

Current Report

Methods

Continuous data were collected for the water quality and environmental parameters shown below. Each of the 15 monitoring stations collected continuous data for water temperature (WT), pH, dissolved oxygen (DO), surface specific conductance (SpC), chlorophyll a fluorescence, and turbidity. Additional sensors were installed at the Antioch, Mallard Island, and Martinez stations in the 1990's to monitor bottom SpC. These measurements, along with river stage data measured at the Mallard Island and Martinez stations, were needed to determine compliance with the salinity standard (also known as X2) that was mandated by the Bay-Delta Plan (SWRCB, 1995). Environmental data, such as air temperature (AT), solar radiation (SRI), wind speed (WV), and wind direction (WD), were measured at all stations as part of D-1641's Table 3 objectives (SWRCB, 1999). The only environmental parameter analyzed for this report was air temperature from a MET-1 Instrument Mod. 062 sensor.

Except for bottom SpC, all water samples were collected at 1-m below the water surface using a float-mounted YSI EXO2 multi-parameter water quality sonde. In contrast, bottom SpC was measured at 1.5 m above the channel bottom using a YSI EXO1 sonde. Water quality data and environmental data were recorded at 15-minute intervals.

Table 2: Parameters sampled by Continuous EMP

Parameter	Units	Frequency
Water Temperature	°C	15 minute instantaneous
Specific Conductance	µS/cm	15 minute instantaneous
DO	mg/L	15 minute instantaneous
pH	unitless	15 minute instantaneous
Turbidity	NTU	15 minute instantaneous
Fluorescence	FU	15 minute instantaneous

QA Status

On a monthly basis, quality assurance and control measures were applied using field verification data sheets. Data affiliated with instrument issues were flagged and excluded from the analysis.

Table 3: Rating criteria for continuous sonde calibration

Analyte	Excellent	Good	Fair	Poor
Water Temperature (°C)	$<\pm 0.2$	$\pm 0.2-0.5$	$\pm 0.5-0.8$	$>\pm 0.8$
Specific Conductance ($\mu\text{S}/\text{cm}$)	$<\pm 3\%$	$\pm 3-10\%$	$\pm 10-15\%$	$>\pm 15\%$
Dissolved Oxygen (mg/L)	$<\pm 0.3$ or $<\pm 5\%$	$\pm 0.3-0.5$ or or $\pm 5-10\%$	$\pm 0.5-0.8$ or $\pm 10-15\%$	$>\pm 0.8$ or $>\pm 15\%$
pH	$<\pm 0.2$	$\pm 0.2-0.5$	$\pm 0.5-0.8$	$>\pm 0.8$
Turbidity (NTU)	$<\pm 0.5$ or $<\pm 5\%$	$\pm 0.5-1.0$ or $\pm 5-10\%$	$\pm 1.0-1.5$ or $\pm 10-15\%$	$>\pm 1.5$ or or $>\pm 15\%$

Regions

The daily averages of the continuous 15-minute data collected for air and water temperature, pH, DO, surface and bottom SpC, chlorophyll a fluorescence, and turbidity for calendar year 2019 are shown in Figures 2 to 8. The range of monthly DO values at the Stockton station is shown below. Data gaps in the daily plots result from days where more than 30% of the 15-minute data are flagged or unavailable.

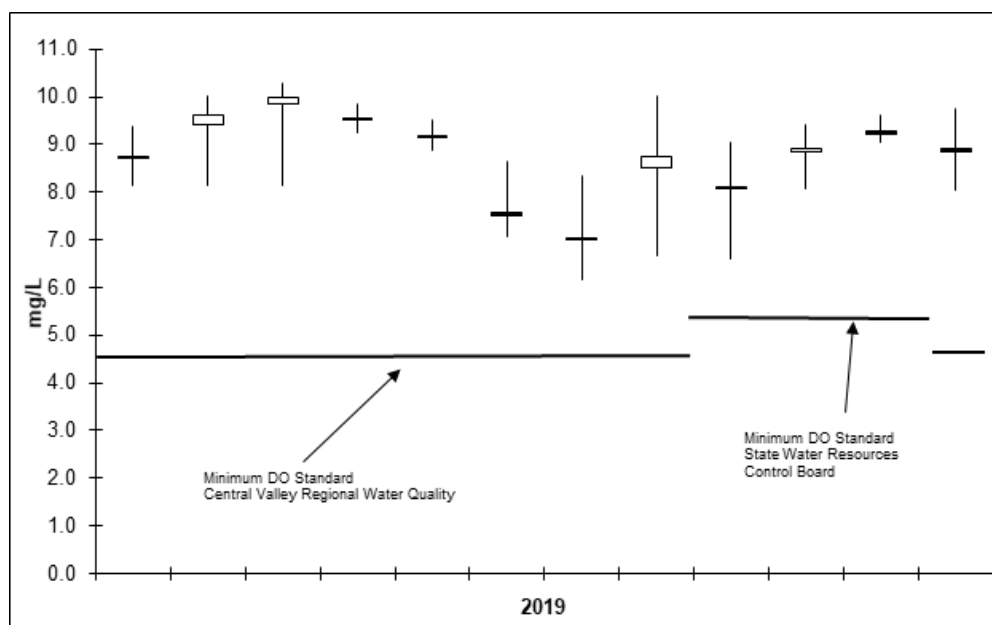


Figure 3: Range of daily dissolved oxygen Rough and Ready Isl. (P8), 2019

Northern Interior Delta

The Northern Interior Delta stations had surface specific conductance values that ranged from 84 $\mu\text{S}/\text{cm}$ (C3A in February) to 284 $\mu\text{S}/\text{cm}$ (D24A in February). Surface turbidity values ranged from 2 NTU (C3A in November) to 169 NTU (D24A in March). Surface water temperature values ranged from 7.8 $^{\circ}\text{C}$ (C3A in January) to 23.8 $^{\circ}\text{C}$ (D24A in July). Surface dissolved oxygen values ranged from 7.5 mg/L (D24A in September) to 11.4 mg/L (C3A in February). Surface pH values ranged from 7.2 (C3A in November) to 7.9 (D24A in May). Surface fluorescence values ranged from 0.58 $\mu\text{g}/\text{L}$ (D24A in August) to 14.46 $\mu\text{g}/\text{L}$ (D24A in March).

Table 4: Summary statistics for Northern Interior Delta, 2019

Statistic	Specific Conductance ($\mu\text{S}/\text{cm}$)	Turbidity (NTU)	Water Temperature ($^{\circ}\text{C}$)	Dissolved Oxygen (mg/L)	pH	Fluorescence ($\mu\text{g}/\text{L}$)
	Surface	Surface	Surface	Surface	Surface	Surface
MIN	84	2	7.8	7.5	7.2	0.6
MAX	284	169	23.8	11.4	7.9	14.5
AVERAGE	149	17	15.5	9.2	7.5	1.7

Central Interior Delta

The Central Interior Delta stations had surface specific conductance values that ranged from 96 $\mu\text{S}/\text{cm}$ (D16A in June) to 956 $\mu\text{S}/\text{cm}$ (D16A in January). Surface turbidity values ranged from 1 NTU (D19A in July) to 67 NTU (D19A in February). Surface water temperature values ranged from 8.3 $^{\circ}\text{C}$ (D19A in January) to 26.60 $^{\circ}\text{C}$ (D19A in August). Surface dissolved oxygen values ranged from 7.0 mg/L (D16A in August) to 13.5 mg/L (D19A in October). Surface pH values ranged from 7.1 (D29 in June) to 9.6 (D19A in September). Surface fluorescence values ranged from 0.67 $\mu\text{g}/\text{L}$ (D19A in October) to 7.67 $\mu\text{g}/\text{L}$ (D19A in February).

Table 5: Summary statistics for Central Interior Delta, 2019

Statistic	Specific Conductance ($\mu\text{S}/\text{cm}$)	Turbidity (NTU)	Water Temperature ($^{\circ}\text{C}$)	Dissolved Oxygen (mg/L)	pH	Fluorescence ($\mu\text{g}/\text{L}$)
	Surface	Surface	Surface	Surface	Surface	Surface
MIN	96	1	8.3	7	7.1	0.67
MAX	956	67	26.6	13.5	9.6	7.67
AVERAGE	225	6	17.1	9.4	7.8	2.27

Southern Interior Delta

The Southern Interior Delta stations had surface specific conductance values that ranged from 77 $\mu\text{S}/\text{cm}$ (C7A in June) to 1,013 $\mu\text{S}/\text{cm}$ (P8A in January). Surface turbidity values ranged from 1 NTU (P8A in November) to 104 NTU (C10A in January). Surface water temperature values ranged from 7.6 $^{\circ}\text{C}$ (C10A in January) to 26.1 $^{\circ}\text{C}$ (P8A in July). Surface dissolved oxygen values ranged from 6.2 mg/L (P8A in July) to 12.7 mg/L (C7A in August). Surface pH values ranged from 6.8 (C10A in June) to 8.7 (C7A in August). Surface fluorescence values ranged from 0.63 $\mu\text{g}/\text{L}$ (P8A in December) to 50.02 $\mu\text{g}/\text{L}$ (C7A in August).

Table 6: Summary statistics for Southern Interior Delta, 2019

Statistic	Specific Conductance ($\mu\text{s}/\text{cm}$)	Turbidity (NTU)	Water Temperature ($^{\circ}\text{C}$)	Dissolved Oxygen (mg/L)	pH	Fluorescence ($\mu\text{g}/\text{L}$)
	Surface	Surface	Surface	Surface	Surface	Surface

Statistic	Specific Conductance (µS/cm)	Turbidity (NTU)	Water Temperature (°C)	Dissolved Oxygen (mg/L)	pH	Fluorescence (µg/L)
MIN	77	1	7.6	6.2	6.8	0.63
MAX	1013	104	26.1	12.7	8.7	50.02
AVERAGE	330	12	16	9.3	7.5	5.03

Confluence

The Confluence stations had surface specific conductance values that ranged from 100 µS/cm (D12A in June) to 12,148 µS/cm (D12A in December). Bottom specific conductance values ranged from 51 µS/cm (D12A in April) to 13,119 µS/cm (D12A in December). Surface turbidity values ranged from 4.0 NTU (D12A in October) to 113 NTU (D12A in January). Surface water temperature values ranged from 8.3°C (D12A in January) to 24.50 °C (D12A in August). Bottom water temperature values ranged from 2 °C (D12A in December) to 24.0 °C (D12A in August). Surface dissolved oxygen values ranged from 7.60 mg/L (D12A in August) to 10.8 mg/L (D12A in January). Surface pH values ranged from 7.1 (D12A in June) to 8.0 (D12A in May). Surface fluorescence values ranged from 0.17 µg/L (D12A in December) to 7.71 µg/L (D12A in March).

Table 7: Rating criteria for Confluence, 2019

Statistic	Specific Conductance (µS/cm)	Specific Conductance (µS/cm)_1	Turbidity (NTU)	Water Temperature (°C)	Water Temperature (°C)_1	Dissolved Oxygen (mg/L)	St
	Surface	Bottom	Surface	Surface	Bottom	Surface	
MIN	100	51	4	8.3	2	7.6	
MAX	12148	13119	113	24.5	24	10.8	
AVERAGE	1273	1882	15	16.4	16.5	9.1	

Grizzly/Suisun Bay

The Grizzly Suisun Bay stations had surface specific conductance values that ranged from 139 µS/cm (D9A in June) to 26,944 µS/cm (D6A in November). Bottom specific conductance values ranged from 192 µS/cm (D6A in March) to 30,440 µS/cm (D6A in December). Surface turbidity values ranged from 7.0 NTU (D6A in September) to 135.0 NTU (D7A in March). Surface water

temperature values ranged from 8.5 °C (D9A in February) to 24.4 °C (D7A in August). Bottom water temperature values ranged from 9.0 °C (D6A in February) to 22.0 °C (D6A in August). Surface dissolved oxygen values ranged from 7.4 mg/L (D6A in August) to 10.7 mg/L (D9A in January). Surface pH values ranged from 7.3 (D9A in January) to 8.1 (D8A in May). Surface fluorescence values ranged from 0.52 µg/L (D9A in December) to 13.34 µg/L (D7A in November).

Table 8: Rating criteria for Grizzly/Suisun Bay, 2019

Statistic	Specific Conductance (µs/cm)	Specific Conductance (µs/cm)_1	Turbidity (NTU)	Water Temperature (°C)	Water Temperature (°C)_1	Dissolved Oxygen (mg/L)	Si
	Surface	Bottom	Surface	Surface	Bottom	Surface	Si
MIN	139	192	7	8.5	9	7.4	
MAX	26994	30440	135	24.4	22	10.7	
AVERAGE	6947	16087	32	16.2	16	9.1	

Parameters

Water Temperature

Average daily water temperatures in the estuary ranged from 7.6 °C to 26.6°C, with the lower values in the Southern Interior Delta location and the higher values found in the Central Delta stations.

Average daily water temperatures at the Northern Interior Delta stations were usually lower in comparison to the Southern Interior Delta stations, with the greatest divergence occurring in the months of July through September at the Southern Interior Delta locations.

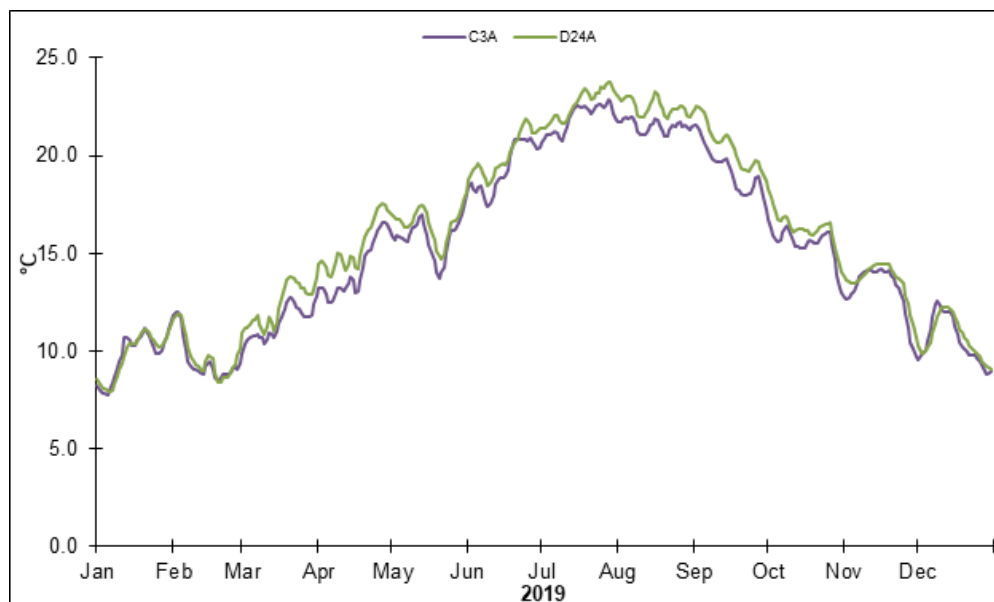


Figure 4: Average daily water temperature in the Northern Interior Delta, 2019

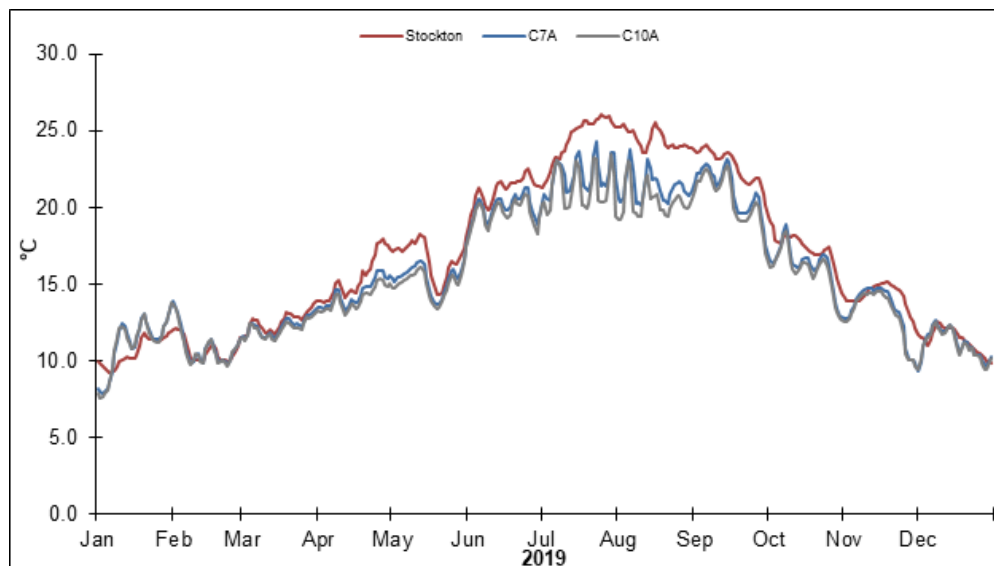


Figure 5: Average daily water temperature in the Southern Interior Delta, 2019

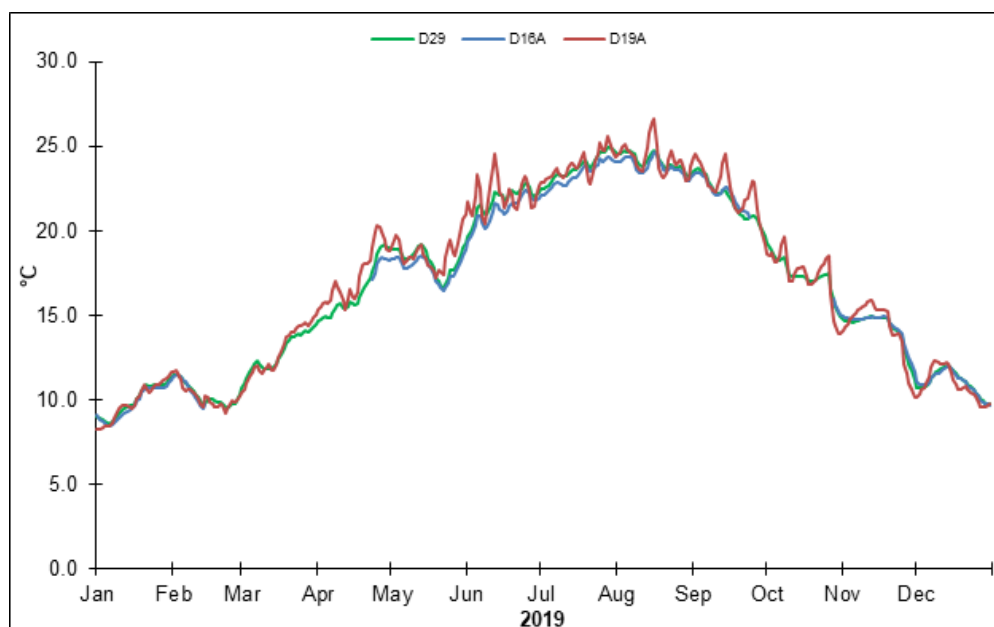


Figure 6: Average daily water temperature in the Central Delta, 2019

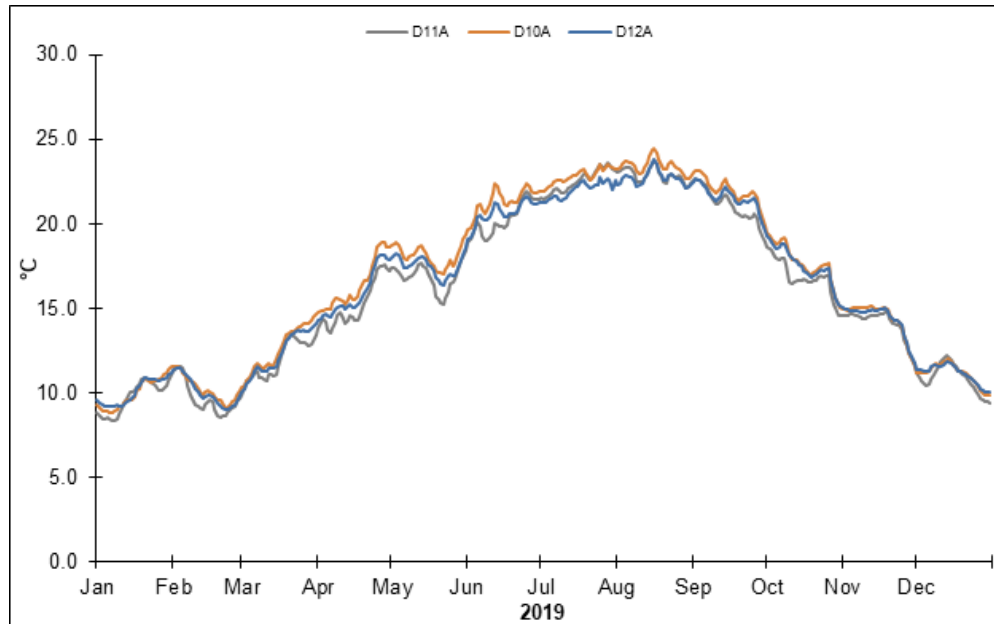


Figure 7: Average daily water temperature in the Confluence, 2019

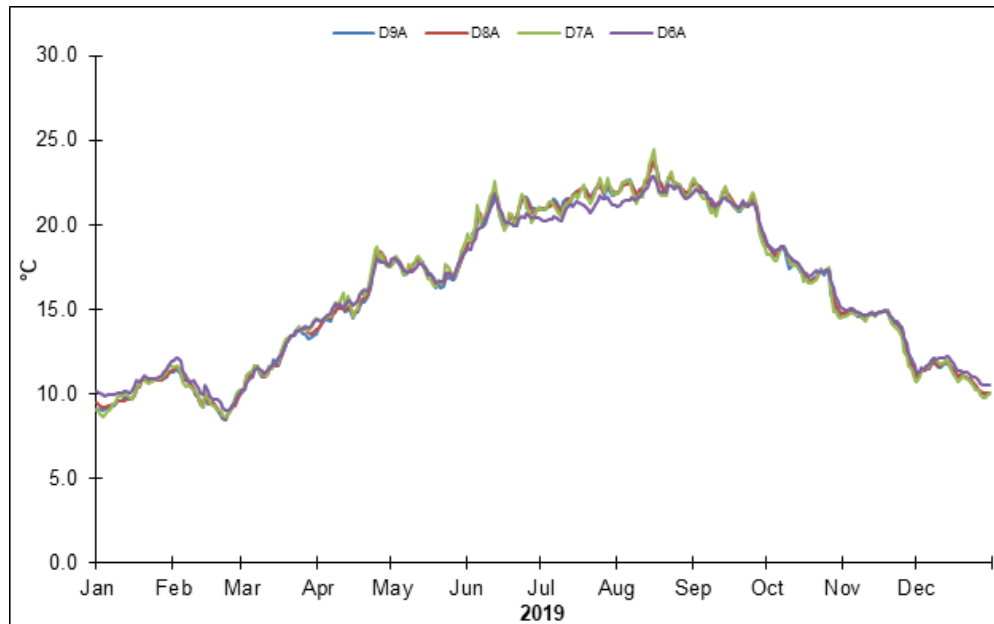


Figure 8: Average daily water temperature in the Grizzly/Suisun Bays, 2019

Specific Conductance

Daily average surface specific conductance for the estuary ranged from 77 $\mu\text{S}/\text{cm}$ to 26,944 $\mu\text{S}/\text{cm}$, with the lower values in the Southern Interior Delta stations and the higher values at the more tidally influenced Grizzly/Suisun Bay locations (Figure 3e). All stations showed a decrease in specific conductance in late March (Figure 3a to 3e). The Northern Interior Delta station C3A and D24 showed a large jump in specific conductance for the months of January, February, March, November, and December 2019. In addition, the Southern Interior Delta stations on the

San Joaquin River showed a significant decrease in surface specific conductance starting April June 2019 (Figure 3b). specific conductance from these 3 stations would remain low until the beginning of July.

Bottom SpC measured in 2019 at D12A, D10A, and D6A stations exhibited seasonal patterns and ranges similar to the surface SpC (Figure 3f).

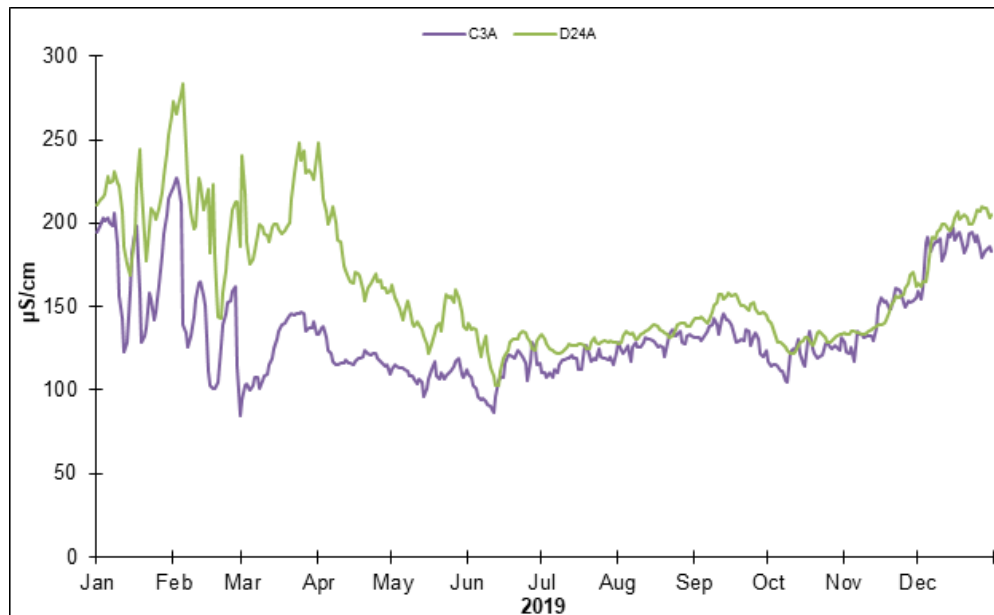


Figure 9: Average daily specific conductance in the Northern Interior Delta, 2019

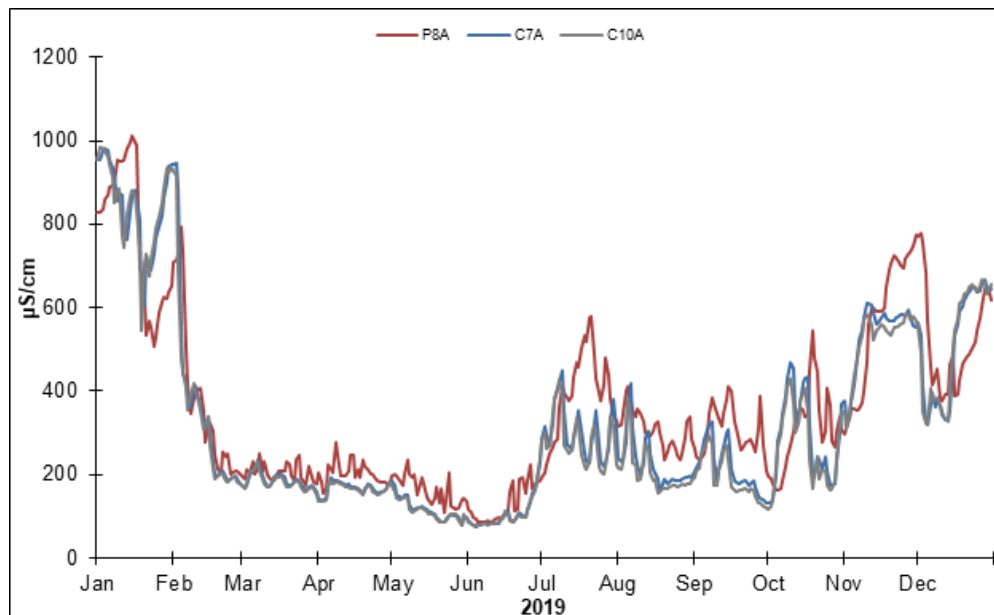


Figure 10: Average daily specific conductance in the Southern Interior Delta, 2019

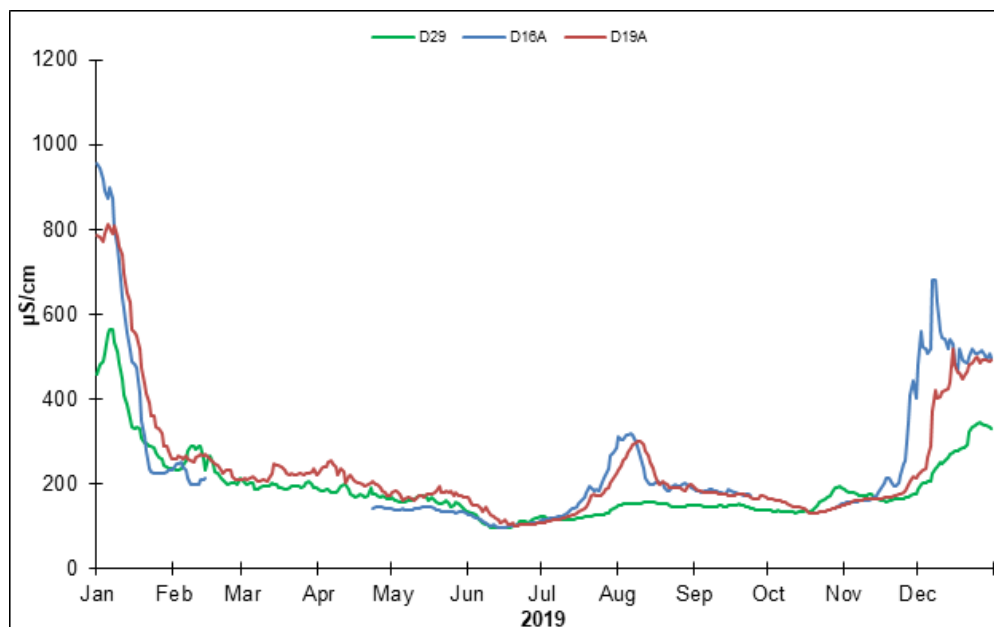


Figure 11: Average daily specific conductance in the Central Delta, 2019

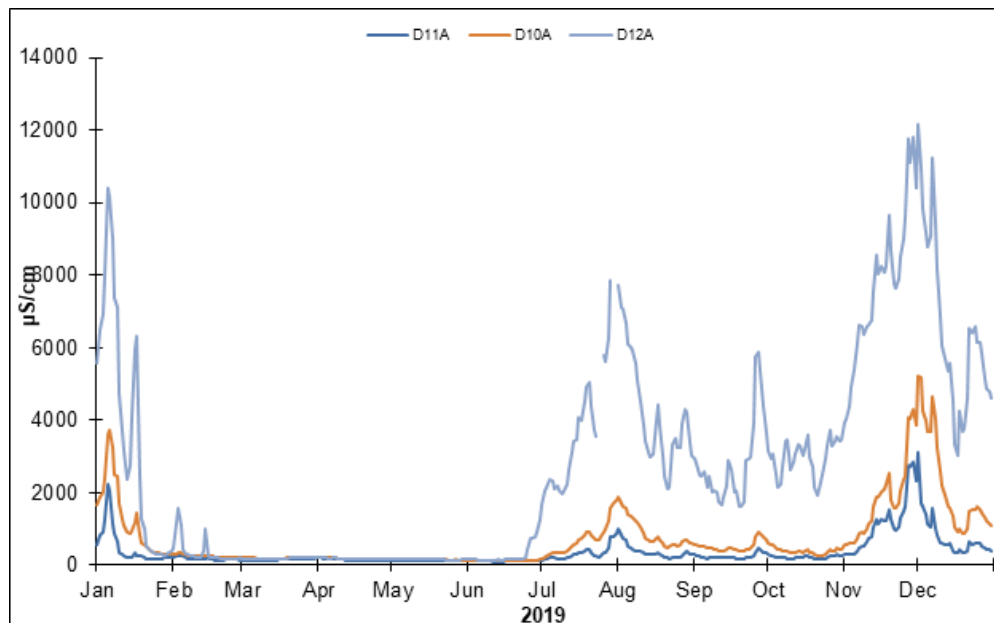


Figure 12: Average daily specific conductance in the Confluence, 2019

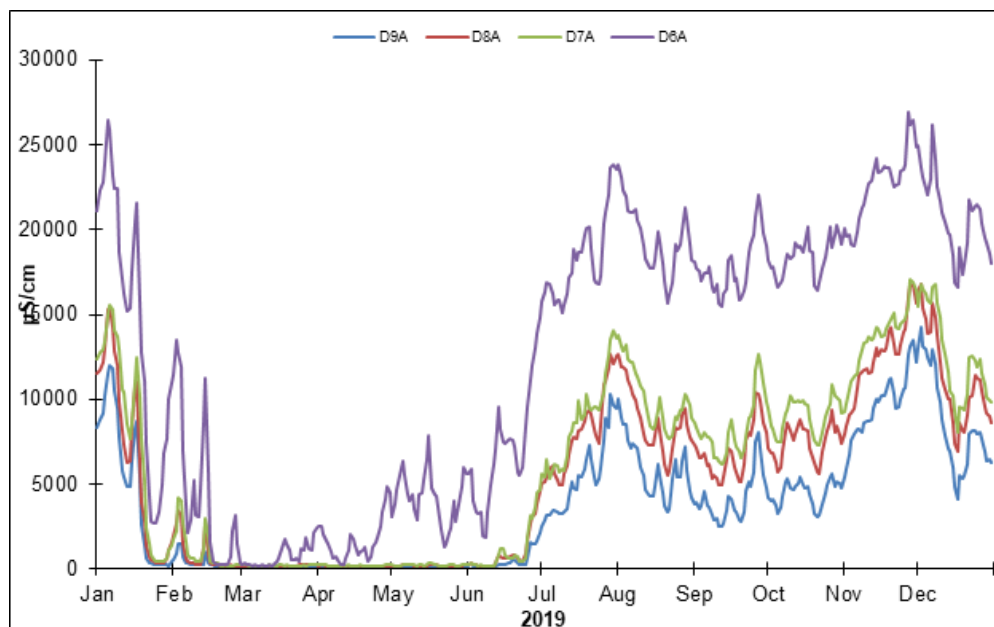


Figure 13: Average daily specific conductance in the Grizzly/Suisun Bays, 2019

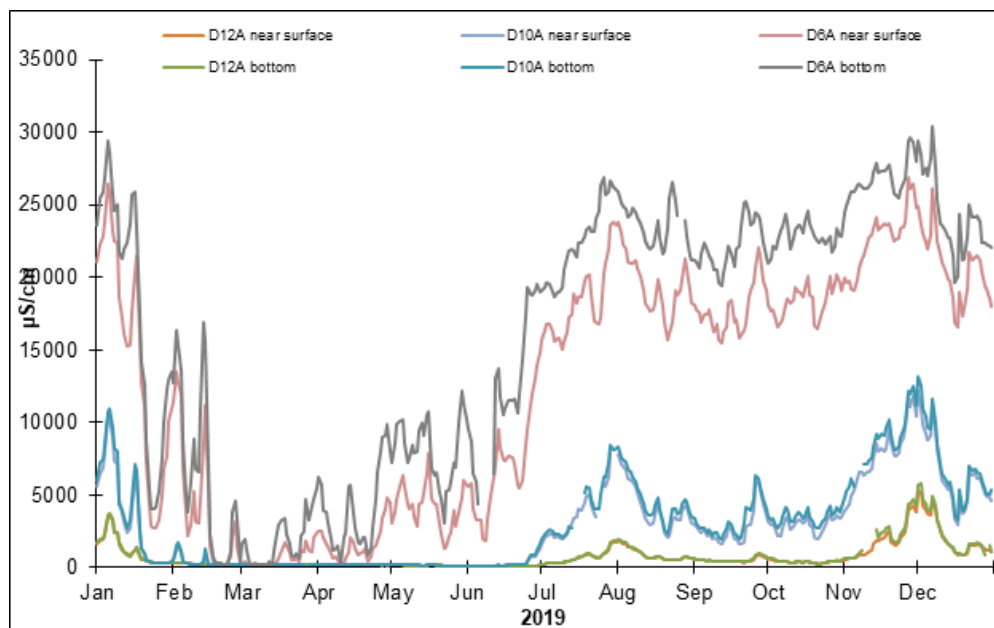


Figure 14: Average daily specific conductance Surface-Bottom, 2019

DO

Average daily DO values in the estuary ranged from 6.2 mg/L to 13.5 mg/L (Figure 4a to 4e). The greatest degree of variability was seen at the Southern Interior Delta stations ranging from 6.2 mg/L at P8A in July 2019 to 12.7 mg/L at the C7A August 2019.

All compliance monitoring stations recorded daily averages above the standard of 5.0 mg/L that was set by the CVRWQCB in the Basin Plan (CVRWQCB, 1998). The monthly average DO levels at the Stockton station did not fall below the 5.0 mg/L standard that was set by the CVRWQCB

(1998). The monthly average DO levels did not drop below the 6.0 mg/L standard (SWRCB, 1995) for the passage of fall-run Chinook salmon through the ship channel for the September through November 2019 control period.

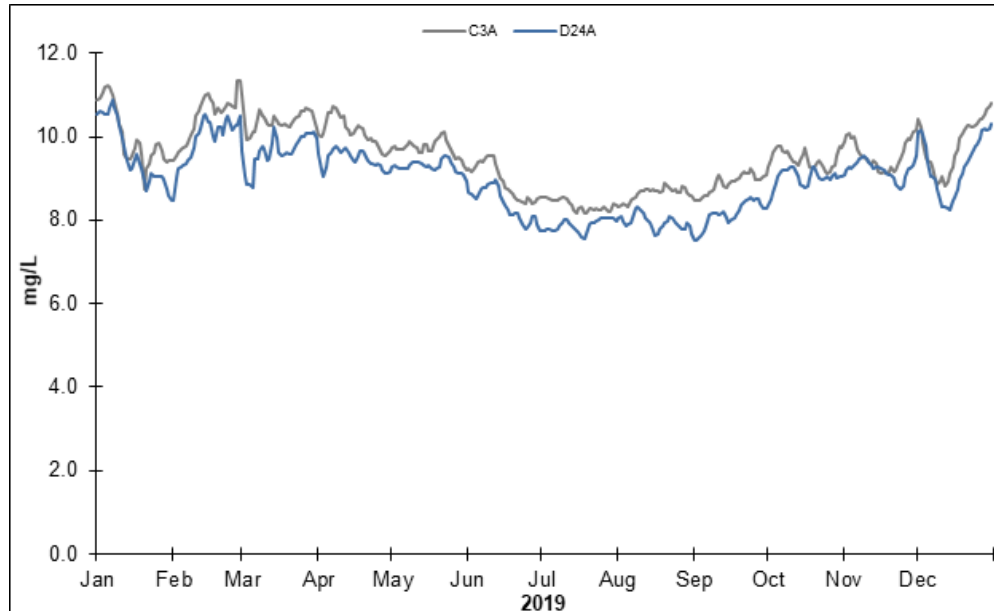


Figure 15: Average daily dissolved oxygen in the Northern Interior Delta, 2019

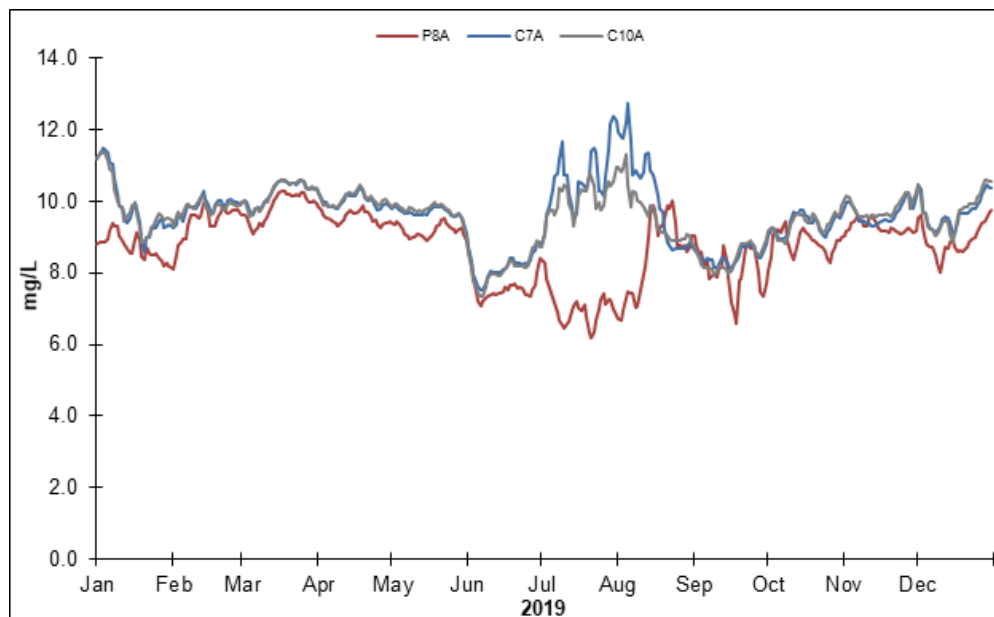


Figure 16: Average daily dissolved oxygen in the Southern Interior Delta, 2019

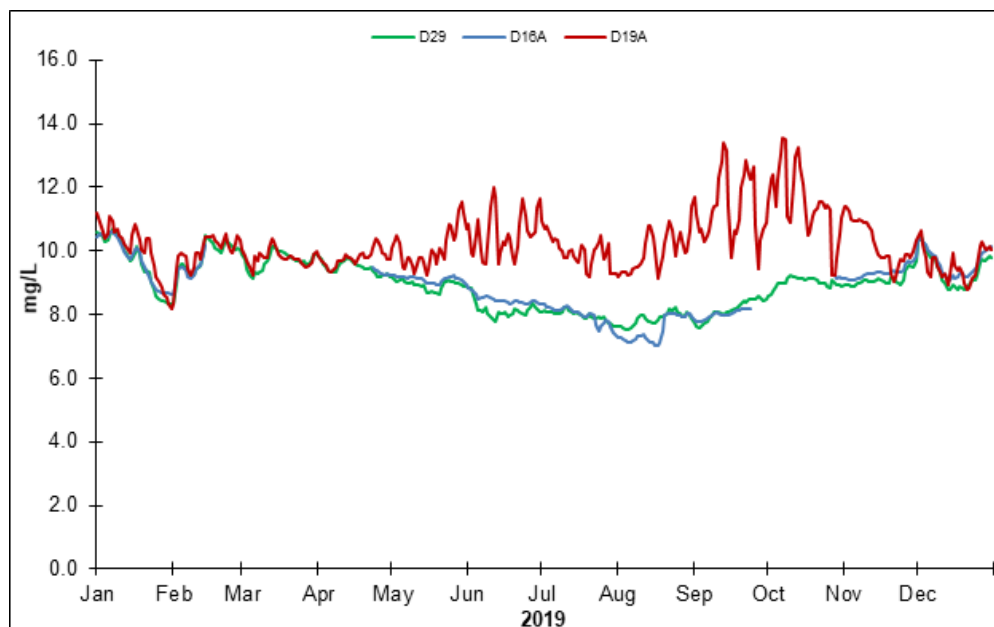


Figure 17: Average daily dissolved oxygen in the Central Delta, 2019

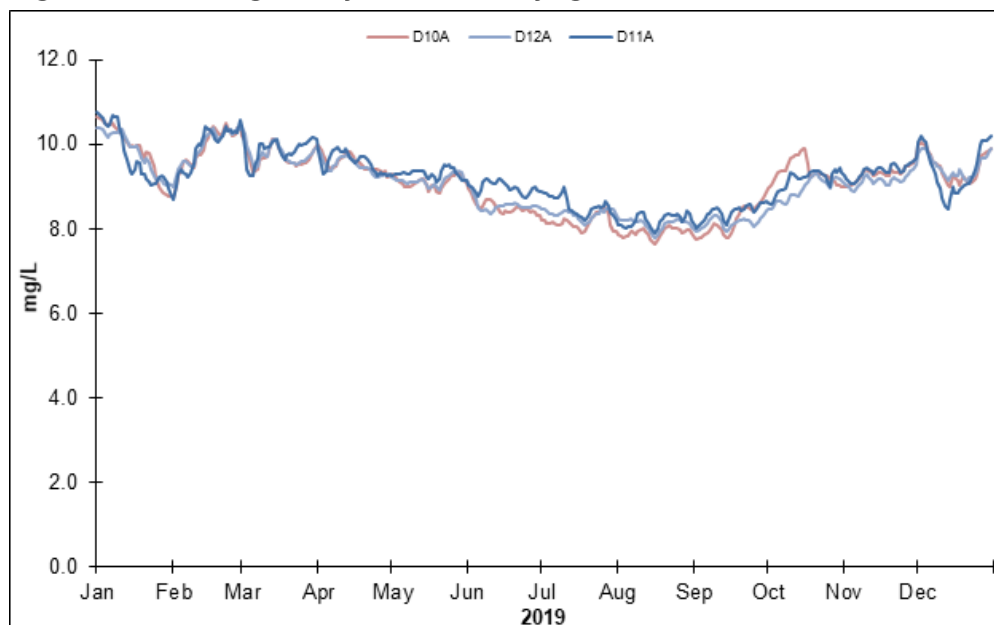


Figure 18: Average daily dissolved oxygen in the Confluence, 2019

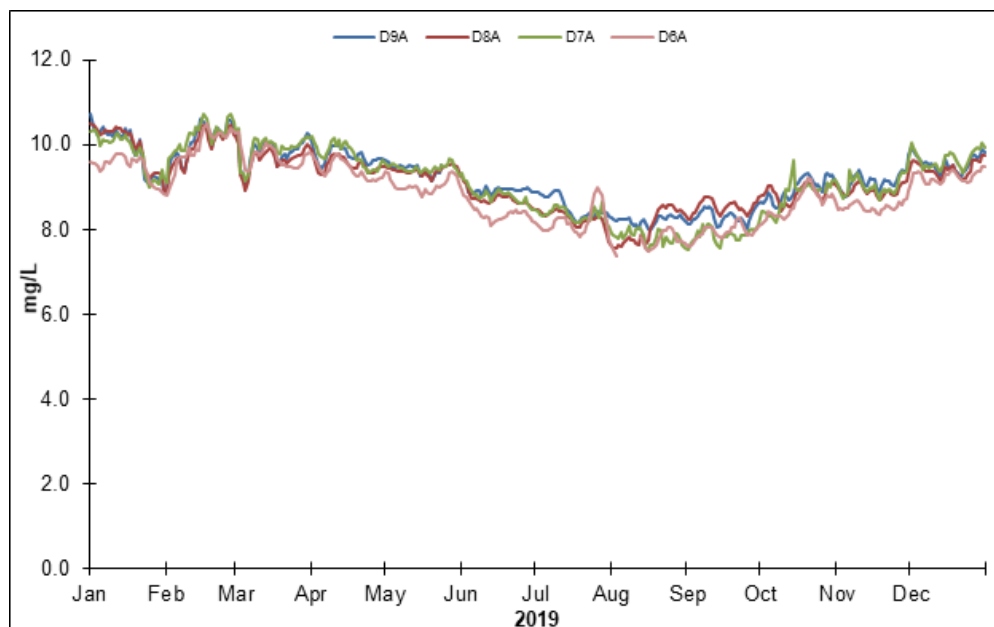


Figure 19: Average daily dissolved oxygen in the Grizzly/Suisun Bays, 2019

pH

Daily average pH levels at all stations in the estuary ranged from 6.8 to 9.6 (Figure 5a to 5e). The Southern Interior Delta stations showed a significant increase in daily average pH beginning June 2019 to September 2019 (Figure b). Values ranged from a low of 6.8 at C10A in June 2019 to a high of 8.7 at C7A in August 2019. The Central Delta station D19A showed an increase in pH values beginning May 2019 until the end of October 2019 (Figure 5c).

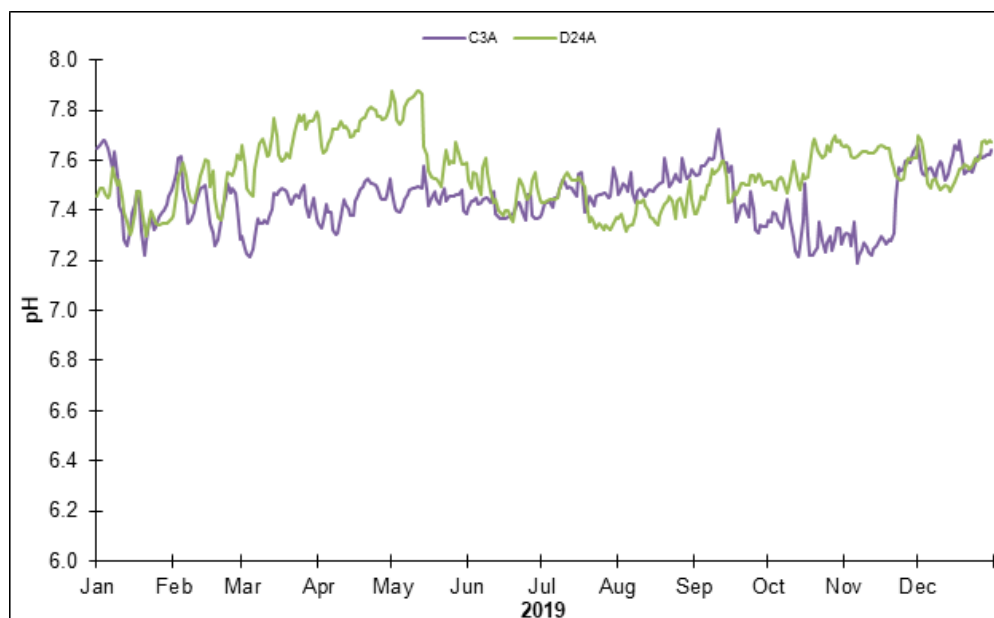


Figure 20: Average daily pH in the Northern Interior Delta, 2019

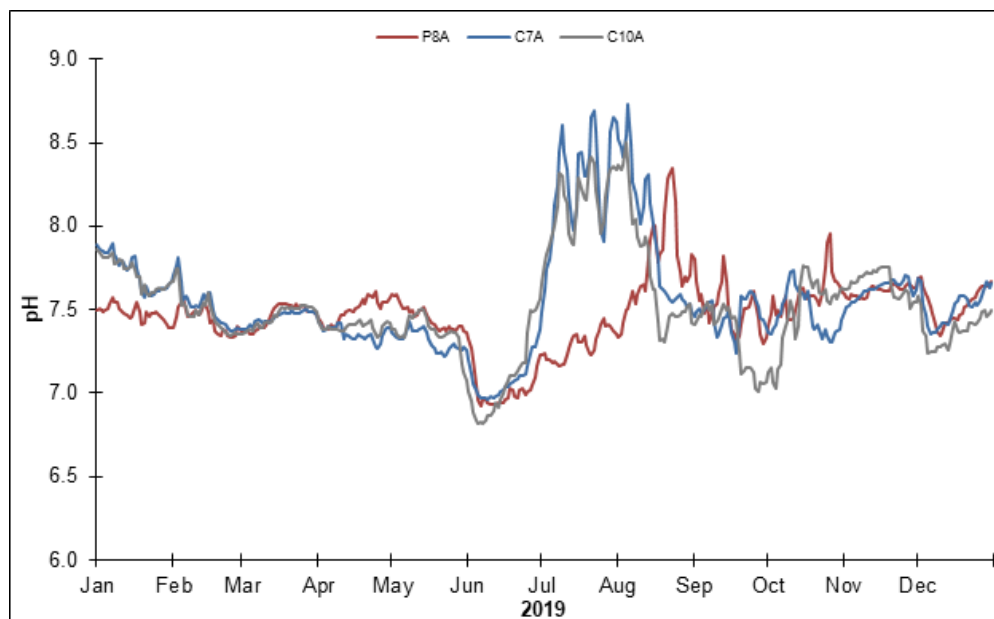


Figure 21: Average daily pH in the Southern Interior Delta, 2019

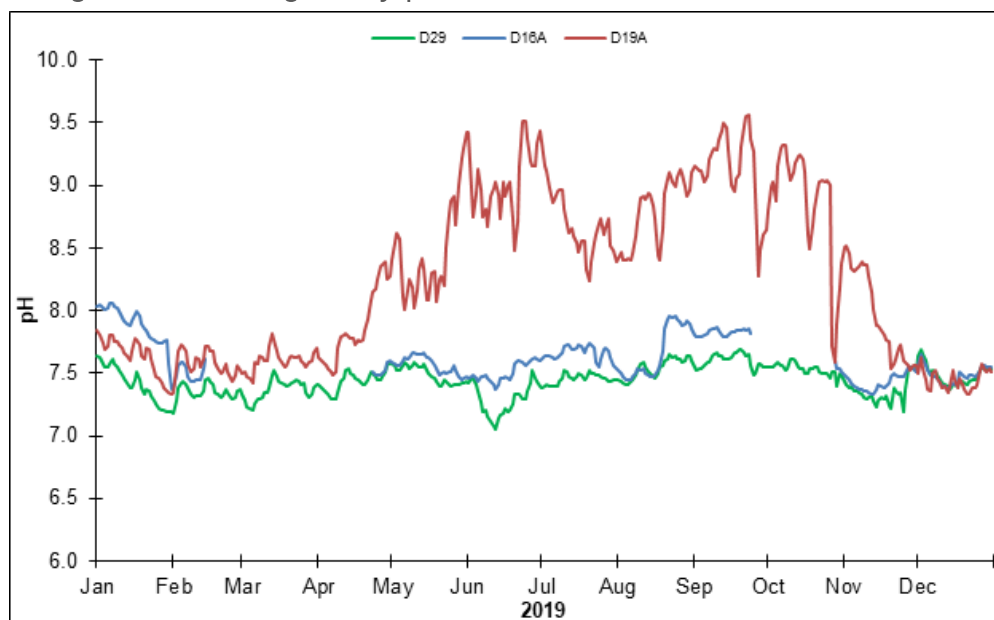


Figure 22: Average daily pH in the Central Delta, 2019

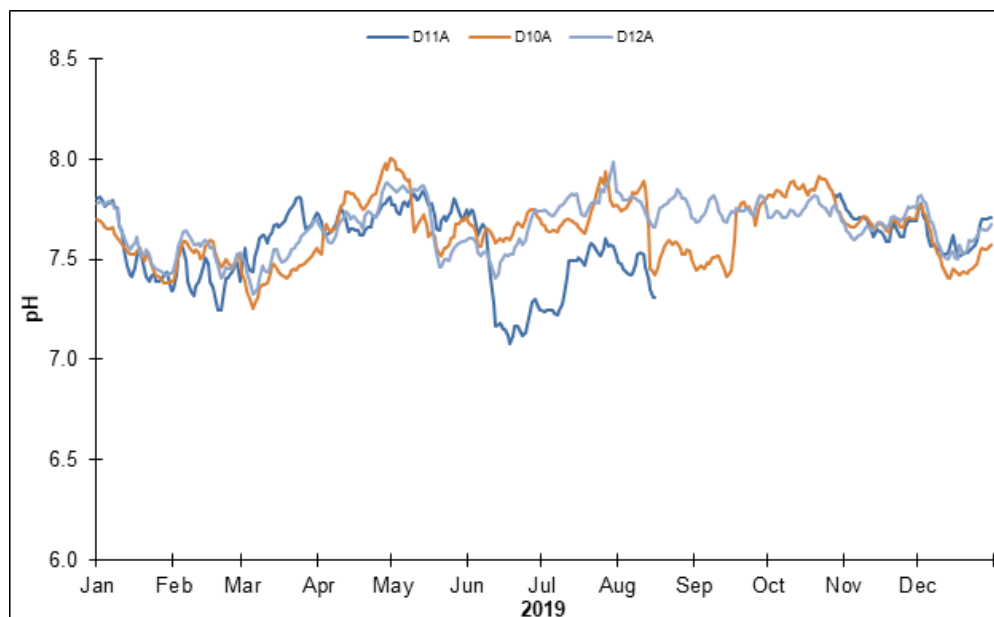


Figure 23: Average daily pH in the Confluence, 2019

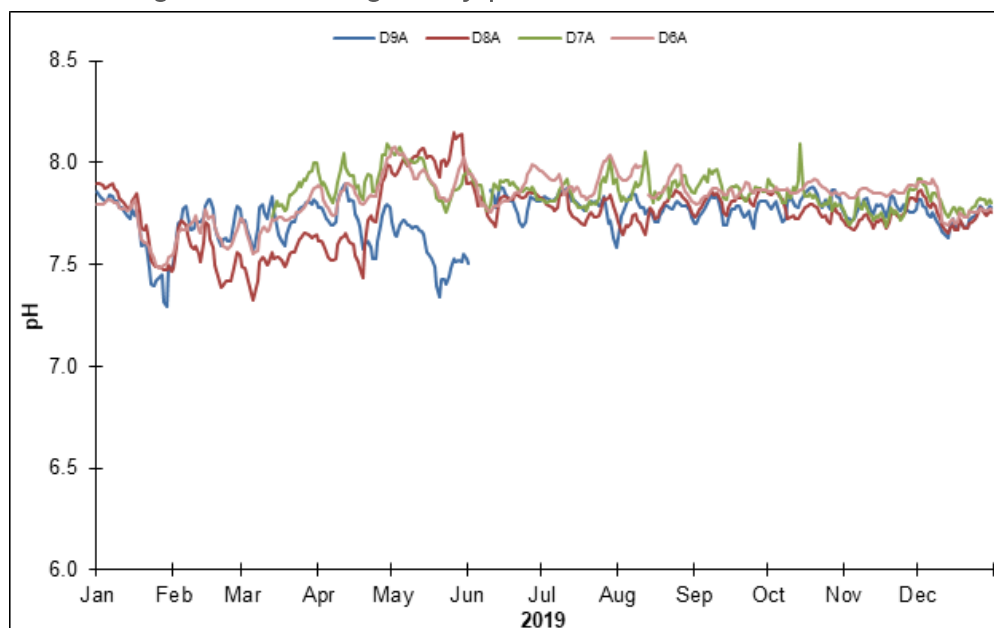


Figure 24: Average daily pH in the Grizzly/Suisun Bays, 2019

Turbidity

Daily average turbidity levels at all stations in the estuary ranged from 1 to 169 (Figure 6a to 6e). The Northern Interior and Southern Interior Delta stations showed significant increase in daily average turbidity beginning January 2019 to the middle of February 2019 (Figure 6b).

Values ranged for the Northern Interior from a low of 6.0 at C3A in January 2019 to a high of 169 at D24A in March 2019.

Values ranged for the Southern Interior Delta from a low of 4.0 at P8A in June 2019 to a high of 104 at C10A in January 2019. The Central Delta station D19A showed an increase in turbidity values beginning January 2019 until the middle of February and the beginning to the middle of December 2019 (6c).

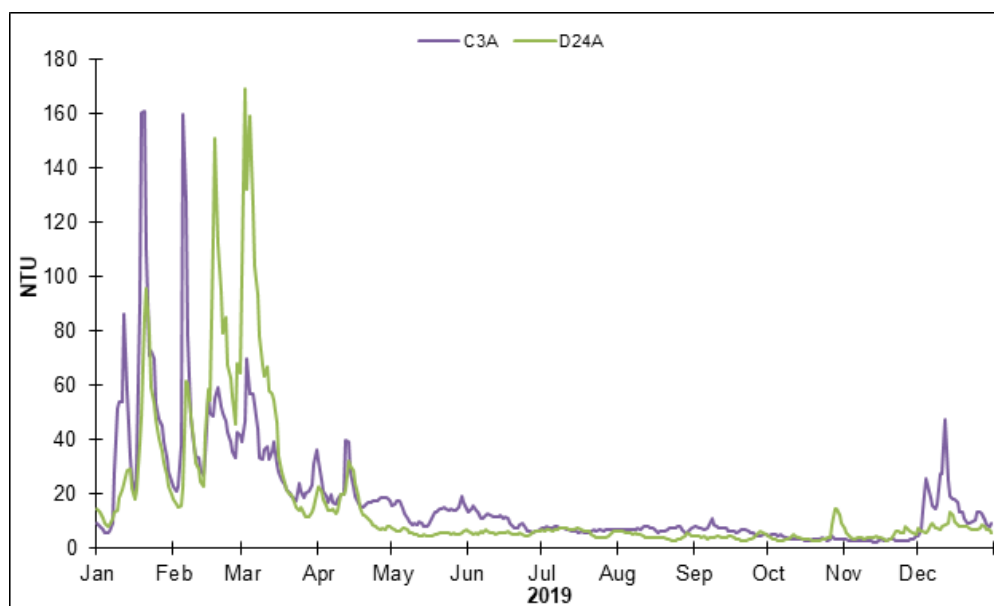


Figure 25: Average daily turbidity in the Northern Interior Delta, 2019

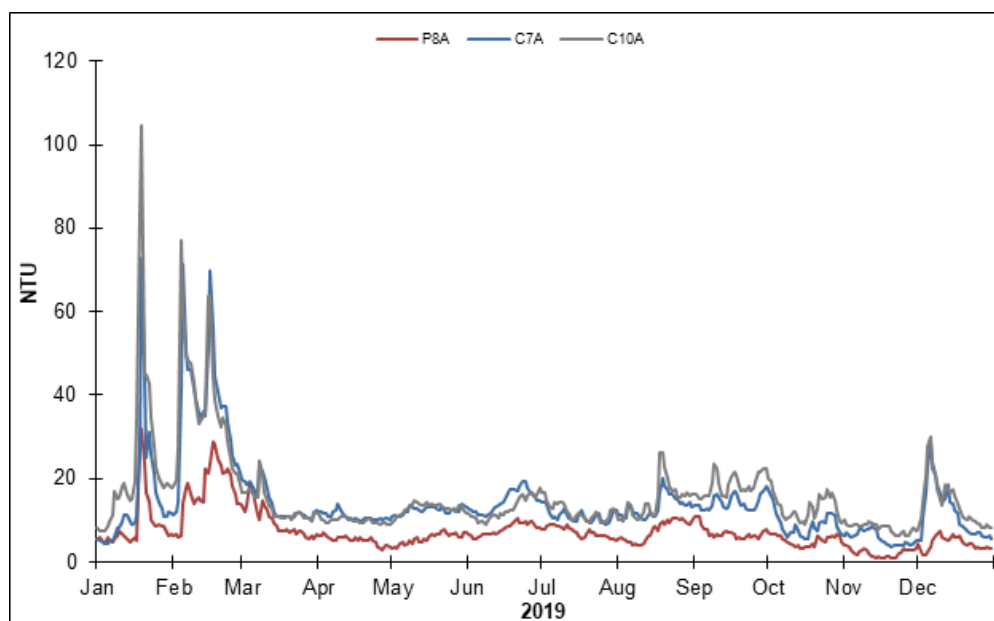


Figure 26: Average daily turbidity in the Southern Interior Delta, 2019

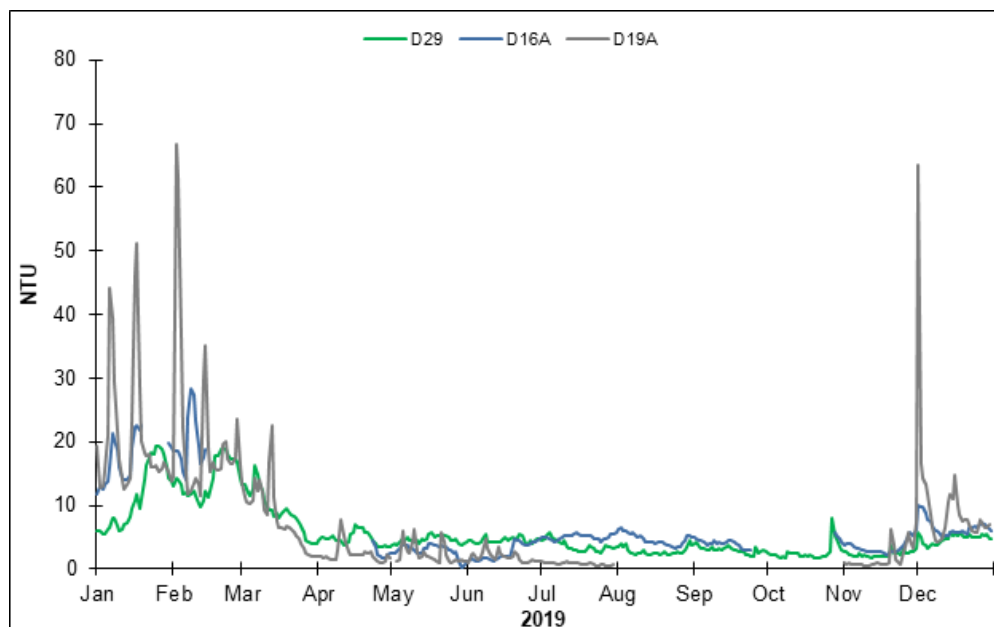


Figure 27: Average daily turbidity in the Central Delta, 2019

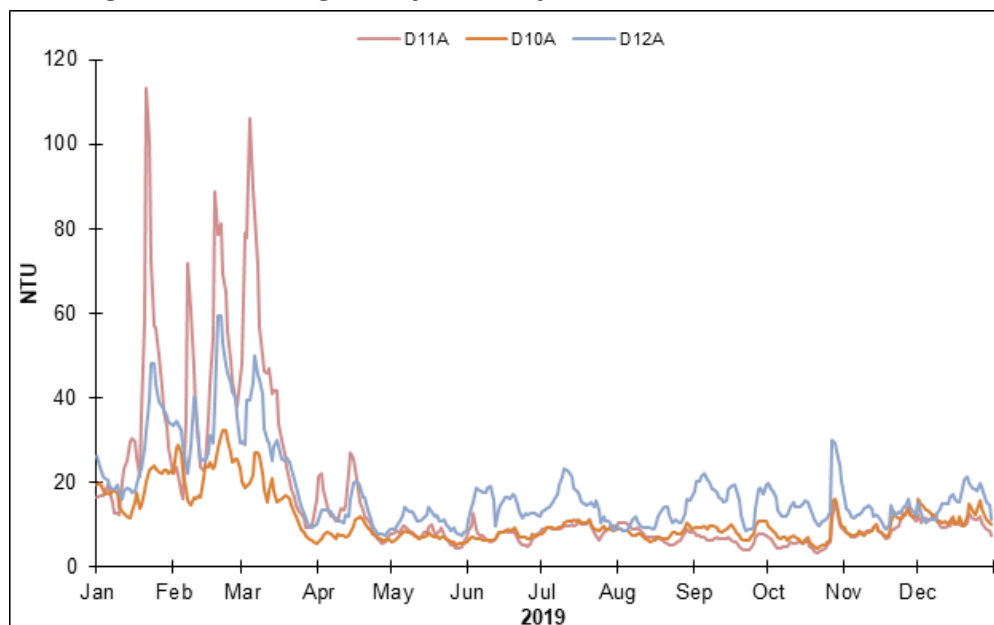


Figure 28: Average daily turbidity in the Confluence, 2019

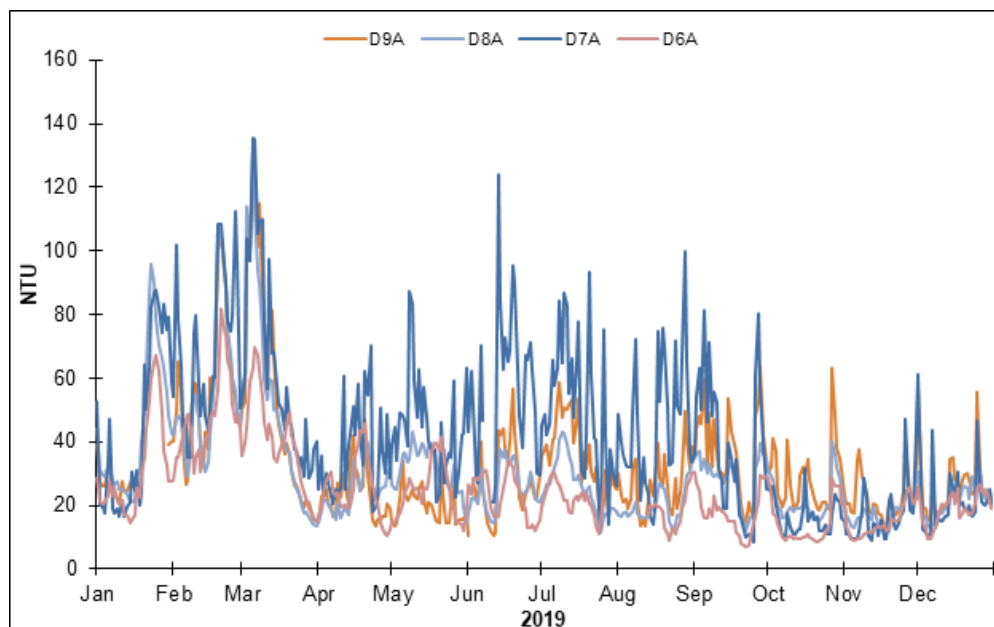


Figure 29: Average daily turbidity in the Grizzly/Suisun Bays, 2019

Chlorophyll a Fluorescence

Daily average chlorophyll a fluorescence recorded at all the stations ranged from a low of 0.17 ($\mu\text{g/L}$) in December 2019 for the Confluence station D11A to a high of 50.02 ($\mu\text{g/L}$) in August 2019 for the Southern Interior Delta station C7A (Figure 7a to 7e).

For most of the 2019 calendar year, daily fluorescence averages at Southern Interior Delta stations were higher than other regions with sustained higher values from July 2019 through the middle of August 2019 with the exception of P8A (Figure 7b).

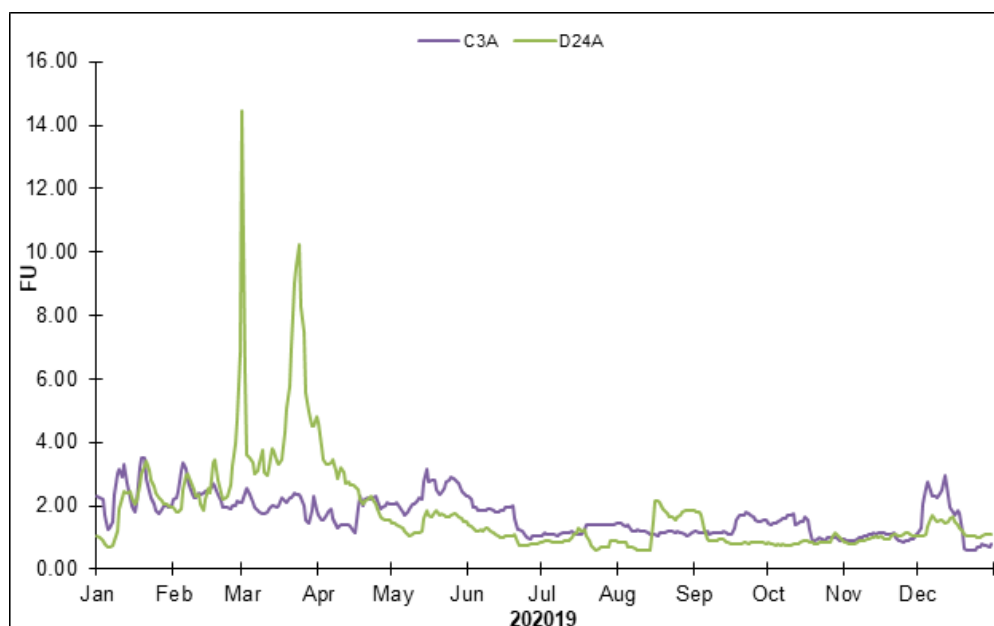


Figure 30: Average daily fluorescence in the Northern Interior Delta, 2019

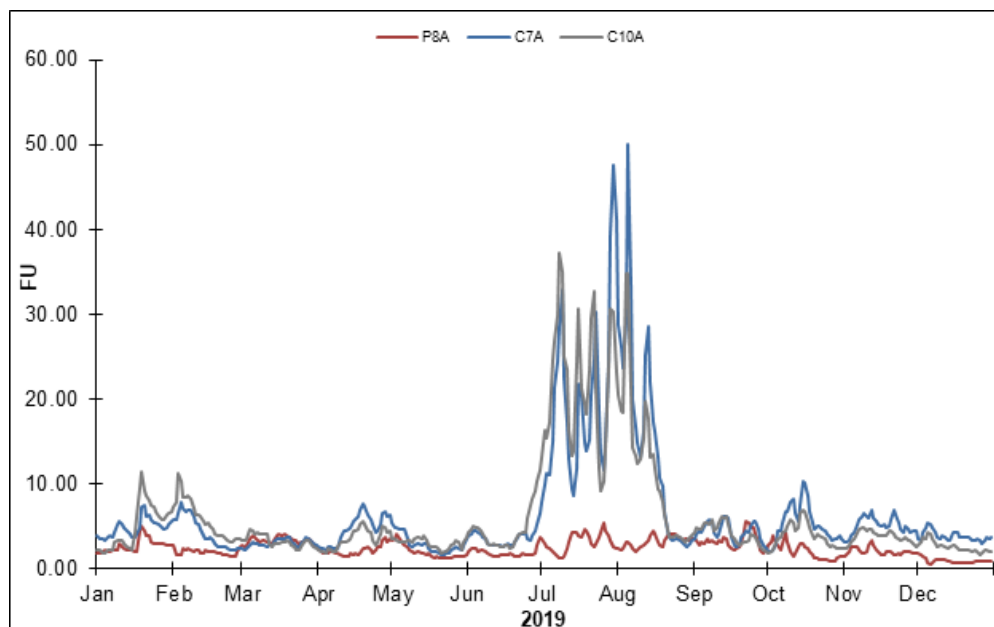


Figure 31: Average daily fluorescence in the Southern Interior Delta, 2019

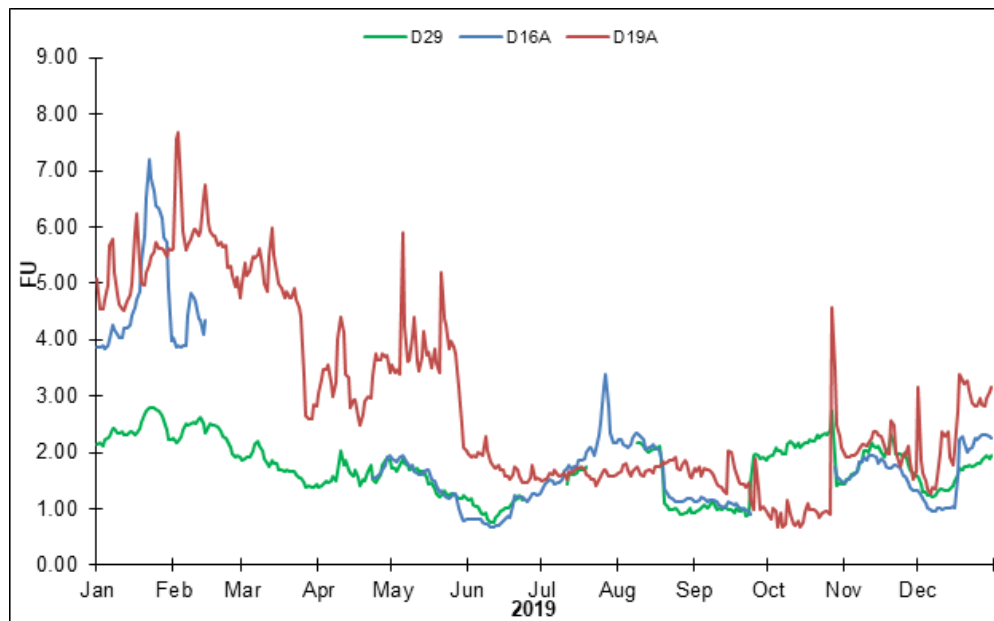


Figure 32: Average daily fluorescence in the Central Delta, 2019

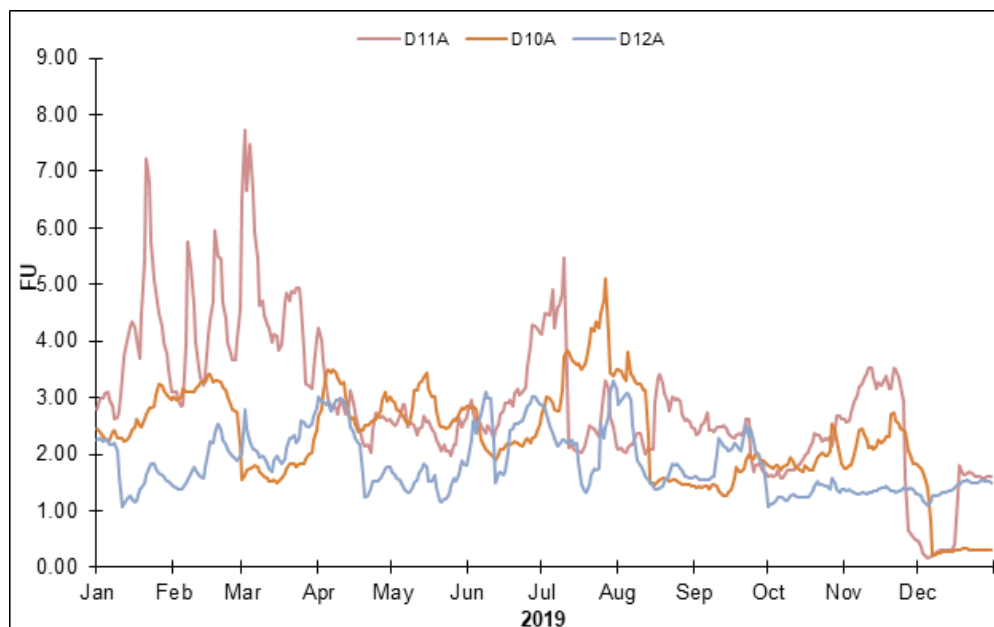


Figure 33: Average daily fluorescence in the Confluence, 2019

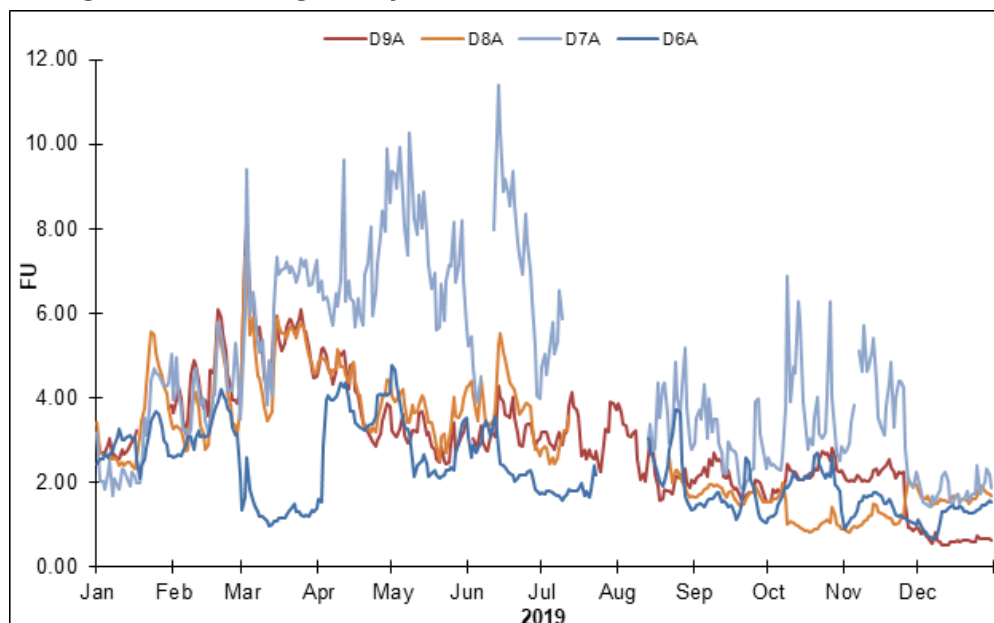


Figure 34: Average daily fluorescence in the Grizzly/Suisun Bays, 2019

Air Temperature

Daily average air temperatures in the estuary ranged from 4.2 °C in January 2019 at Southern Interior station C10A to 30.6 °C in June 2019 at the Southern Interior Delta station C7A (Figure 8a to f).

References

[CVRWQCB] Central Valley Regional Water Quality Control Board. (1998). Water Quality Control Plan for the California Regional Water Quality Control Board Central Valley Region, the Sacramento River Basin, and San Joaquin River Basin [Basin Plan] (4th ed.).

[SWRCB] State Water Resources Control Board. (1995). Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Estuary [Bay-Delta Plan] (Adopted May 22, 1995, pursuant to Water Right Order 95-1). Sacramento, CA.

[SWRCB] State Water Resources Control Board. (1999). Water Rights Decision 1641 for the Sacramento-San Joaquin Delta and Suisun Marsh (Adopted December 29, 1999, Revised in Accordance with order WR2000-02 March 15, 2000). Sacramento, CA.

Contact Info

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