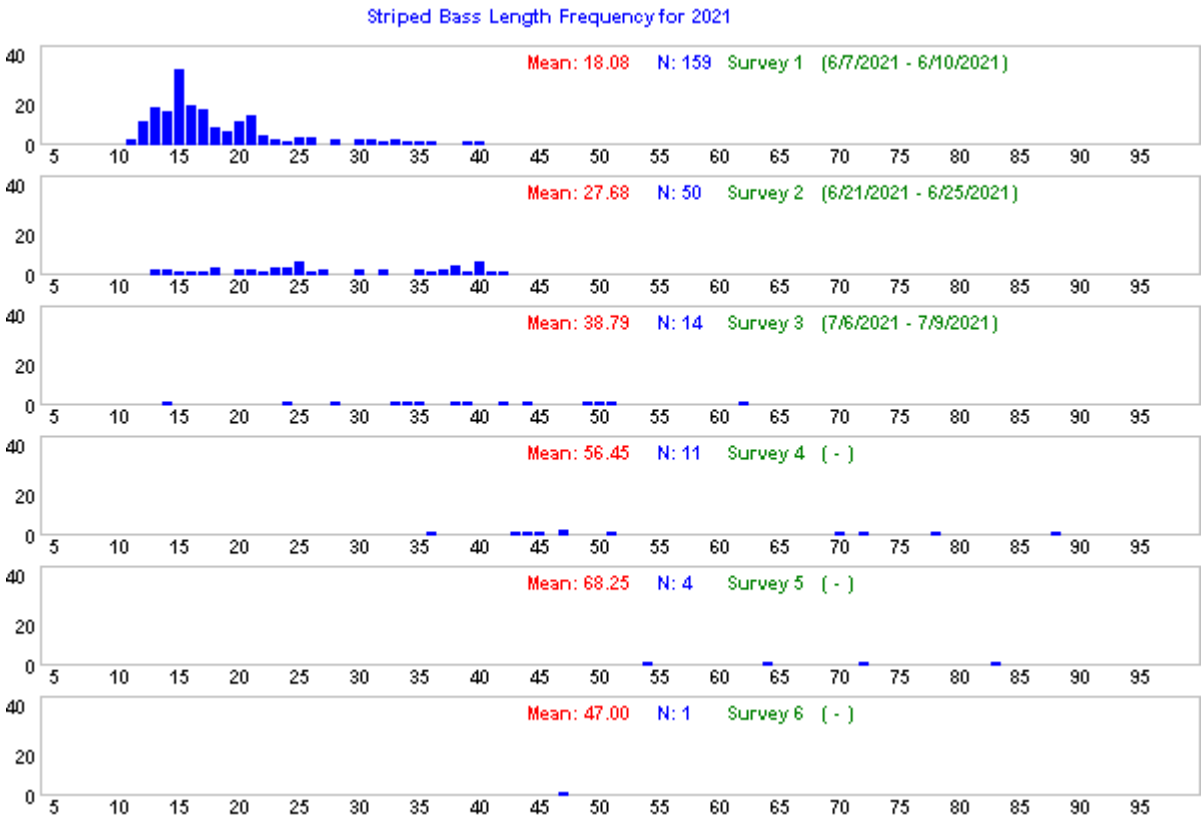

Figure 16. Summer Townet's Striped Bass length frequency histograms for surveys 1-6.

Acknowledgements

We would like to acknowledge all the individuals involved with the success of the 2021 Summer Townet Survey. Including: Steve Slater, James White, Spencer Breining-Aday, Ken Flowers, Ramiro Soto, Mike Grady, Spencer Lewis, Paul Macias, Jessica Jimenez, Tricia Bippus, Brian Jones, Evan Broberg, and Cole Anderson.

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Appendices

Appendix 1. List of quantitative and qualitative environmental variables measured by Summer Townet Survey.

Variable	**Type**	**Values**	**Units**
Tidal state	Qualitative	High Slack, Ebb, Low Slack, Flood	n/a
Station depth	Quantitative	Nearest foot	feet
Tow direction	Qualitative	with, against, unknown (relative to current)	n/a
Weather	Qualitative rank	1= cloud coverage 0-33%, 2= cloud coverage 33-66%, 3= cloud coverage 66-100%, 4= raining	n/a
Wave status	Qualitative rank	1= calm, 2= waves without whitecaps, 3= waves with whitecaps	n/a
Wind direction	Qualitative	N, NE, E, SE, S, SW, W, NW, N/A	n/a
Secchi depth	Quantitative	Nearest cm	cm
Microcystis spp.	Qualitative rank	1 = absent, 2= low, 3= medium, 4= high, 5= very high	n/a
Microcystis spp. Present in CB	Binomial	0=Absent, 1=Present	n/a
Bottom water temperature	Quantitative	Nearest tenth of degree	°C
Bottom water electrical conductivity (proxy for salinity)	Quantitative	Nearest whole value	specific conductance µS/cm ; normalized @ 25°C
Top water temperature	Quantitative	Nearest tenth of degree	°C
Top water electrical conductivity (proxy for salinity)	Quantitative	Nearest whole value	specific conductance µS/cm ; normalized @ 25°C
Top water turbidity	Quantitative	Nearest tenth of value	Nephelometric Turbidity Unit (NTU)