Gualala River Estuary
Water Quality Physical-Chemical Sampling
February 19-October 23, 2003

Elmer Dudik
Environmental Scientist
North Coast Regional Water Quality Control Board
January 23, 2004

Table of Contents

List of Figures

List of Tables

Summary of Gualala Estuary Sampling, February-October, 2003

The North Coast Regional Water Quality Control Board (Regional Board) conducted six field-sampling events in the Gualala Estuary (estuary) from February through October 2003. The purpose of the sampling was to provide baseline information, summarized in reports and Excel worksheets, about the physical-chemical variability in the estuary as conditions change from an early season, tidally influenced body of water, to a freshwater dominated lagoon. A grant awarded by the State Coastal Conservancy titled *Gualala River Estuary and Lower River Assessment* (assessment) in the amount of $150,000 was awarded to the Gualala River Watershed Council. The grant was administered by the Sotoyome Resources Conservation District and was used to assess current habitat conditions, timing and use of the estuary by salmonids, and changes in physical and water quality habitat conditions throughout the sampling period ending in 2004-2005. The Regional Board's reports and Excel worksheets are available to participants in the assessment to supplement results of their work.

Five key parameters were sampled that included dissolved oxygen, water temperature, pH, specific conductance, and salinity. A short summary pertaining to each sampling event during 2003 is provided below:

February 19-24: Continuous recording datasondes (sondes) were deployed and retrieved at four locations in the estuary. Even though a sandbar was in place for much of the sampling period separating the river form the ocean, the influence of tidal pressures, without the presence of saltwater intrusion into the estuary, was detectable as variations in water depth that coincided with oceanic tidal changes. However, during the last morning of sampling the sandbar at the river mouth was breached resulting in the estuary being subject to saltwater intrusion as far as 1.07 miles upstream.

May 30-June 2: From May 30-June 2, four continuous recording sondes gathered data at two locations; two sondes were situated 0.50 mile upstream from the mouth at the "Wickerman" and two more were anchored 1.07 miles from the river mouth at the Mill Bend. At each site one sonde was resting on the bottom and the other was chained approximately 3 to 4-1/2 feet shallower. At 0.50 mile tidal fluctuations influenced all parameters, while at mile 1.07 only depth changes responded in near synchrony with tides at the river mouth. Diel fluctuations of dissolved oxygen and temperature were noticeable at mile 1.07, the Mill Bend, but were largely disguised, if present at all, at mile 0.50, the Wickerman, due to tidal disruptions during the 24-hour day-night cycle.

June 26: Depth profiles in the river thalweg were conducted at twelve locations in the estuary with measurements taken at each site for all parameters from the estuary bottom, stopping at 1-foot increments, and then ending at the water's surface. A barrier sandbar isolated the Gualala River from the ocean, creating lagoon instead of estuary conditions. The profiles showed that the influence of salt water extended from the river mouth at 0.10 mile, continuing upstream to mile 1.29 which was located under the Highway 1 bridge. The saltiest water formed a layer below a less salty, to nearly freshwater layer. At some of these locations there was an abrupt transition, or pycnocline, between the two layers. Three sites upstream from the bridge at 1.62, 1.85, and 3.24 miles were completely dominated by freshwater river discharges.

July 30: At most sites, in addition to thalweg profiles at seven locations, additional depth profiles were conducted at various points on either side of the thalweg resulting in abbreviated cross sections. Contrasting with conditions found on June 26 where all of the sites from the mouth to mile 1.29 were influenced by salt water to some degree, depth profiles on this date showed freshwater conditions were present to the same distance upstream. The only exception was a small remnant of saltier water resting on the bottom at mile 1.07, the Mill Bend. Except for the latter site, all parameters measured showed a fairly uniform, well mixed body of water with moderate to high dissolved oxygen concentrations. Temperatures were generally moderate with the highest readings in the pocket of salty water on the lagoon bottom at the Mill Bend.

September 11: Depth profiles in the thalweg and at locations on either side of the thalweg were completed at six locations from mile 0.10 to the Highway 1 bridge at mile 1.29. Lagoon conditions were again present with only a small pocket of saline water still persisting on the lagoon bottom of the Mill Bend at mile 1.07. At all other locations freshwater dominated the lagoon; however, in contrast to previous sampling efforts dissolved oxygen levels had dropped considerably, reaching a high of only 8.7 mg/L at two locations. A low of 0.6 mg/L was measured in the pocket of salt water at mile 1.07. Water temperatures were well within the limits for the survivability of most aquatic organisms, including salmonids.

October 23: Contrasting with the September 11 sampling event the influence of salt water intrusions, as noted by increased salinity and conductivity results, were evident on this date from depth profiles at seven of ten locations sampled, including one of three depth profiles under the Highway 1 bridge at mile 1.29. In the days prior to sampling the sandbar did not breach but wave wash over the barrier sandbar was reported by residents, explaining the elevations in salinity and specific conductivity. In addition, dissolved oxygen concentrations were highly elevated, ranging from 7.7-21.0 mg/L. Temperatures were generally lower than previously encountered, ranging from 14.7 ^{O}C-18.0 ^{O}C.

Recommendations for Future Sampling:

1. Locations for depth profiles, especially when cross sections are included, should be referenced to benchmarks or known, permanent landmarks. At the very least using a laser assisted rangefinder would provide fairly accurate distances to the riverbank from each sampling point.

2. It would be informative to cross-reference depth changes resulting from tidal fluctuations to the results from the tidal stations installed by Kammen Hydrology and Engineering, Inc. If these tidal stations are discontinued, continue to reference any tidally related depth changes in the estuary to Point Arena (the nearest referenced tide station in published tide tables) and then correct for the time and height of tides at the Gualala River mouth.

3. Money and time permitting, collect and analyze chlorophyll, and possibly nutrient samples, especially during the latter period of any sampling season when dissolved oxygen levels appear to drop as a result of persistent lagoon conditions and decreased discharges of freshwater from upstream.

Contents of CD available for the Gualala Estuary sampling completed by the Regional Board

Upon request a CD is available that contains the following WORD files and Excel spreadsheets in separate folders for the particular month of sampling.

The individual reports for each sampling event during the 2003 sampling season conducted by the Regional Board are included in the following WORD files:

Feb_2003 rpt.doc
May_2003 rpt.doc
June_2003 rpt.doc
July_2003 rpt.doc
Sept_2003 rpt.doc
Oct_03.xls

Excel worksheets for each sampling event are also included, from which charts, tables, and graphs were made by the Regional Board for the individual reports are:

February 19-24, 2003 sampling:

R5 feb19_03.xls
R2 feb19_03.xls
R3 feb19_03.xls
R4 feb19_03.xls
R5 feb19_03.xls

May 30-June 2, 2003 sampling:

GUA-2 may30_03.xls
GUA-3 may30_03.xls
GUA-5 may30_03.xls
GUA-6_May_03.xls

June 26, 2003 sampling:

ProfilesJune_03.xls

July 30, 2003 sampling:

ProfilesJuly_03.xls

September 11, 2003 sampling:

ProfilesSept_03.xls

October 23, 2003 sampling:

ProfilesOct_2003 rpt.doc

Gualala Estuary, Regional Board Continuous Sampling, February 19-24, 2003

From February 19 -24, 2003, the North Coast Regional Water Quality Control Board (Regional Board) deployed five YSI Series 6 remote datasondes (sondes), designated as R1, R2, R3, R4, and R5, at various locations and depths in the Gualala Estuary. All sondes were calibrated the afternoon prior to deployment and programmed to begin data collection at 8:00 a.m on February 19, 2003 in the Regional Board laboratory. Parameters sampled were dissolved oxygen, percent oxygen saturation, salinity, specific conductivity, temperature, pH, and depth.

Locations for sonde deployment in the estuary were preselected based on previous knowledge and sampling results conducted by ECORP, Inc., and Kamman Hydrology and Engineering, Inc. Site conditions on February 19, necessitated eliminating two prospective upstream sites from Mile 1.07, known locally as the Mill Bend, due to extreme currents. Sondes were deployed and retrieved using Ocean Kayaks by Richard Fadness and Elmer Dudik of the Regional Board. Figure 1 denotes the chosen sites of sonde placement during the sampling period.

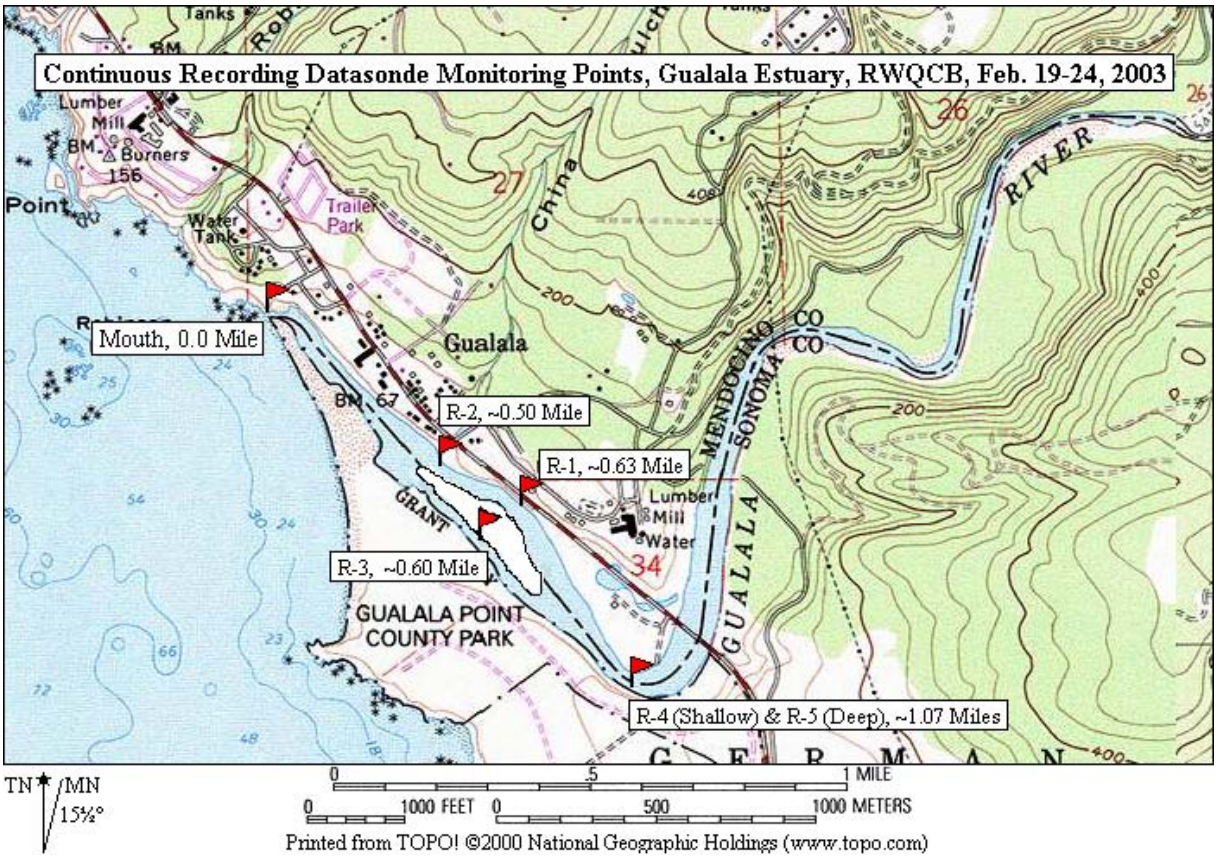

Figure 1 Regional Board sonde locations, Gualala Estuary, February 19-24, 2003.

For all of the sondes there were appreciable variances in amplitude for dissolved oxygen, temperature and depth during all days of deployment. Except for a small dip in dissolved oxygen and pH, and a similar elevation in temperature as a tidally induced saline wedge reached each sonde on February 24, changes prior to that date do not appear to be tidally related as the amplitudes for each parameter gently rise and fall over a number of high-low tide cycles, while conductivity and salinity remained in the freshwater range. Dissolved oxygen concentrations ranged from 12.98 mg/L at R4 to 8.25 mg/L at

R3. The maximum and minimum data for pH varied from 8.06 at R4 to 6.54 at R3. Diel changes throughout the sampling period are particularly noticeable for dissolved oxygen concentrations and temperature, with both parameters gradually rising during the daylight hours and depressing as darkness progressed until the next warming cycle during the following daylight period. Maximum temperatures ranged from a high of 11.87 ^{O}C at R4 to 11.01 ^{O}C at R1, while minimums ranged from 8.42 ^{O}C at R3 to 9.00 ^{O}C at R2.

Figure 2 for sonde R2, below, clearly demonstrates the points discussed above and is used to represent the data for sondes R3-R5. Except for differing depth placement of the sondes at each site, the chart for R2 is representative of the other three sondes during the February 19-24 sampling period. Along with R2, Figure 9 through Figure 13. are individual charts for all of the sondes

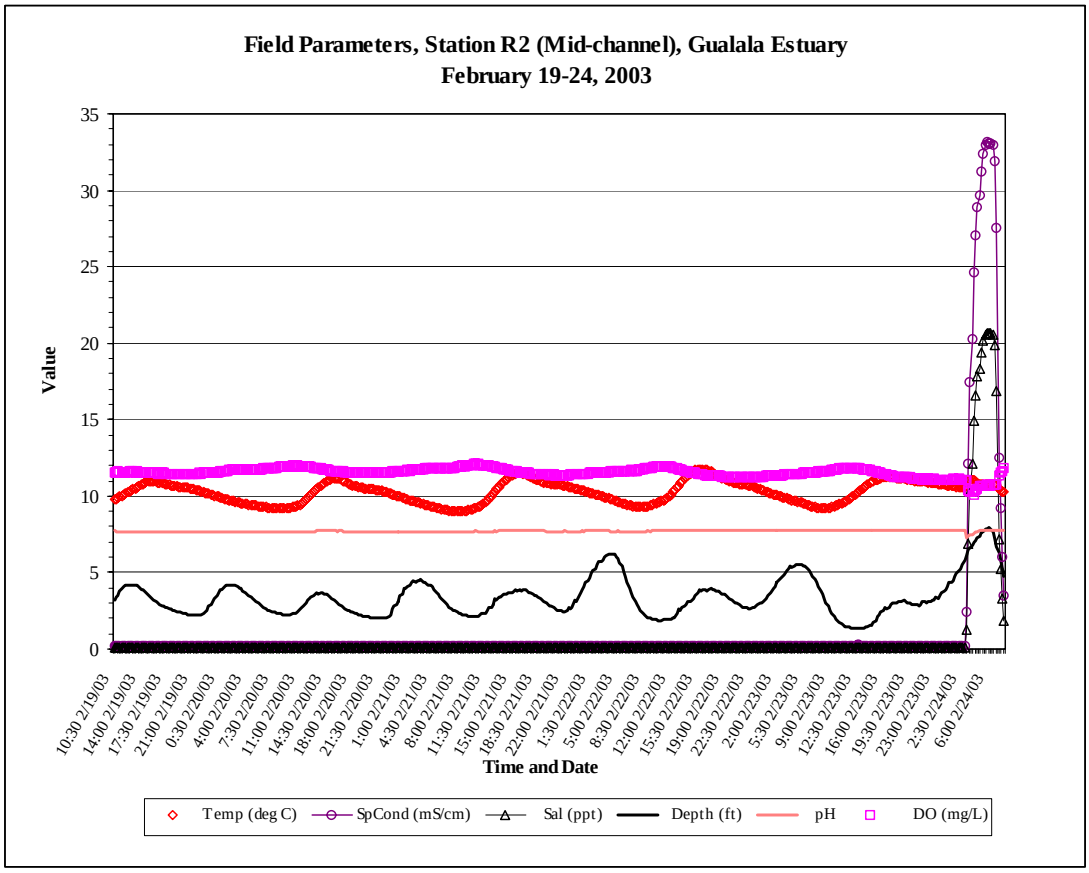

Figure 2 Continuously recorded physical parameters at datasonde R2, Gualala Estuary, 0200-0730, February 24, 2003

The fluctuations in the amplitudes of depth at the sondes closely corresponds to the time of tidal maximums and minimums at the mouth of the Gualala River during the five days they were deployed (Figure 3 below). As noted previously, all graphed and tabulated depths are relative, as none of the sondes were surveyed to benchmarks or referenced to tidal datums. The greatest depth range at all locations was between 0500 to 0630 on February 24, corresponding to an ocean tide of 5.9 feet at Point Arena. The depth fluctuations in the river from February 19-23 are thought to be the result of tidal differences on the ocean side of the sandbar backing up freshwater in the river portions of the estuary as the river attempted to equalize the differences in height between the two bodies of water. To accomplish this it is postulated that river flows may have been strong enough to seep through the sandbar due to a greater pressure differential than that exerted by the ocean, leaving predominantly

freshwater conditions in the river until the morning of February 24. This became evident as all five sondes, as mentioned, showed tidally correlated depth differences, but did not show increased salinity or specific conductance changes reflecting saltier water conditions, until after 0200 on the morning of February 24. The sandbar was breached when we arrived on February 24 and was the probable source of the elevated conductivity and salinity data at all of the locations from 0200 until data-logging ceased at 0800 on February 24. Also, local citizens observing from a bluff overlooking the river mouth reported that wave wash over the sandbar, an additional source of salt water to the estuary, from extremely rough ocean conditions was frequent the morning of February 24. Sand deltas resulting from wave wash scouring the sandbar were clearly visible on the river side of the bar that morning.

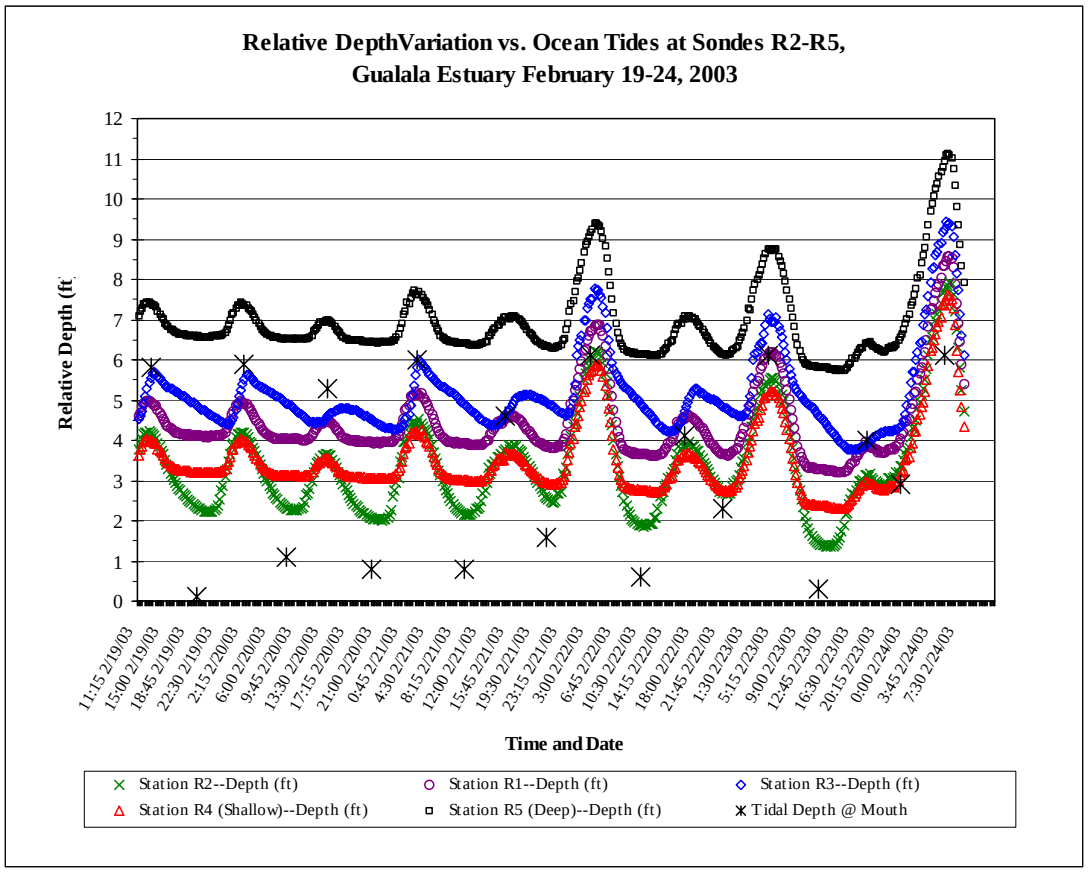

Figure 3 Relative depth variations at sondes R2-R5 in the Gualala Estuary from 1115-0800, February 19-24, 2003

Figure 6 and Figure 11 for Sonde R3, which was located along the south bank in a side-channel isolated from main river flows, also follow the general pattern for the other three sondes but has more jagged, irregular responses along the frequency of the graph for each parameter. The morning of February 24 sonde R3 had a maximum salinity of 9.41 parts per thousand (ppt) that was lower by approximately half than all of the other sondes. Perhaps because of its location in a quiet side-channel R3 was not subject to the extremes of salt water intrusion that the other sondes experienced.
The data show that the saltwater wedge intruded to, and possibly beyond sondes R4 and R5, located approximately 1.07 miles upstream. Sonde R5, which was on the same tether chain but purposely anchored on the river bottom approximately 3.4 feet below sonde R4, had slightly higher salinities and specific conductances than did R4. This was probably due to the increased density of saltier water sinking below less dense fresh water from upstream river discharges. Salinity ranged from 20.7 ppt at R2, the sonde nearest the river mouth, to lows of 0.080 ppt for all of the sondes at various times.

Conductivity varied from 33.130 mS/cm at R2, to 0.166 at both R4 and R5. Figure 4 through Figure 13 and Table 1 through Table 10 illustrate key points discussed above. The data in Figure 4 through Figure 8 and accompanying Table 1 through Table 5 were chronologically truncated from 0200 through approximately 0800 on February 24, 2003 to show only the specific conductance, salinity, and depth for all of the sondes. Table 6 through Table 10 are the maximum, minimum, median, and average data ranges for all of the parameters recorded from February 19-24

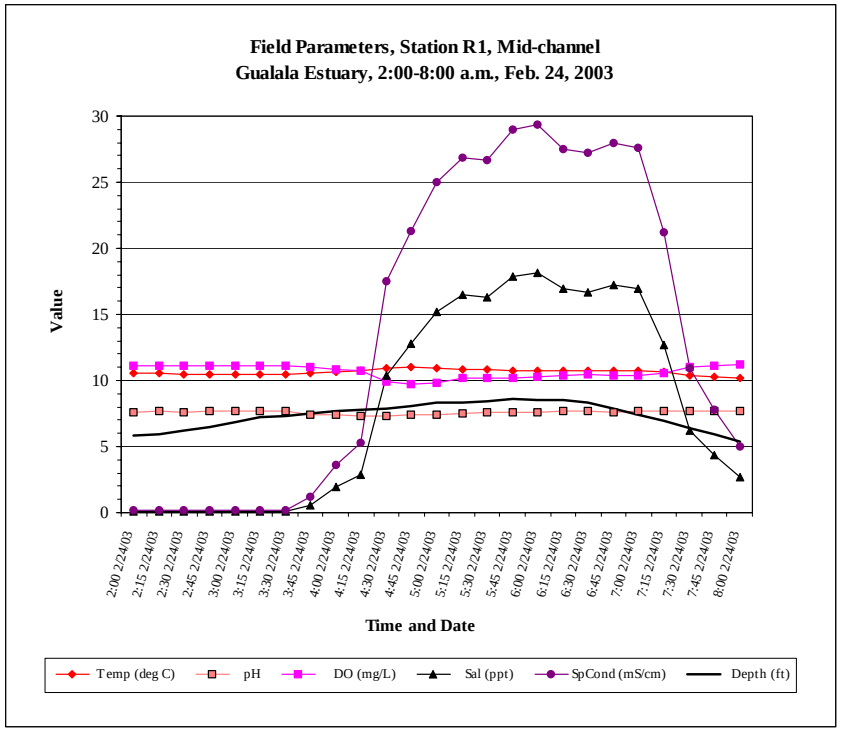

Figure 4 Continuously recorded physical parameters at datasonde R1 from 0200-0800, Gualala Estuary, February 24, 2003

Table 1 Continuously recorded physical parameters from 0200-0800 at R1, February 24, 2003

Time (a.m.)	Depth (ft)	DO (mg/L)	pH	Sal (ppt)	SpCond (mS/cm)	Temp (deg C)
2:00	5.798	11.09	7.62	0.09	0.192	10.52
2:15	5.92	11.08	7.64	0.09	0.191	10.52
2:30	6.186	11.09	7.63	0.09	0.193	10.5
2:45	6.477	11.09	7.66	0.09	0.193	10.49
3:00	6.815	11.09	7.67	0.09	0.191	10.49
3:15	7.233	11.08	7.67	0.09	0.192	10.49
3:30	7.296	11.08	7.66	0.09	0.191	10.49
3:45	7.473	11.01	7.41	0.6	1.198	10.52
4:00	7.65	10.84	7.4	1.91	3.605	10.62
4:15	7.818	10.75	7.33	2.85	5.265	10.71
4:30	7.898	9.93	7.33	10.34	17.51	10.97
4:45	8.045	9.74	7.38	12.81	21.33	11.01
5:00	8.335	9.85	7.44	15.22	25.00	10.97
5:15	8.358	10.14	7.52	16.48	26.89	10.87
5:30	8.471	10.16	7.57	16.32	26.65	10.85
5:45	8.567	10.14	7.58	17.85	28.94	10.78
6:00	8.553	10.29	7.57	18.12	29.33	10.76
6:15	8.529	10.39	7.64	16.91	27.54	10.77
6:30	8.307	10.43	7.65	16.69	27.21	10.76
6:45	7.881	10.41	7.61	17.21	27.99	10.74
7:00	7.384	10.4	7.64	16.97	27.63	10.75
7:15	6.922	10.53	7.68	12.73	21.22	10.64
7:30	6.434	11.01	7.67	6.23	10.95	10.38
7:45	5.904	11.1	7.64	4.34	7.808	10.29
8:00	5.411	11.17	7.66	2.68	4.962	10.23

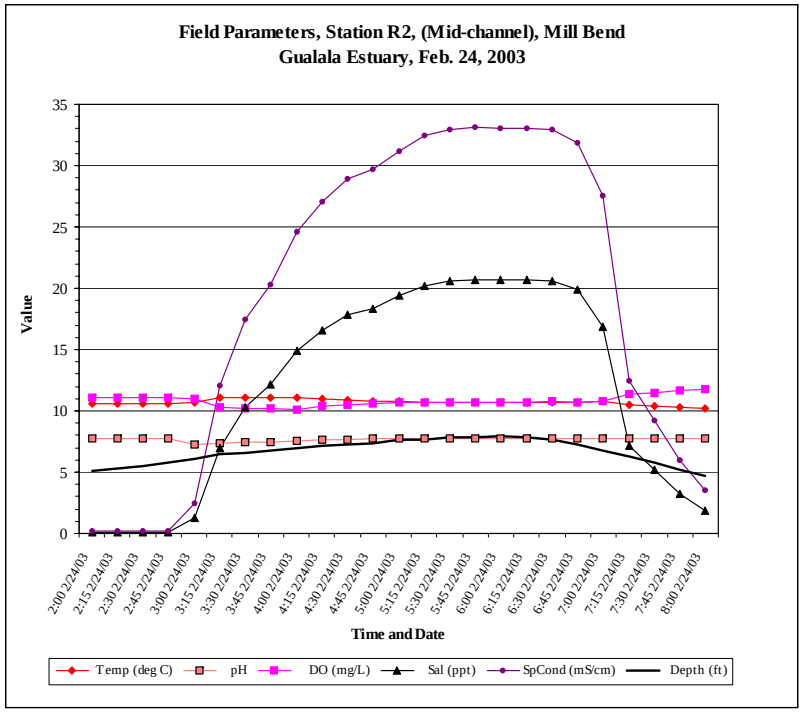

Figure 5 Continuously recorded physical parameters at datasonde R2 from 0200-0745, Gualala Estuary, 0200-0730, February 24, 2003

Table 2 Continuously recorded physical parameters from 0200-0800 at R2, February 24, 2003

Time (a.m.)	Depth (ft)	DO (mg/L)	pH	SpCond (mS/cm)	Sal (ppt)	Temp (deg C)
2:00	5.133	11.11	7.72	0.186	0.09	10.59
2:15	5.277	11.09	7.72	0.185	0.09	10.58
2:30	5.528	11.08	7.72	0.186	0.09	10.56
2:45	5.774	11.07	7.72	0.185	0.09	10.57
3:00	6.111	11.02	7.24	2.412	1.25	10.71
3:15	6.485	10.34	7.4	12.08	6.93	11.08
3:30	6.563	10.23	7.45	17.42	10.28	11.1
3:45	6.799	10.23	7.5	20.28	12.13	11.05
4:00	6.97	10.09	7.52	24.6	14.95	11.07
4:15	7.117	10.37	7.62	27.05	16.58	10.94
4:30	7.258	10.47	7.68	28.93	17.85	10.86
4:45	7.396	10.63	7.72	29.71	18.37	10.81
5:00	7.662	10.71	7.75	31.19	19.37	10.76
5:15	7.69	10.71	7.77	32.41	20.2	10.73
5:30	7.83	10.71	7.77	32.96	20.58	10.73

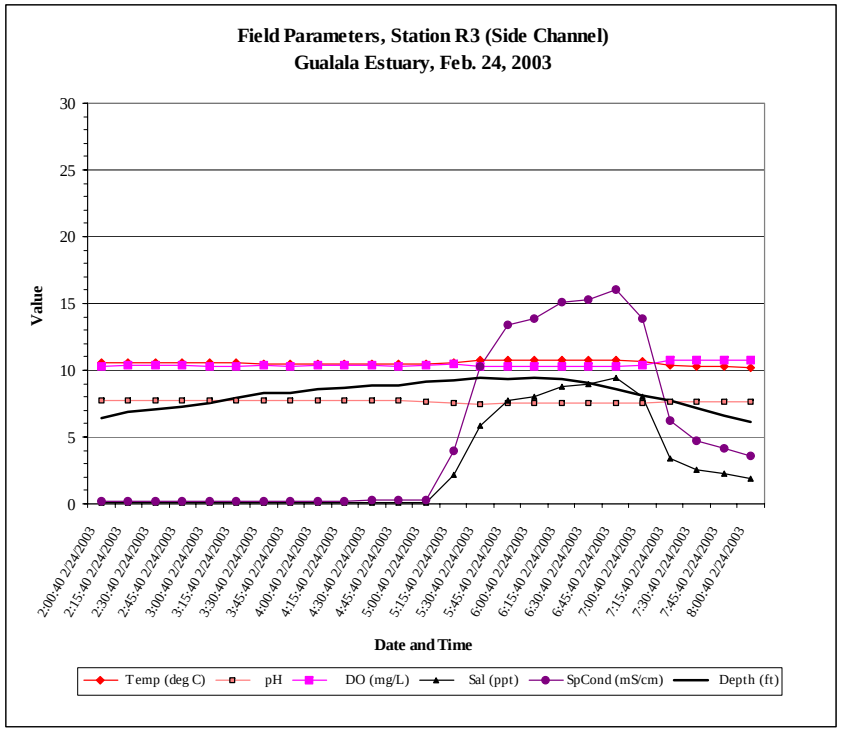

Figure 6 Continuously recorded physical parameters at datasonde R3 from 0200-0745, Gualala Estuary, 0200-0730, February 24, 2003

Table 3 Continuously recorded physical parameters from 0200-0800 at R3, February 24, 2003

Time (a.m.)	Depth (ft)	DO (mg/L)	pH	SpCond (mS/cm)	Sal (ppt)	Temp (deg C)
2:00:40	6.452	10.32	7.7	0.19	0.09	10.56
2:15:40	6.882	10.34	7.7	0.188	0.09	10.56
2:30:40	7.117	10.34	7.7	0.188	0.09	10.55
2:45:40	7.251	10.36	7.7	0.188	0.09	10.55
3:00:40	7.569	10.32	7.7	0.188	0.09	10.54
3:15:40	7.911	10.33	7.7	0.188	0.09	10.54
3:30:40	8.255	10.36	7.7	0.188	0.09	10.49
3:45:40	8.297	10.33	7.7	0.205	0.1	10.48
4:00:40	8.592	10.37	7.7	0.207	0.1	10.49
4:15:40	8.691	10.35	7.7	0.212	0.1	10.49
4:30:40	8.876	10.34	7.7	0.243	0.12	10.48
4:45:40	8.904	10.32	7.7	0.263	0.13	10.46
5:00:40	9.184	10.35	7.7	0.276	0.13	10.43
5:15:40	9.246	10.43	7.6	4.005	2.13	10.54
5:30:40	9.434	10.29	7.5	10.33	5.85	10.73
5:45:40	9.356	10.27	7.6	13.38	7.74	10.78
6:00:40	9.404	10.29	7.6	13.86	8.04	10.77
6:15:40	9.305	10.25	7.6	15.08	8.8	10.76
6:30:40	9.053	10.28	7.6	15.3	8.94	10.76
6:45:40	8.621	10.3	7.6	16.06	9.41	10.75
7:00:40	8.152	10.38	7.6	13.83	8.01	10.66
7:15:40	7.722	10.72	7.6	6.222	3.4	10.39
7:30:40	7.141	10.79	7.7	4.678	2.51	10.29
7:45:40	6.608	10.8	7.7	4.198	2.24	10.26
8:00:40	6.131	10.79	7.6	3.595	1.9	10.23

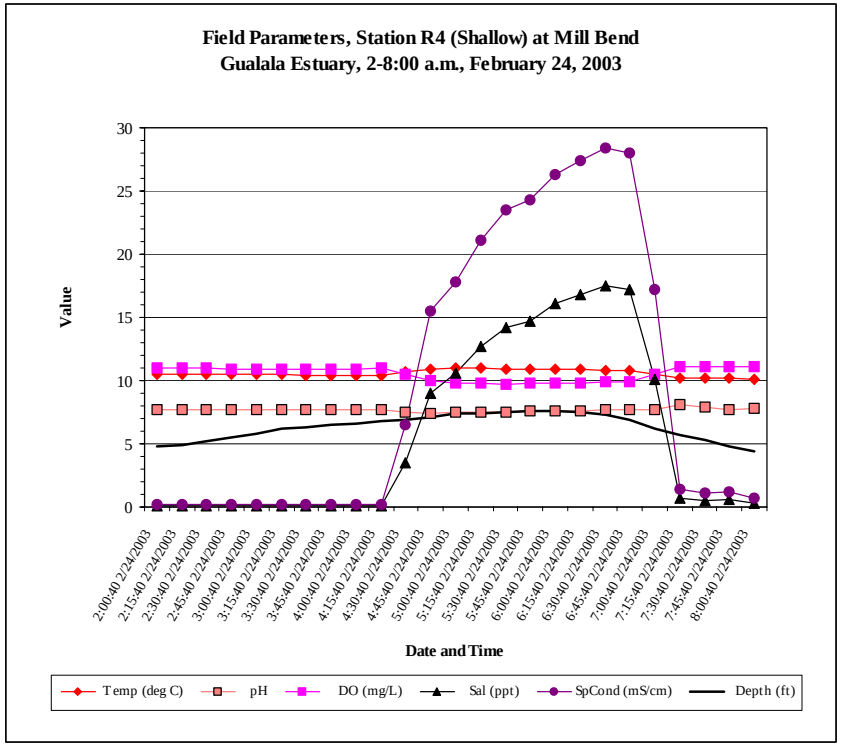

Figure 7 Continuously recorded physical parameters at datasonde R4 from 0200-0800, Gualala Estuary, February 24, 2003.

Table 4 Continuously recorded physical parameters from 0200-0800 at R4, February 24, 2003

Time (a.m.)	Depth (ft)	DO (mg/L)	pH	SpCond (mS/cm)	Sal (ppt)	Temp (deg C)
2:00:40	4.82	10.96	7.7	0.181	0.09	10.5
2:15:40	4.927	10.96	7.7	0.181	0.09	10.48
2:30:40	5.202	10.98	7.7	0.181	0.09	10.46
2:45:40	5.517	10.94	7.7	0.181	0.09	10.47
3:00:40	5.847	10.93	7.7	0.182	0.09	10.46
3:15:40	6.227	10.93	7.7	0.182	0.09	10.46
3:30:40	6.291	10.92	7.7	0.183	0.09	10.45
3:45:40	6.492	10.91	7.7	0.184	0.09	10.44
4:00:40	6.648	10.92	7.7	0.187	0.09	10.43
4:15:40	6.825	10.96	7.7	0.245	0.12	10.42
4:30:40	6.93	10.51	7.5	6.456	3.54	10.69
4:45:40	7.074	9.96	7.5	15.48	9.05	10.94
5:00:40	7.399	9.84	7.5	17.85	10.56	10.97
5:15:40	7.368	9.77	7.5	21.11	12.67	10.97
5:30:40	7.489	9.74	7.5	23.51	14.24	10.95
5:45:40	7.605	9.83	7.6	24.29	14.75	10.9
6:00:40	7.571	9.76	7.6	26.34	16.11	10.91
6:15:40	7.519	9.83	7.6	27.37	16.8	10.87
6:30:40	7.293	9.91	7.7	28.42	17.5	10.82
6:45:40	6.853	9.89	7.7	27.99	17.21	10.83
7:00:40	6.231	10.49	7.7	17.2	10.14	10.53
7:15:40	5.704	11.06	8.1	1.415	0.71	10.25
7:30:40	5.258	11.07	7.9	1.094	0.55	10.18
7:45:40	4.825	11.09	7.7	1.244	0.62	10.16
8:00:40	4.354	11.11	7.8	0.7	0.34	10.13

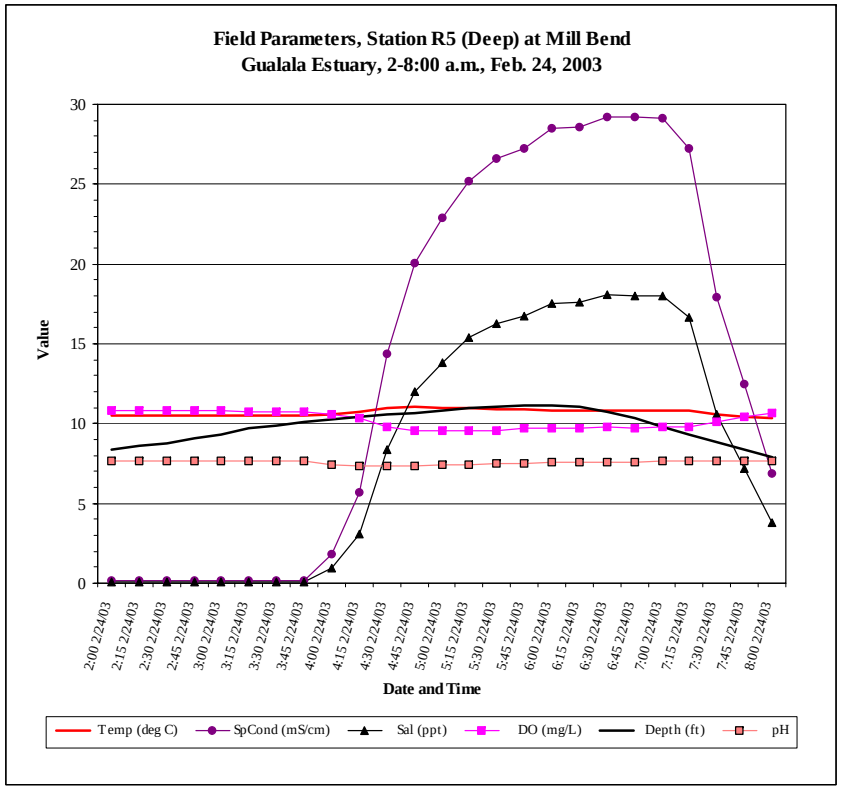

Figure 8 Continuously recorded physical parameters at datasonde R5 from 0200-0800, Gualala Estuary, February 24, 2003

Table 5 Continuously recorded physical parameters from 0200-0800 at R5, February 24, 2003

Time (a.m.)	Depth (ft)	DO (mg/L)	pH	SpCond (mS/cm)	Sal (ppt)	Temp (deg C)
2:00	8.405	10.8	7.63	0.182	0.09	10.52
2:15	8.607	10.79	7.63	0.182	0.09	10.51
2:30	8.799	10.79	7.63	0.182	0.09	10.5
2:45	9.062	10.79	7.63	0.182	0.09	10.49
3:00	9.34	10.78	7.63	0.182	0.09	10.49
3:15	9.712	10.76	7.63	0.183	0.09	10.5
3:30	9.878	10.77	7.63	0.184	0.09	10.48
3:45	10.066	10.76	7.63	0.184	0.09	10.48
4:00	10.276	10.61	7.4	1.829	0.93	10.57
4:15	10.393	10.33	7.36	5.698	3.1	10.73
4:30	10.556	9.81	7.32	14.4	8.37	10.97
4:45	10.675	9.59	7.37	20.07	11.99	11.03
5:00	10.805	9.58	7.41	22.87	13.82	11
5:15	10.951	9.56	7.45	25.22	15.36	10.98
5:30	11.076	9.59	7.49	26.58	16.27	10.92
5:45	11.123	9.69	7.53	27.27	16.73	10.9
6:00	11.106	9.74	7.57	28.49	17.55	10.85
6:15	11.032	9.75	7.58	28.59	17.62	10.84
6:30	10.769	9.77	7.6	29.25	18.06	10.82
6:45	10.324	9.75	7.61	29.18	18.01	10.81
7:00	9.828	9.8	7.62	29.13	17.98	10.8
7:15	9.346	9.82	7.62	27.21	16.69	10.79
7:30	8.865	10.14	7.64	17.93	10.6	10.59
7:45	8.341	10.4	7.64	12.48	7.17	10.44
8:00	7.907	10.64	7.67	6.882	3.79	10.31

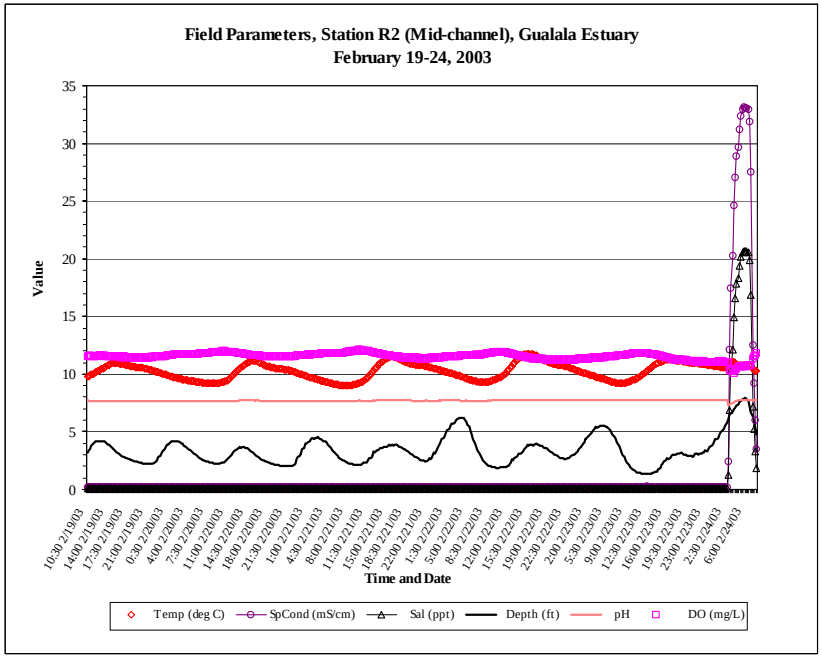

Figure 9 Continuously recorded physical parameters at datasondeR2, Gualala Estuary, February 19-24, 2003.

Table 6 Maximum, minimum, median, average physical parameters at sonde R2, February 19-24, 2003

R2 2/19-24/04	Temperature (deg C)	D.O. (mg/L)	Sp Con (mS/cm)	Salinity (ppt)	pH
Maximum	11.76	12.10	33.130	20.690	7.77
Minimum	9.00	10.09	0.168	0.080	7.24
Median	10.34	11.47	0.197	0.09	7.68
Average	10.27	11.54	1.206	0.714	7.70

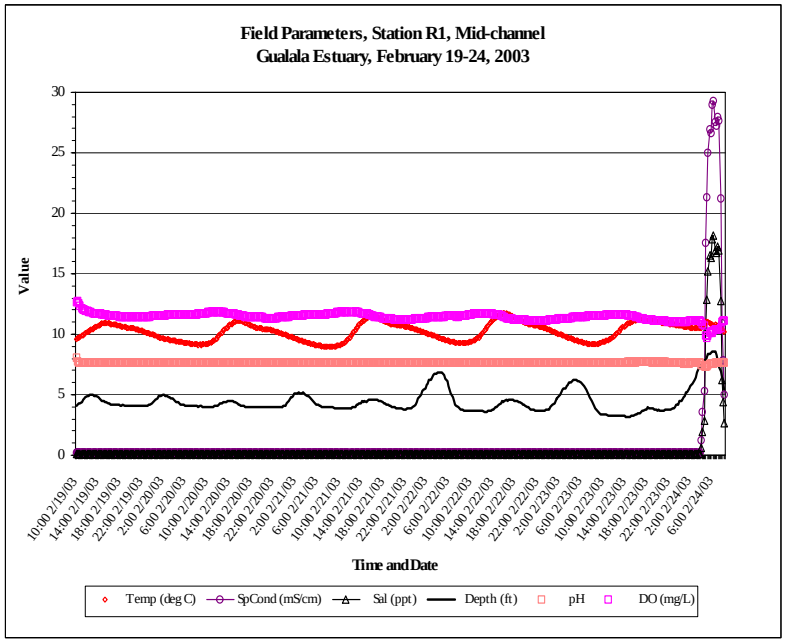

Figure 10 Continuously recorded physical parameters at datasondeR1, Gualala Estuary, February 19-24, 2003.

Table 7 Maximum, minimum, median, average physical parameters at sonde R1, February 19-24, 2003

R1 2/19-24/03	Temperature (deg C)	D.O. (mg/L)	Sp Con (mS/cm)	Salinity (ppt)	pH
Maximum	11.01	11.17	29.330	18.120	7.68
Minimum	8.96	9.74	0.173	0.080	7.33
Median	10.37	11.56	0.191	0.09	7.71
Average	10.23	10.64	0.911	0.527	7.57

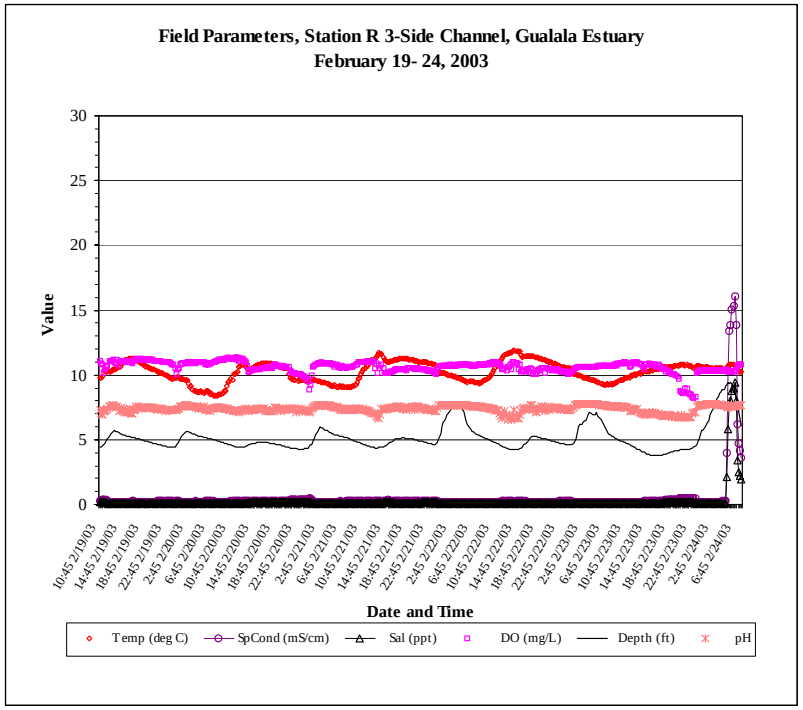

Figure 11 Continuously recorded physical parameters at datasondeR3, Gualala Estuary, February 19-24, 2003.

Table 8 Maximum, minimum, median, average physical parameters at sonde R3, February 19-24, 2003

R3 2/19-24/03	Temperature (deg C)	D.O. (mg/L)	Sp Con (mS/cm)	Salinity (ppt)	pH
Maximum	11.87	11.33	16.060	9.410	7.72
Minimum	8.42	8.25	0.178	0.080	6.54
Median	10.42	10.68	0.233	0.11	7.39
Average	10.23	10.60	0.496	0.262	7.37

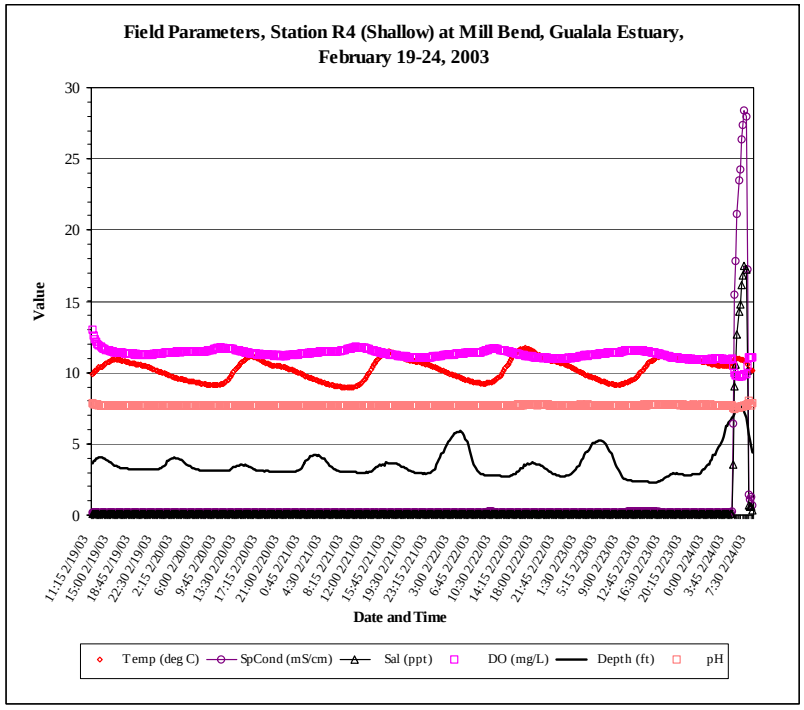

Figure 12 Continuously recorded physical parameters at datasondeR4, Gualala Estuary, February 19-24, 2003.

Table 9 Maximum, minimum, median, average physical parameters at sonde R4, February 19-24, 2003

R4 2/19-24/03	Temperature (deg C)	D.O. (mg/L)	Sp Con (mS/cm)	Salinity (ppt)	pH
Maximum	11.72	12.98	28.420	17.500	8.06
Minimum	8.94	9.74	0.166	0.080	7.45
Median	10.35	11.32	0.188	0.09	7.72
Average	10.22	11.30	0.697	0.396	7.72

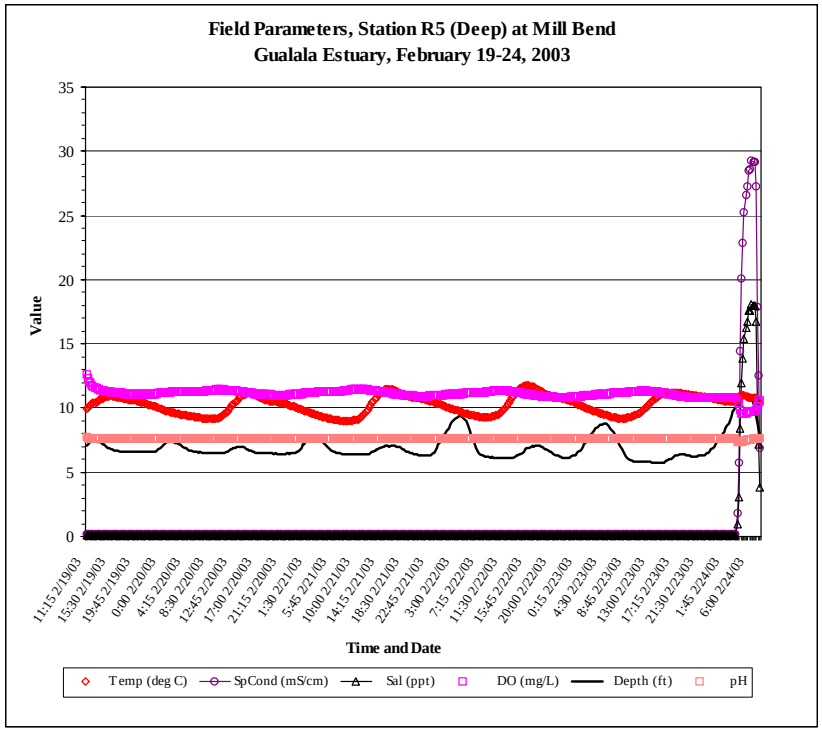

Figure 13 Continuously recorded physical parameters at datasonde R5, Gualala Estuary, February 19-24, 2003.

Table 10 Maximum, minimum, median, average physical parameters at sonde R5, February 19-24, 2003

R5 2/19-24/03	Temperature (deg C)	D.O. (mg/L)	Sp Con (mS/cm)	Salinity (ppt)	pH
Max	11.74	12.60	29.2500	18.060	7.70
Min	8.98	9.56	0.1660	0.080	7.32
Avg	10.26	11.11	0.9370	0.540	7.63

Gualala Estuary, Regional Board Continuous Sampling, May 30-June 2, 2003

From May 30-June 2, 2003 the North Coast Regional Water Quality Control Board (Regional Board) deployed five YSI Series 6 remote datasondes (sondes), designated as GUA-2, GUA-3, GUA-4, GUA-5, and GUA-6 at various locations in the Gualala River Estuary (Estuary). All sondes were calibrated in the Regional Board laboratory the afternoon prior to deployment and programmed to begin data collection at 8:00 a.m (0800) on May 30, 2003 for: dissolved oxygen, percent oxygen saturation, salinity, specific conductivity, temperature, pH, and depth. However, only sondes GUA-2, 5, and 6 collected the full suite of parameters during the sample period. GUA-4 did not activate at all due to a programming error. GUA-3 collected all parameters but salinity. The river mouth was open during sonde deployment, presumably resulting in estuarine conditions. Sondes were deployed and retrieved by Richard Fadness and Elmer Dudik of the Regional Board using Ocean Kayaks.

Locations of the sondes during this sampling period were preselected based on previous sampling experience during February, 2003 by the Regional Board (Figure 14). Though no sampling was conducted, a marker was also placed at the mouth of the Gualala River in Figure 14 that was used as a reference for determining upstream distances.

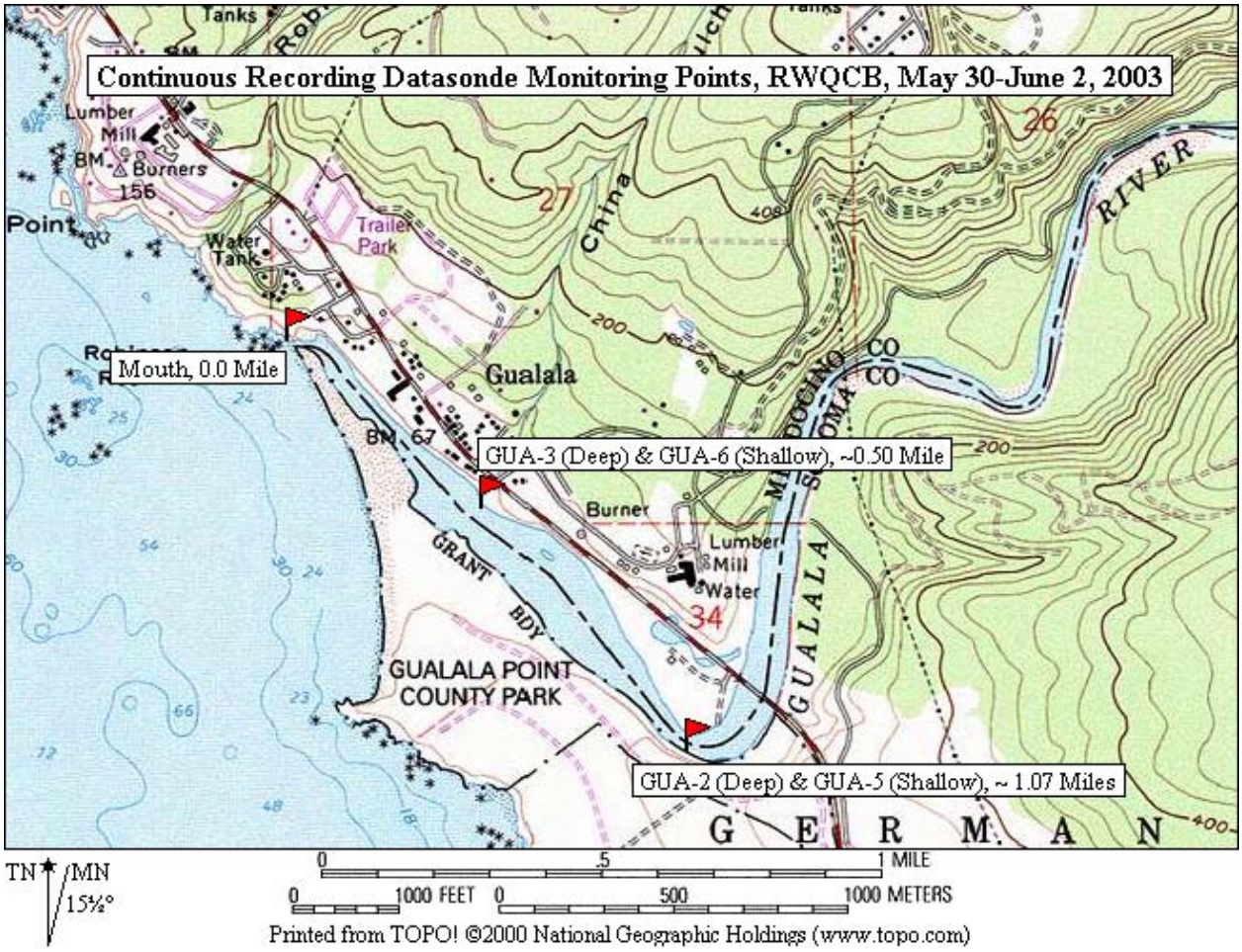

Figure 14 Regional Board datasonde locations, Gualala Estuary, May 30 through June 3, 2003.

Figure 15 through Figure 22 are graphical representations of the data collected during this sampling event. Several results stand out when looking at the data, particularly at GUA-3 and GUA-6, depicted in Figure

19 and Figure 20, where the salinity and conductivity maximums and minimums closely correspond to the rise and fall of the ocean tides at the mouth of the Gualala River. GUA-2 and GUA-5, located approximately 0.7 miles upstream from GUA-3 and –6, also showed responses to tidal fluctuations. As seen in Figure 15 and Figure 16 for GUA-2 and -3, except for depth and to a lesser extent pH, the response curves for the other physical parameters were much smoother compared to the jagged traces in Figure 14 and Figure 18 for GUA-3 and -6. Both GUA-2 and -5 were tethered to the same chain, with GUA-5 being locked approximately 4-4-1/2 feet above GUA-2.

GUA-2 had maximum results for salinity and specific conductivity of 0.15 ppt and 0.304 mS/cm (304 uS/cm), respectively. The choice was made to use mS/Cm instead of the more traditional uS/cm as the data could be represented on the same graph/chart with all of the other parameters. GUA-5 had slightly lower maximum conductivity and salinity readings of 0.299 mS/cm and 0.14 ppt, respectively, than GUA-2, which is expected considering GUA-5 was placed approximately 4-4-1/2 feet above GUA-2 where any saline water, if present, would likely be less dense than water near the bottom. At both GUA-2 and –5 minimum salinity and conductivity results were 0.214 mS/cm and 0.217 mS/cm, respectively. In general, the differences for both parameters at each sonde were not substantial and indicate mostly freshwater conditions. GUA-2 and –5 did have slightly higher levels of salinity and conductivity, typically noticeable on the downward limb of high tides, indicating that very minor influxes of salt water influenced results 1.07 miles upsteam from the river mouth. However, the force and volume of tidal salt water intrusions were probably insufficient to completely overwhelm the moderate to high river discharges present during the sampling period of GUA-2 and –5. Interestingly, even though the sondes were carefully attached with GUA-5 measured at approximately 4-4-1/2 feet above GUA-2, the depth results from the datalogger indicated that GUA-5 was only situated an average of about 0.02-0.03 feet above GUA-2. GUA-3 and GUA-6, both situated at different depths at the same location, but downstream from GUA-2 and –5, show a noticeable average depth difference of ~3.30 feet. Reasons for the depth disparity between the sondes at the upstream location has not been determined.

Despite being located only 0.57 mile upstream from GUA-3 and-6, both of which were noticeably influenced by tidal rhythms and accompanying spikes for all physical-chemical parameters, the same parameters at GUA-2 and –5 do vary, but were much more subdued. For example in Figure 15 and Figure 16 for GUA-2 and –5, temperature and dissolved oxygen variations appear as a gentle, sinusoidal wave, while pH stays within the mid- to high 7.0 range, appearing as a nearly straight line. Both temperature and dissolved oxygen gradually increase between the hours of 0730- 1900, although the temperature peak lags behind the dissolved oxygen peak by a few hours. The opposite occurs during the night time hours. This periodicity tends to indicate diel, rather than tidally moderated changes at this location. However, it is noteworthy that depth maximums coincide with dissolved oxygen minimums for all days during sonde deployment, indicating there may be some influences between depth and oxygen concentrations. Conductivity and salinity levels at GUA-2 and –5 essentially flatlined on the abscissa for both charts (see Figure 15 and Figure 16), indicating freshwater conditions throughout the sampling period.

Contrasting sharply with the upsream locations of GUA-2 and –5, GUA-3 and –6 were strikingly influenced by tidal rhythms for all parameters recorded (refer to Figure 17 through Figure 22 and Table 14 and Table 15). Conductivity at GUA-3 and GUA-6 showed marked elevations during mean higher high water (MHHW) with GUA-3 reaching maximums of 31.36 mS/cm between the hours of 0015 and 0030 on May 31, and 29.90 mS/cm between 2315 and 2400 on June 1. GUA-6 had lower maximum conductivities of 27.06 mS/cm and 21.34 mS/cm, respectively, within approximately the same time frames as the maximums at GUA-3. This is to be expected since GUA-6 was placed at the same location but on average approximately 3.3 feet shallower than GUA-3.

At GUA-3 and –6 there were a total of three MHHW tidal cycles from May 30-June 2 when the sondes were deployed, with subsequent conductivity and salinity maxima that rose and fell in near synchrony with the tidal curves (see Figure 19 and Figure 20). However, GUA-3, situated much deeper at a maxmum relative depth of 9.49 feet, than GUA-6, at 6.21 feet, had prolonged conductivity maximums that plateaued for hours during the MHHW tidal periods It then gradually dropped, bottoming out well into the falling limb of the mean lower low water (MLLW) and into the rising limb of the next mean lower high water (MLHW) tidal periods. Likewise, at both locations as expected, the same parameters reached what would be freshwater conditions in concert with the MLLW periods of the tidal cycle and reflecting the influence of higher, dominant upstream discharges from the Gualala River.

For the three days of sampling at the lowest MLLW tide, GUA-6 from 0600- ~0900 on May 31 recorded conductivity and salinity drops to essentially zero. This was accompanied by a similar drop in temperature for the same 3-hour period. In contrast, dissolved oxygen jumped from 8.42 mg/L to 12.17 mg/L in the space of 15 minutes, while pH rose more moderately, from 7.5 at 0545 to 7.75 at 0600, peaking at 8.09 during this 3-hour period. Temperature dropped abruptly from ~15.9 ^{O}C to 9.64 ^{O}C from 0545 to 0600, it then varied for the next 1.5 hours before gradually rising to the mid-12 ^{O}C range. Temperatures between 8-10 ^{O}C were previously experienced during the February, 2003 sampling period. As Table 11 shows conductivity reached a low of 0.0 mS/cm from 0830-0900 before abruptly jumping to 0.961 mS/cm at 0915, results also not seen during 2003.. Since GUA-3 was, on average, 3.3-feet deeper than GUA-6, the results for this time interval may be explained in two ways, 1) GUA-6 may have received a sudden pulse of extremely cool, ion free river water that, being less dense, did not sink to the sensor depths of GUA-3; this may also explain the drop in salinity and conductivity and, possibly, the rise in dissolved oxygen and drop in pH or, 2) there may have been a sonde malfunction for this 3-hour interval, which is possible in light of the minimum conductivities reaching 0.0 mS/cm which, as mentioned, appears anomalous compared to other data analyzed. Interestingly, upstream data from GUA-2 and –5 also did not experience these levels of deviation for the affected parameters during the same time intervals. Results for the questionable time interval, bracketed by more “normal” data, are included in Table 11,below.

Temperatures, briefly mentioned above, at GUA-6 were noticeably affected during periods of salt water intrusion, particularly around the peaks of the MHHW periods. As seen by the three spikes portrayed for conductivity and salinity in Figure 18, there also were resultant drops in temperature in response to much cooler tidal flows. However, unlike GUA-3, GUA-6, the shallower of the two sondes, also appears to respond to some extent to diel fluctuations in temperature as it does for dissolved oxygen. This becomes evident when looking at the discernable elevations of temperature during the daylight hours that slowly drop after nightfall, only to be disrupted by the regularity of tidal influences, discussed above.

Table 11 Parameter results at GUA-6 from 0545-0915, May 31, 2003

Date	Time	Depth (ft)	Temp (deg C)	SpCond (mS/cm)	Sal (ppt)	DO (mg/L)	pH
5/31/03	5:45	1.801	15.86	1.029	0.510	8.42	7.5
5/31/03	6:00	1.576	10.4	0.004	0.000	12.17	7.75
5/31/03	6:15	1.399	10.51	0.002	0.000	12.12	7.91
5/31/03	6:30	1.27	9.64	0.002	0.000	12.5	7.97
5/31/03	6:45	1.243	10.05	0.002	0.000	12.46	8.01
5/31/03	7:00	1.248	9.95	0.002	0.000	12.6	8.04
5/31/03	7:15	1.245	10.44	0.002	0.000	12.56	8.06
5/31/03	7:30	1.239	11.01	0.001	0.000	12.46	8.07
5/31/03	7:45	1.241	11.57	0.001	0.000	12.38	8.06

Date	Time	Depth (ft)	Temp (deg C)	SpCond (mS/cm)	Sal (ppt)	DO (mg/L)	pH
5/31/03	8:00	1.238	12.13	0.001	0.000	12.27	8.09
5/31/03	8:15	1.235	12.14	0.001	0.000	12.33	8.07
5/31/03	8:30	1.24	12.22	0	0.000	12.35	8.06
5/31/03	8:45	1.246	12.45	0	0.000	12.32	8.07
5/31/03	9:00	1.371	12.43	0	0.000	12.38	7.99
5/31/03	9:15	1.706	12.26	0.961	0.480	12.47	7.85

For all other time periods at GUA-3, dissolved oxygen, temperature, and pH appear to be more influenced by salt water intrusions mixing with freshwater, than the periodic diel rhythms experienced at the upstream sites of GUA-2 and -5. For example, at all three of the MHHW events temperature drops as salinity-conductivity increases, a possible response to much cooler, saltier ocean water entering the estuary. Dissolved oxygen responds with expected drops during all of the low water tidal cycles, followed by abrupt increases as tides gradually rise.

Excluding the May 31, 0600-0900 time interval, discussed above, GUA-6, situated 3.3 feet above GUA-3, on the other hand, does appear to respond more noticeably to the influence of river flows. This becomes evident when looking at the pronounced spiking and subsequent abrupt drops of conductivity and salinity, indicating shorter residence times for these parameters due to the flushing influence of less dense river discharges during the three MHHW tidal periods that did not affect GUA-3. The same data at the deeper GUA-3, as previously mentioned, experienced extended plateaus for those same parameters during various time frames.

Dissolved oxygen concentrations at GUA-6 also appeared to be moderated by a possible combination of upstream river flows and diel drops in dissolved oxygen during the night time hours It is, however, difficult to positively state that dissolved oxygen levels rise and fall only due to the influence of tides, or to decreased nightime photosynthetic rates, as both factors coincide with each other chronologically. That is, the MHHW event occured at night during the same period of time when dissolved oxygen would be expected to fall due to decreased photoynthetic activity. It also appears that tidal pressures have some influence near the MLLW tidal periods. Evidence for this, seen in Figure 18, are the abrupt “crests” in dissolved oxygen levels coinciding with, and slightly after the rising limb of each MLLW period, followed by a gradual drop that bottoms out during MHHW (excluding the questionable three hour time interval discussed above). Dissolved oxygen then begins a slow ascent before again cresting at the rising limb of each MLLW period. The dissolved oxygen maximums during this time frame are when the estuary should be dominated by river discharges. However, confounding this assumption are the very minor elevations in conductivity and salinity that appear at each MLLW period in near synchrony with the crests of dissolved oxygen at GUA-6 (see Figure 18 and Figure 22). It may be possible that the strength of the outgoing tide, coupled with dominant river flows at each low point of the MLLW period resulted in a flushing of residual salt water from upstream locations that registered as slight elevations in conductivity-salinity as it swept past GUA-6.

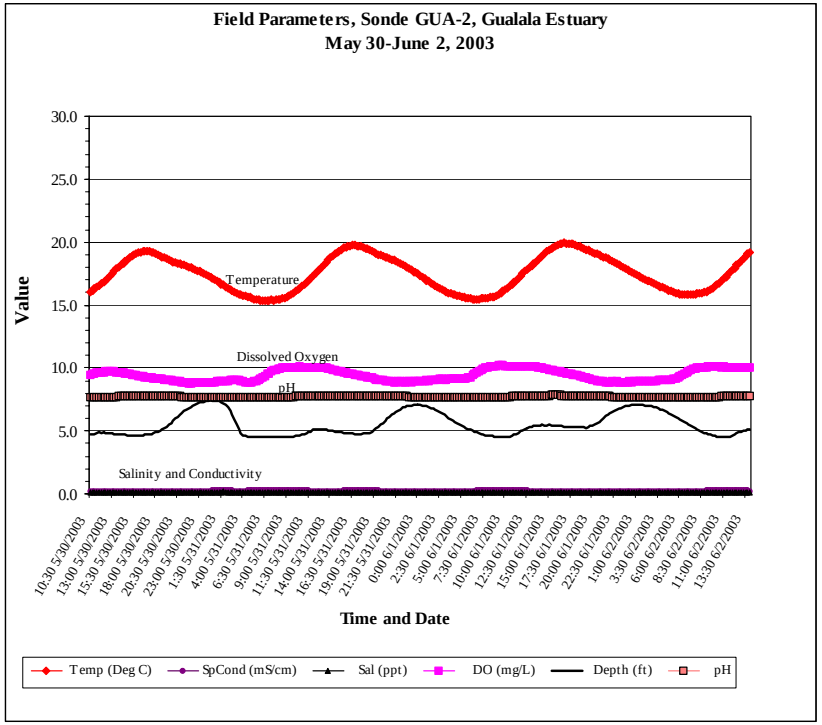

Figure 15 Continuously recorded physical parameters at GUA-2, the Mill Bend, Gualala Estuary, May 30-June 2, 2003.

Table 12 Maximum, minimum, and average statistics for physcial parameters at GUA-2

	DO (mg/L)	pH	Salinity (ppt)	SpCond (mS/cm)	Temp (deg C)
Maximum	10.19	7.82	0.15	0.304	19.92
Minimum	8.77	7.64	0.10	0.214	15.38
Median	9.36	7.72	0.11	0.234	17.38
Average	9.43	7.73	0.11	0.240	17.44

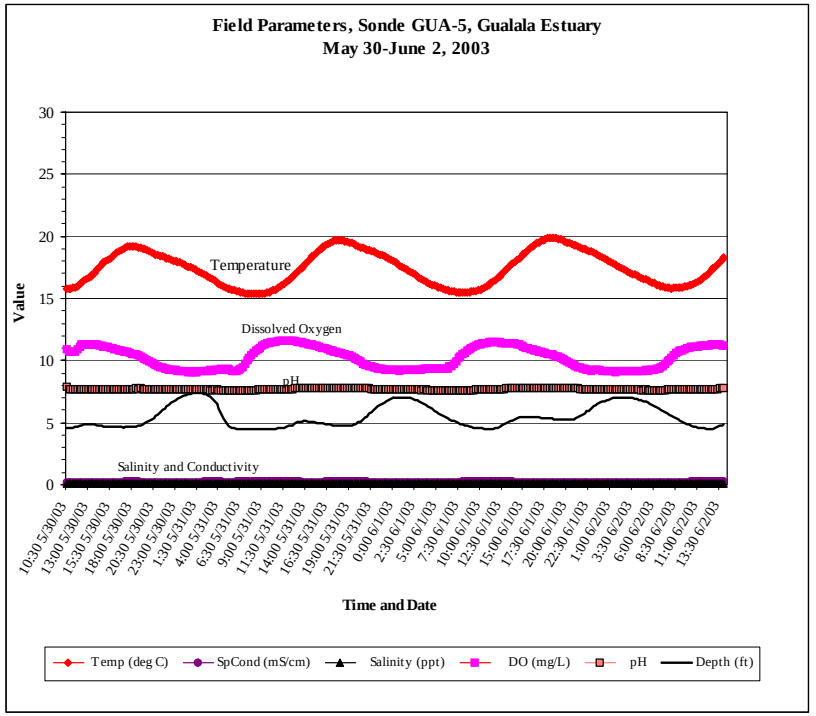

Figure 16 Continuously recorded physical parameters at GUA-5, the Mill Bend, Gualala Estuary, May 30-June 2, 2003.

Table 13 Maximum, minimum, and average statistics for physcial parameters at GUA-5

	DO (mg/L)	pH	Salinity (ppt)	SpCond (mS/cm)	Temp (deg C)
Maximum	11.58	7.88	0.14	0.299	19.86
Minimum	9.09	7.59	0.10	0.217	15.37
Median	10.30	7.71	0.11	0.236	17.35
Average	10.23	7.71	0.11	0.242	17.42

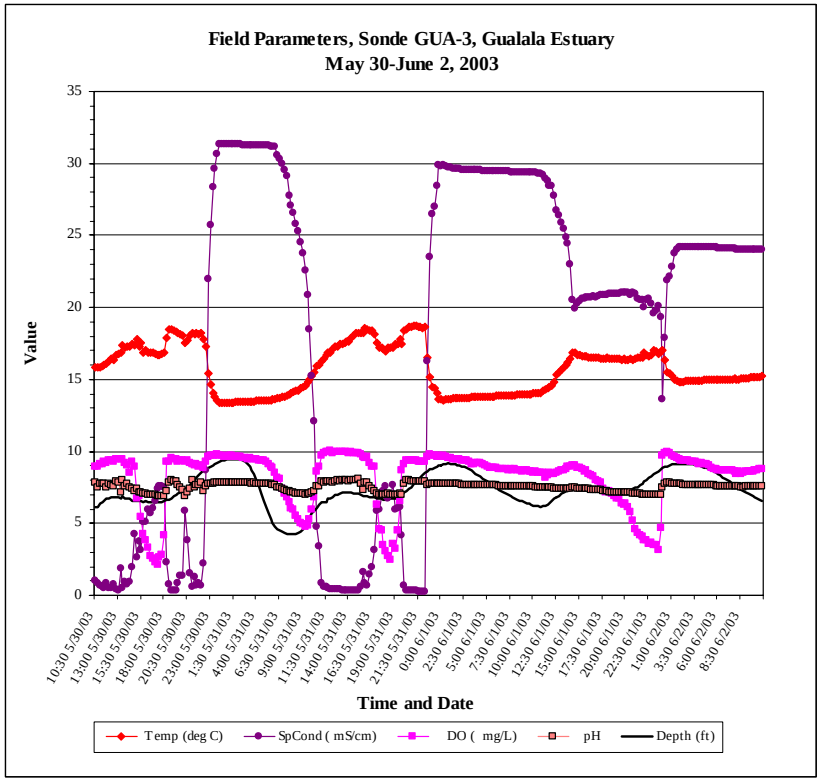

Figure 17 Continuously recorded physical parameters at GUA-3, the "Wickerman," May 30-June 2, 2003.

Table 14 Maximum, minimum, median, and average statistics for physcial parameters at GUA-3 the "Wickerman", Gualala Estuary, May 30-June 2, 2003.

	DO (mg/L)	pH	SpCond (mS/cm)	Temp (deg C)
Maximum	10.07	8.1	31.36	18.72
Minimum	2.09	6.87	0.284	13.35
Median	8.93	7.60	22.055	15.47
Average	8.21	7.53	17.97	15.69

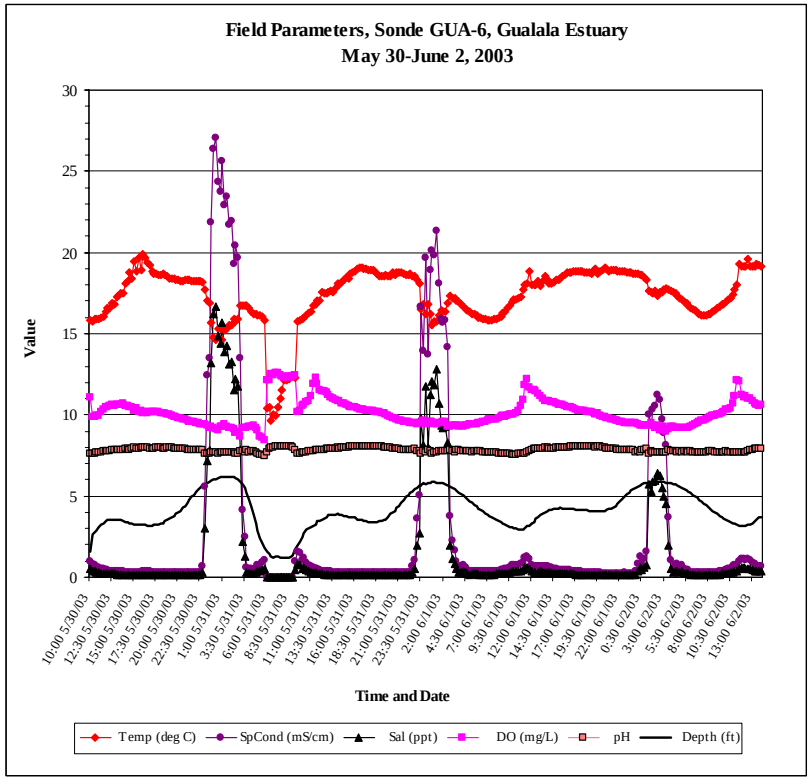

Figure 18 Continuously recorded physical parameters at GUA-6, the "Wickerman," Gualala Estuary, May 30-June 2, 2003.

Table 15 Maximum, minimum, and average statistics for physical parameters at GUA-6 the "Wickerman", Gualala Estuary, May 30-June 2, 2003.

	DO (mg/L)	pH	Salinity (ppt)	SpCond (mS/cm)	Temp (deg C)
Maximum	12.6	8.09	16.64	27.06	19.92
Minimum	8.42	7.5	0.00	0	9.64
Median	9.96	7.82	0.20	0.408	17.61
Average	10.12	7.83	1.52	2.64	17.29

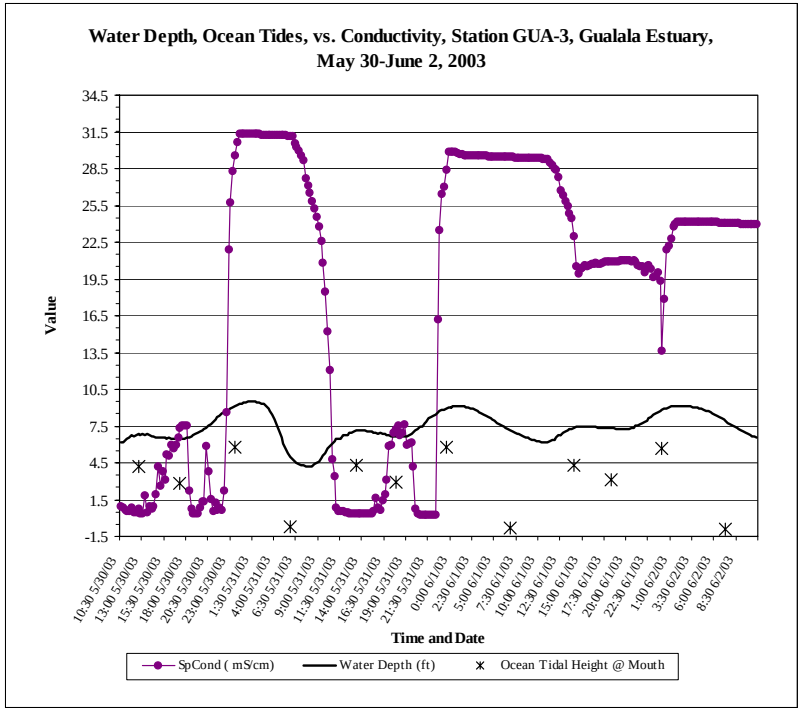

Figure 19 Water depth and tidal time and height vs. conductivity (salinity did not activate) at GUA-3 in the Gualala Estuary, May 30-June 2, 2003.

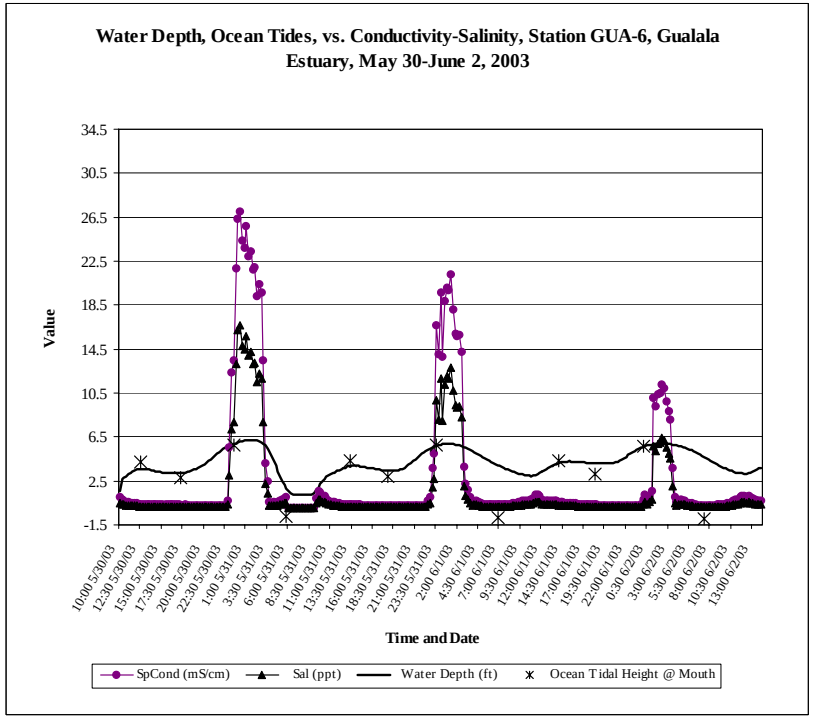

Figure 20 Water depth and tidal time and height vs. conductivity and salinity at GUA-6 in the Gualala Estuary, May 30-June 2, 2003.

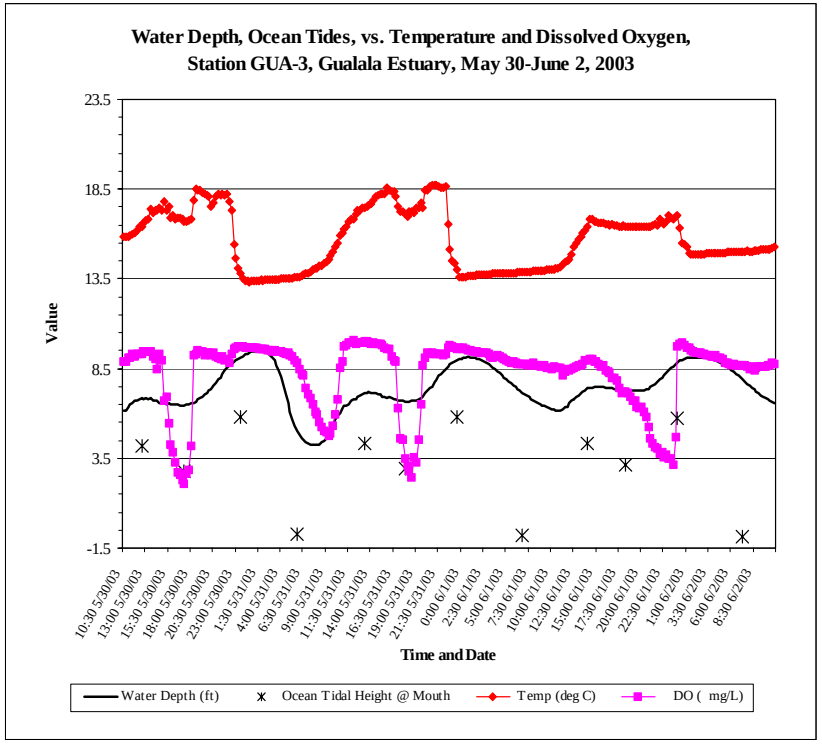

Figure 21 Water depth and tidal time and height vs. temperature and dissolved oxygen at GUA-3 in the Gualala Estuary, May 30-June 2, 2003.

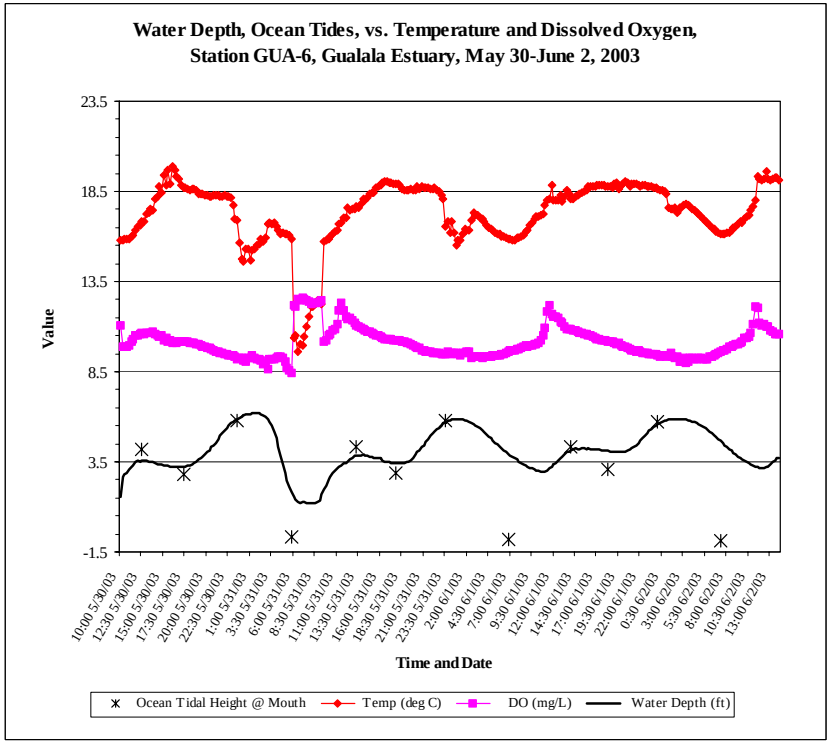

Figure 22 Water depth and tidal time and height vs. temperature and dissolved oxygen at GUA-6 in the Gualala Estuary, May 30-June 2, 200

Gualala Estuary, Regional Board Depth Profile Sampling, June 26, 2003

On June 26, 2003 the North Coast Regional Water Quality Control Board (Regional Board) used a YSI 600 XL data sonde (sonde) to sample physical parameters in the Gualala Estuary. The sonde was precalibrated and programmed for discrete sampling in the late afternoon of June 25th at the Regional Board laboratory prior to sampling the next day. Measurements were taken at various points along the length of the Gualala Estuary by Rich Fadness and Elmer Dudik using Ocean Kayaks to access the sample locations shown in Figure 23. At each Profile Point (Pt) depth profiles were conducted in the approximate thalweg of the channel from the estuary bottom, pausing at 1-foot intervals to stabilize the sonde for another measurement, ending at approximately 0.2 foot from the water surface. Physical-chemical parameters recorded included dissolved oxygen, percent oxygen saturation, salinity, specific conductivity, temperature, pH, and depth.

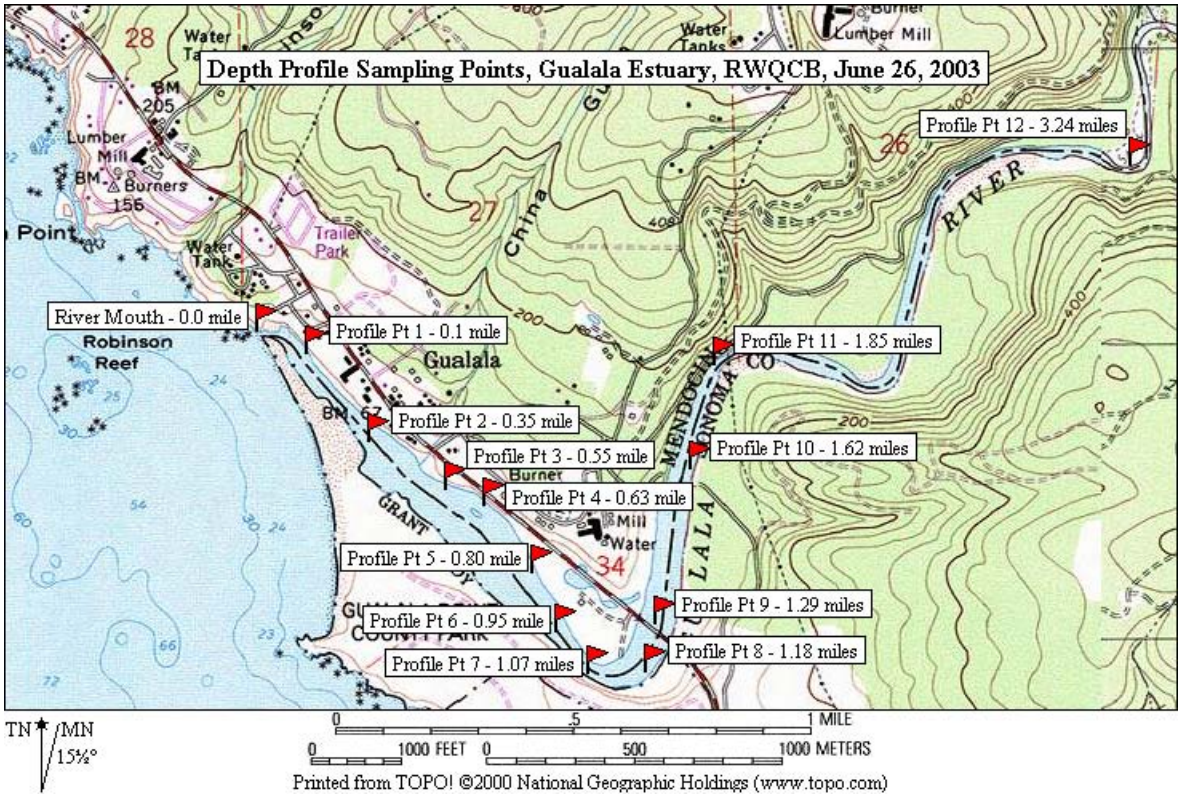

Figure 23 Regional Board Depth Profile Points, Gualala Estuary, June 26, 2003.

Depth profiles began at Pt-1, approximately 0.1 mile from the ocean, ending at Pts-10, 11, and 12, locations that were dominated completely by freshwater flows from upstream. Pts-10 and 11 are approximately 1.62 and 1.85 miles, respectively, from the ocean. Pt-12 at 3.24 miles from the ocean, was chosen as an extreme upstream sample point to verify an upper extent for freshwater flows. The river was only 2.5 feet deep at Pt-12; measurements were taken half way to the bottom, at approximately 1-1/4 feet, and on the bottom itself.

A sandbar was in place during sampling that isolated the Gualala River from the ocean, creating a lagoon, instead of true estuarine conditions. Sonde results of both salinity and specific conductance showed that stratification was evident at all locations from Pts-1-9 between more dense, saline water and overlying,

less dense freshwater. One could visually discern the deeper lying saline water from the freshwater by differences in color. Also, small pieces of waterlogged leaves, twigs, and other organic matter that easily sank through the overlying freshwater formed a layer of drifting debris that was unable to sink below the denser saline water layer. This transitional layer between less dense freshwater and denser saline water is analogous to the pycnocline seen in the open ocean and many tidally active estuaries. A pycnocline is generally defined as "a boundary layer formed in water masses of different salinity or temperature. It can be a halocline, a more permanent barrier formed between water layers of different salinity, or a thermocline, a usually more seasonal barrier formed between water layers of different temperature" (Mann and Lazier, 1991). This difference between the densities of fresh and more saline water in the Gualala Estuary-Lagoon, discussed in more detail below, is readily apparent when the physical characteristics at particular depth profiles are studied.

Figure 24 graphically illustrates the relationship between water depth, distance between points, and the five parameters of temperature, salinity, conductance, dissolved oxygen, and pH. Table 16is the raw data used to synthesize Figure 24, each depicts only the single result at or near the thalweg of the lagoon bottom for that point. Figure 25 through Figure 36 and Table 17 through Table 28 at the end of the report are the data at each sample point at 1-foot increments as they were recorded in the field.

Table 16 Regional Board physical parameters at the bottom along thalweg, Gualala Estuary-Lagoon, June 26, 2003

Distance from Mouth (miles)	Sample Point-Water Depth along Thalweg (ft)	D.O. (mg/L)	pH	Salinity (ppt)	SpCond (mS/cm)	Temp (deg C)
0.1	Pt 1-8.7	9.87	7.87	29.48	45.635	11.21
0.35	Pt 2-6.5	11.56	7.95	26.99	42.065	12.91
0.55	Pt 3-7.7	11.58	7.99	28.32	43.951	12.42
0.63	Pt 4-8.4	10.41	7.91	28.46	44.169	12.19
0.8	Pt 5-5.2	14.55	8.13	23.3	36.474	15.56
0.95	Pt 6-8.6	10.99	7.97	24.32	38.224	14.78
1.07	Pt 7-11.0	11.63	8.02	24.99	39.187	14.4
1.18	Pt 8-12.4	12.62	8.04	24.88	39.022	14.63
1.29	Pt 9-5.5	13.58	8.21	17.17	27.85	18.6
1.62	Pt 10-3.7	8.61	7.87	0.1	0.216	19.68
1.85	Pt 11-6.5	8.93	7.92	0.1	0.216	19.07
3.24	Pt 12-1.0	9.76	7.87	0.1	0.217	21.42

As previously noted, salinity and conductance essentially flatlined from Pt-10 through Pt-12, representing freshwater conditions. Conductivities at the three upstream points were consistently between 0.216 and 0.217 mS/cm, (216 and 217 uS/cm) while salinity was consistently < 0.1 ppt. These values were so low for both parameters that they could not be represented in Figure 24 due to the choice of using mS/Cm as a unit of measure that could be presented along with the other parameters on the same graph. It should be noted that in the Water Quality Control Plan for the North Coast Region (Basin Plan) conductivity is expressed as uS/cm for freshwater systems. There are no numeric criteria in the Basin Plan at this time for specific conductivity (as well as the other four parameters measured) for the lower Gualala River during estuarine and/or lagoon conditions.

At all points pH was consistently between 7.8 to 8.8 (see Table 17 through Table 28), a difference of only 1.0 standard pH unit. There were very small, localized variances that generally were at those depths that coincided with the transition between fresher surface water and underlying, saltier water as the lagoon bottom was approached. Conductivity and salinity at most of the locations through Pt-12, as alluded to

earlier, increased with depth and decreased as you moved upstream. As illustrated, the lagoon was completely freshwater at Pts-10-12.

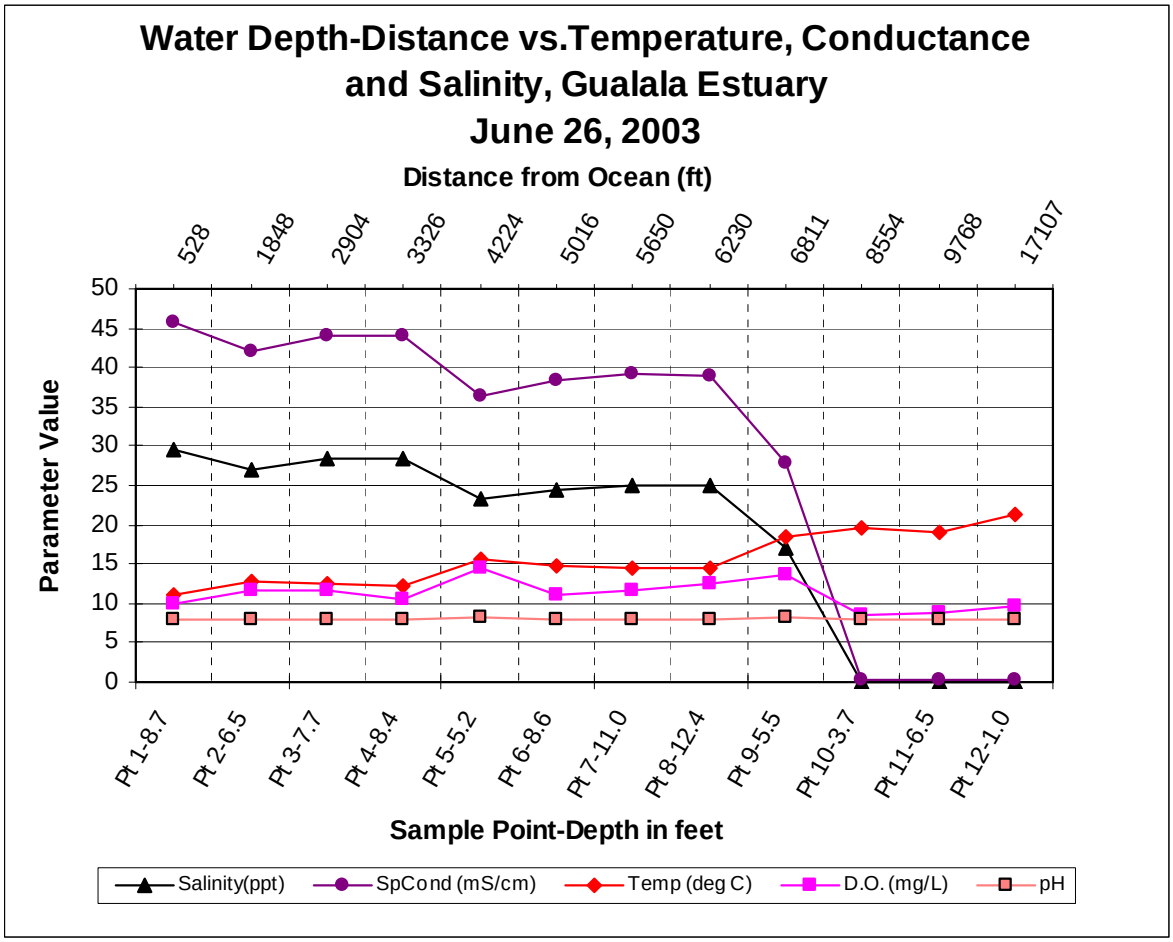

Figure 24 Regional Board physical parameters sampling along thalweg, Gualala Estuary-Lagoon, June 26, 2003

Dissolved oxygen concentrations remained moderate to high at all points for each depth profile and would be supportive to the survival of salmonids and other aquatic vertebrates requiring adequately oxygenated waters. Interestingly, at most of the profiles as the depth increased along with accompanying higher specific conductivities and salinities there is a corresponding bulge in dissolved oxygen concentrations between 2- to 5-feet, before decreasing slightly again toward the estuary bottom. This trend is seen from Pts-3-9 depicted in Figure 27 through Figure 33 and is particularly pronounced at Pts-7 and 8, where, at 4.01 feet and 4.4 feet the dissolved oxygen bulge peaks at 16.40 mg/L and 16.22 mg/L, respectively.

Water temperatures at the same locations discussed for dissolved oxygen, above, decreased from the low to mid-19 ^{O}C range to the mid-18 ^{O}C from the surface until developing a depressive "bulge", beginning around 3.5 feet instead of near 2.5 feet, as did dissolved oxygen (refer to the appropriate figure and table). The temperatures then sharply decreased below the 4- to 4.5-foot depth to the mid-16 ^{O}C range until reaching the estuary bottom, where it peaked in the mid-14^{O}C range. In general though, at the water's surface and at varying depths, with some minor irregularities, temperatures at lagoon and riverine locations steadily increased from Pt-1 near the river mouth to Pt-12.

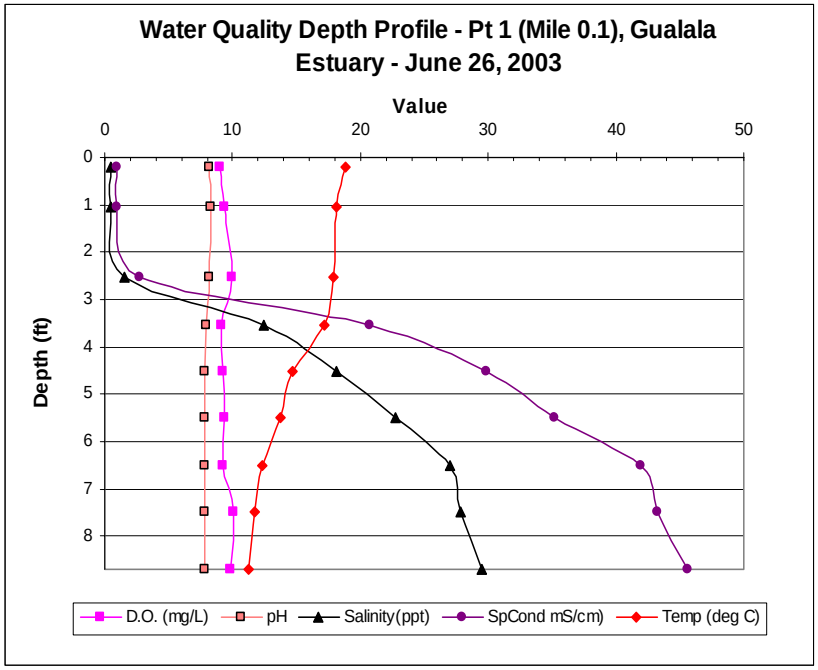

Figure 25 Depth profile of physical parameters at Point 1 near the left bank of the Gualala Lagoon, June 26, 2003.

Table 17 Physical parameters at Point 1 near the left bank of the Gualala Lagoon, June 26, 2003.

Water Depth (ft)	D.O. (mg/L)	pH	Salinity (ppt)	SpCond (mS/cm)	Temp (deg C)
0.2	9.03	8.2	0.49	0.989	18.9
1.05	9.38	8.3	0.5	1.005	18.1
2.53	9.99	8.2	1.5	2.73	17.9
3.54	9.16	7.9	12.48	20.744	17.2
4.52	9.23	7.9	18.16	29.801	14.7
5.5	9.32	7.9	22.73	35.23	13.7
6.5	9.28	7.8	26.99	41.902	12.3
7.5	10.09	7.8	27.85	43.298	11.8
8.7	9.87	7.9	29.48	45.635	11.2

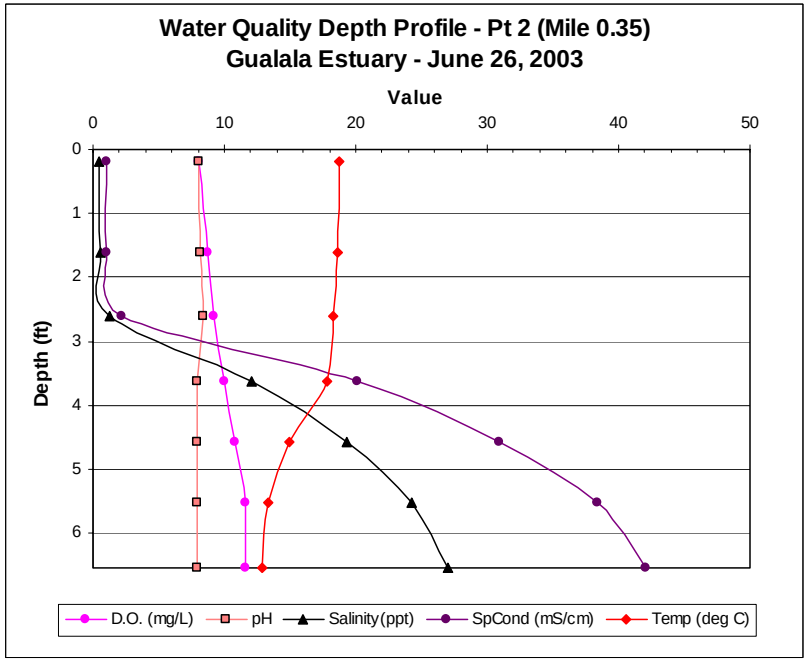

Figure 26 Depth profile of physical parameters at Point 2 of the thalweg of the Gualala Lagoon, June 26, 2003.

Table 18 Physical parameters at Point 2 of the thalweg of the Gualala Lagoon, June 26, 2003.

Water Depth (ft)	D.O. (mg/L)	pH	Salinity (ppt)	SpCond (mS/cm)	Temp (deg C)
0.2	8.1	8.1	0.5	1.002	18.8
1.6	8.71	8.2	0.6	1.072	18.6
2.6	9.19	8.4	1.3	2.201	18.3
3.63	10	7.9	12.1	20.076	17.8
4.58	10.84	7.9	19.3	30.939	14.9
5.53	11.6	8.0	24.3	38.336	13.3
6.54	11.56	8.0	27.0	42.065	12.9

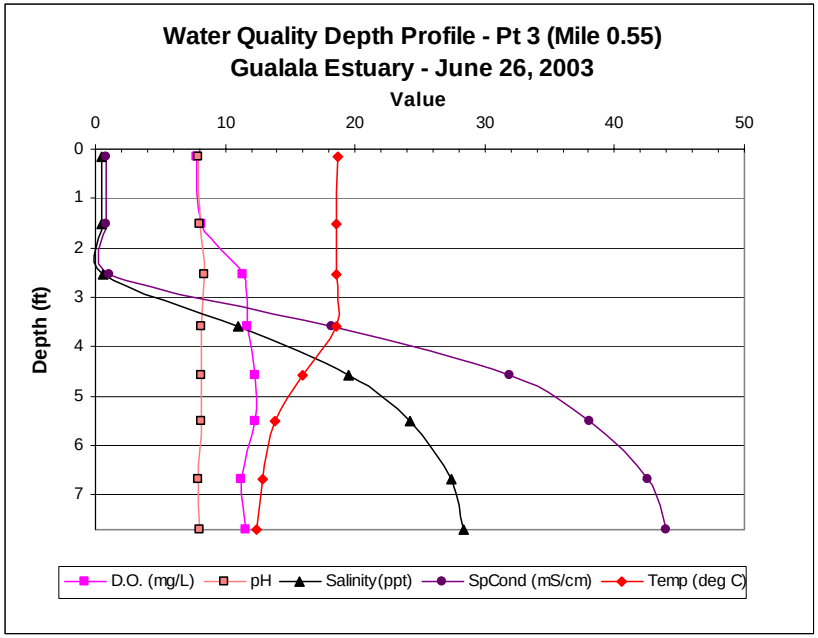

Figure 27 Depth profile of physical parameters at Point 3 near the right bank of the Gualala Lagoon, June 26, 2003.

Table 19 Physical parameters at Point 3 near the right bank of the Gualala Lagoon, June 26, 2003.

WaterDepth (ft)	D.O. (mg/L)	pH	Salinity (ppt)	SpCond (mS/cm)	Temp (deg C)
0.17	7.86	7.9	0.42	0.861	18.7
1.53	8.15	8.0	0.42	0.86	18.5
2.53	11.32	8.4	0.61	1.093	18.6
3.58	11.7	8.2	11.02	18.221	18.5
4.57	12.24	8.1	19.53	31.96	16.0
5.5	12.34	8.1	24.21	38.118	13.9
6.68	11.26	7.9	27.4	42.584	12.9
7.7	11.58	8.0	28.32	43.951	12.4

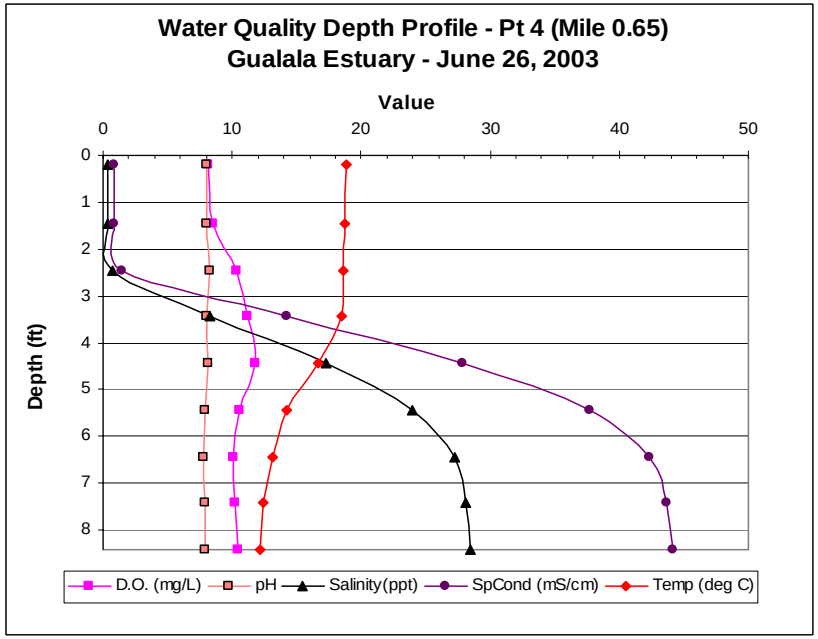

Figure 28 Depth profile of physical parameters at Point 4 of the Gualala Lagoon, June 26, 2003.

Table 20 Physical parameters at Point 4 of the Gualala Lagoon, June 26, 2003.

Water Depth (ft)	D.O. (mg/L)	pH	Salinity (ppt)	SpCond (mS/cm)	Temp (deg C)
0.21	8.12	8.0	0.42	0.846	18.9
1.46	8.53	8.1	0.42	0.848	18.8
2.46	10.28	8.3	0.73	1.44	18.6
3.42	11.25	8.1	8.25	14.28	18.5
4.44	11.84	8.1	17.23	27.902	16.7
5.43	10.55	7.9	24.01	37.76	14.2
6.45	10.04	7.8	27.22	42.326	13.1
7.42	10.2	7.9	28.1	43.637	12.4
8.42	10.41	7.9	28.46	44.169	12.2

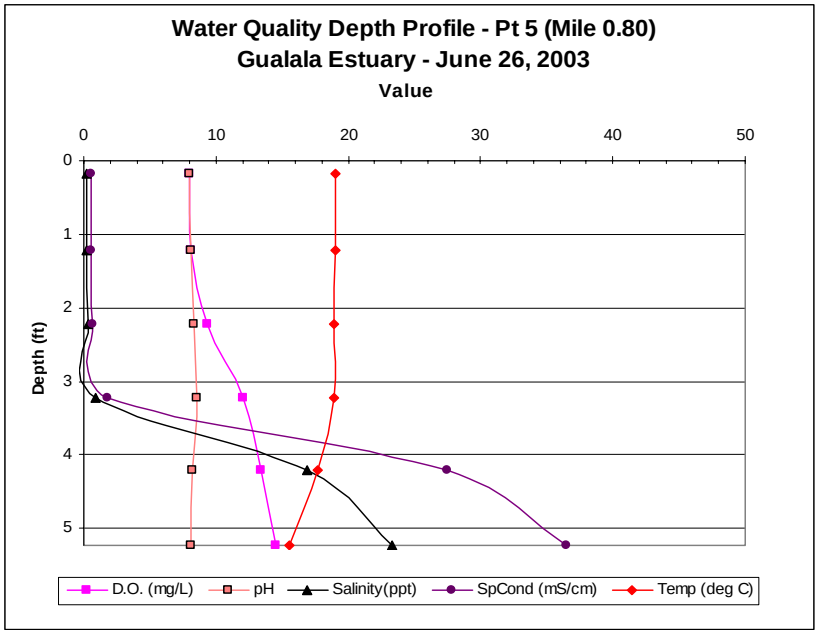

Figure 29 Depth profile of physical parameters at Point 5 of the thalweg of the Gualala Lagoon, July 30, 2003.

Table 21 Physical parameters at Point 5 of the thalweg of the Gualala Lagoon, July 30, 2003.

Water Depth (ft)	D.O. (mg/L)	pH	Salinity (ppt)	SpCond (mS/cm)	Temp (deg C)
0.17	7.97	8.0	0.26	0.529	19.0
1.21	8.08	8.1	0.26	0.541	19.0
2.22	9.33	8.4	0.31	0.632	19.0
3.22	12	8.5	0.91	1.791	19.0
4.21	13.42	8.2	16.92	27.424	17.7
5.23	14.55	8.1	23.3	36.474	15.6

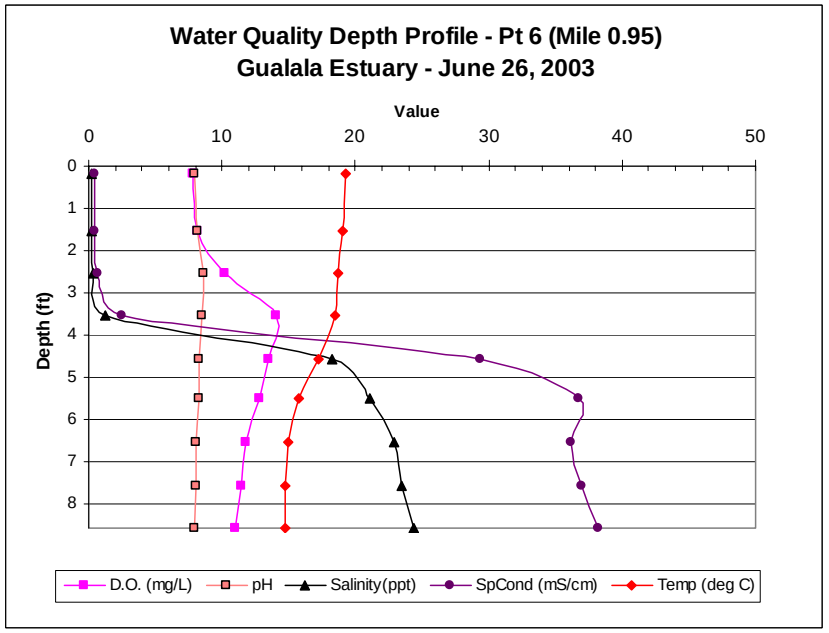

Figure 30 Depth profile of physical parameters at Point 6 near the right bank of the Gualala Lagoon, June 26, 2003.

Table 22 Physical parameters at Point 6 near the right bank of the Gualala Lagoon, June 26, 2003.

Water Depth (ft)	D.O. (mg/L)	pH	Salinity (ppt)	SpCond (mS/cm)	Temp (deg C)
0.18	7.77	8.0	0.21	0.437	19.2
1.55	8.14	8.2	0.21	0.433	19.0
2.54	10.21	8.6	0.35	0.736	18.7
3.54	14.07	8.5	1.3	2.507	18.4
4.56	13.44	8.3	18.25	29.377	17.2
5.51	12.86	8.2	21.14	36.698	15.7
6.54	11.76	8.1	22.87	36.127	15.0
7.57	11.4	8.0	23.45	36.994	14.7
8.58	10.99	8.0	24.32	38.224	14.8

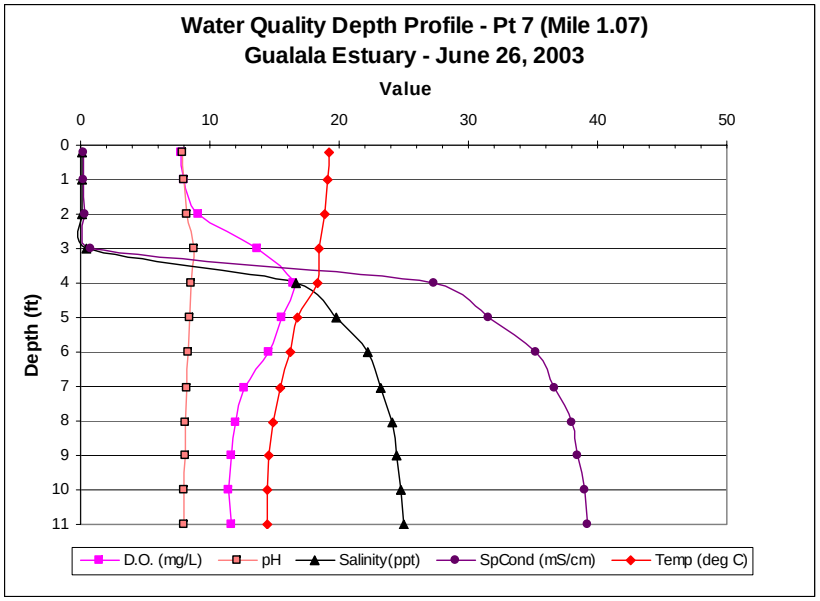

Figure 31 Depth profile of physical parameters at Point 7 of the Gualala Lagoon, June 26, 2003.

Table 23 Physical parameters at Point 7 of the Gualala Lagoon, June 26, 2003.

Water Depth (ft)	D.O. (mg/L)	pH	Salinity (ppt)	SpCond (mS/cm)	Temp (deg C)
0.2	7.74	7.9	0.13	0.276	19.2
1	7.96	8.0	0.13	0.27	19.1
2.02	9.09	8.2	0.15	0.305	18.9
3.01	13.68	8.8	0.4	0.783	18.4
4.01	16.4	8.5	16.62	27.3	18.4
5.02	15.52	8.5	19.75	31.56	16.8
6.02	14.5	8.3	22.24	35.204	16.2
7.04	12.69	8.2	23.23	36.66	15.4
8.03	12.04	8.1	24.14	37.945	14.9
9.01	11.68	8.1	24.48	38.458	14.6
10.02	11.46	8.0	24.82	38.945	14.5
11	11.63	8.0	24.99	39.187	14.4

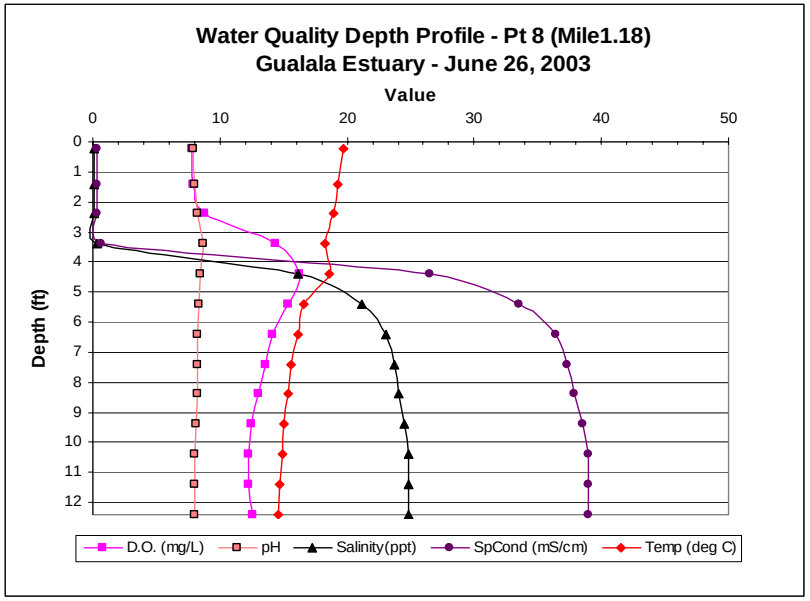

Figure 32 Depth profile of physical parameters at Point 8 at the thalweg of the Gualala Lagoon, June 26, 2003.

Table 24 Physical parameters at Point 8 at the thalweg of the Gualala Lagoon, June 26, 2003.

Water Depth (ft)	D.O. (mg/L)	pH	Salinity (ppt)	SpCond (mS/cm)	Temp (deg C)
0.23	7.76	7.9	0.13	0.279	19.7
1.4	7.95	8.0	0.14	0.292	19.2
2.4	8.84	8.2	0.16	0.325	18.9
3.41	14.32	8.7	0.33	0.661	18.2
4.4	16.22	8.5	16.17	26.454	18.6
5.4	15.36	8.4	21.12	33.552	16.6
6.4	14.14	8.3	23.05	36.379	16.1
7.41	13.58	8.2	23.72	37.327	15.6
8.39	13.07	8.2	24.04	37.83	15.3
9.41	12.52	8.1	24.53	38.494	15.0
10.4	12.2	8.1	24.8	38.929	14.9
11.39	12.21	8.1	24.88	39.012	14.7
12.41	12.62	8.0	24.88	39.022	14.6

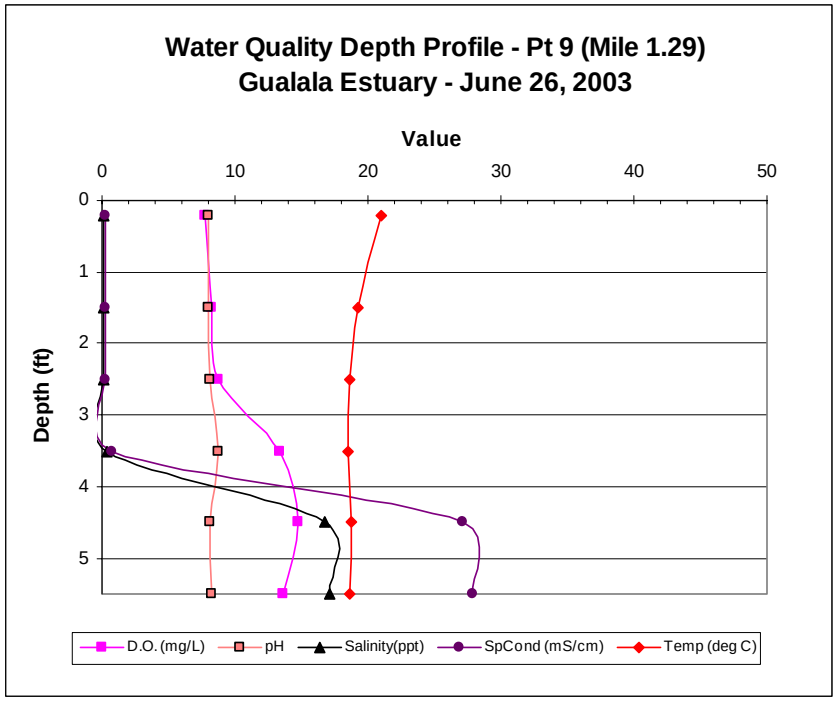

Figure 33 Depth profile of physical parameters at Point 9 near the right bank of the Gualala Lagoon, June 26, 2003.

Table 25 Physical parameters at Point 9 near the right bank of the Gualala Lagoon, June 26, 2003.

Depth (ft)	D.O. (mg/L)	pH	Salinity (ppt)	SpCond (mS/cm)	Temp (deg C)
0.2	7.8	7.9	0.12	0.244	21.0
1.5	8.3	8.0	0.12	0.259	19.3
2.51	8.78	8.1	0.12	0.25	18.7
3.5	13.41	8.7	0.38	0.689	18.5
4.49	14.75	8.2	16.7	27.13	18.8
5.5	13.58	8.2	17.17	27.85	18.6

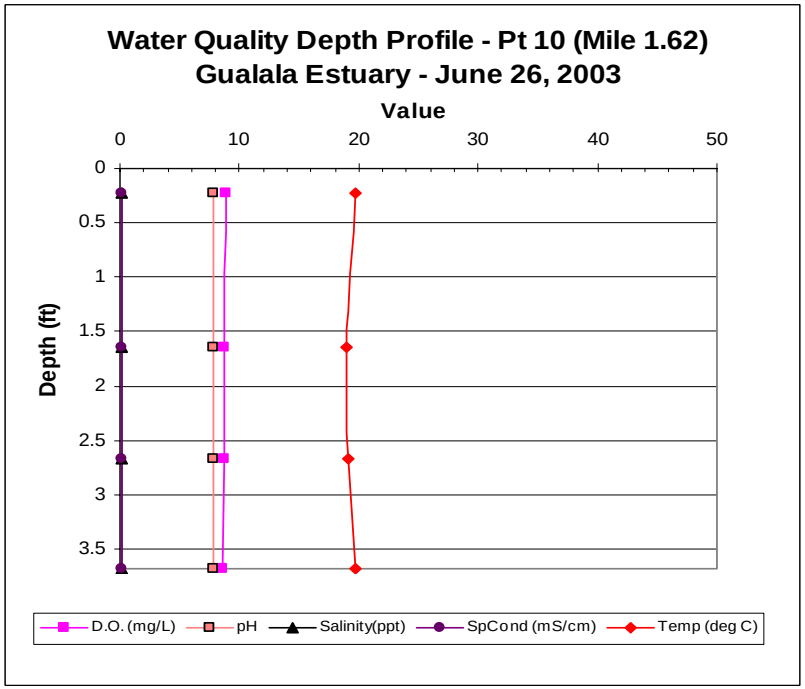

Figure 34 Depth profile of physical parameters at Point 10 near the left bank of the Gualala Lagoon, June 26, 2003.

Table 26 Physical parameters at Point 10 near the left bank of the Gualala Lagoon, June 26, 2003.

Depth (ft)	D.O. (mg/L)	pH	Salinity (ppt)	SpCond (mS/cm)	Temp (deg C)
0.22	8.93	7.9	0.1	0.217	19.7
1.65	8.72	7.9	0.1	0.217	19.0
2.67	8.67	7.9	0.1	0.216	19.1
3.68	8.61	7.9	0.1	0.216	19.7

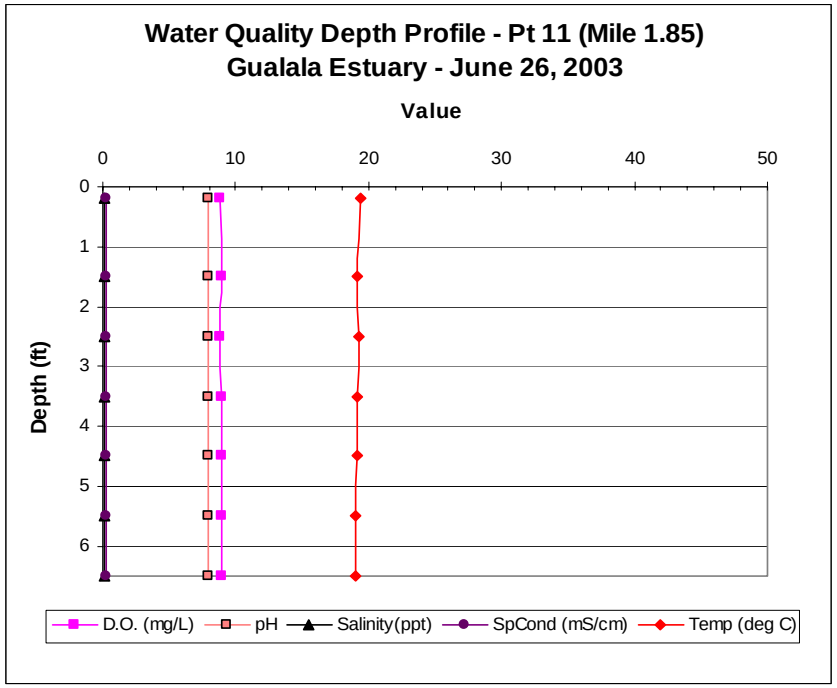

Figure 35 Depth profile of physical parameters at Point 11 of the Gualala Lagoon, June 26, 2003.

Table 27 Physical parameters at Point 11of the Gualala Lagoon, June 26, 2003.

Depth (ft)	D.O. (mg/L)	pH	Salinity (ppt)	SpCond (mS/cm)	Temp (deg C)
0.19	8.87	7.9	0.1	0.216	19.4
1.5	8.88	7.9	0.1	0.216	19.2
2.49	8.87	7.9	0.1	0.216	19.2
3.51	8.88	7.9	0.1	0.216	19.1
4.5	8.89	7.9	0.1	0.216	19.1
5.5	8.91	7.9	0.1	0.216	19.1
6.5	8.93	7.9	0.1	0.216	19.1

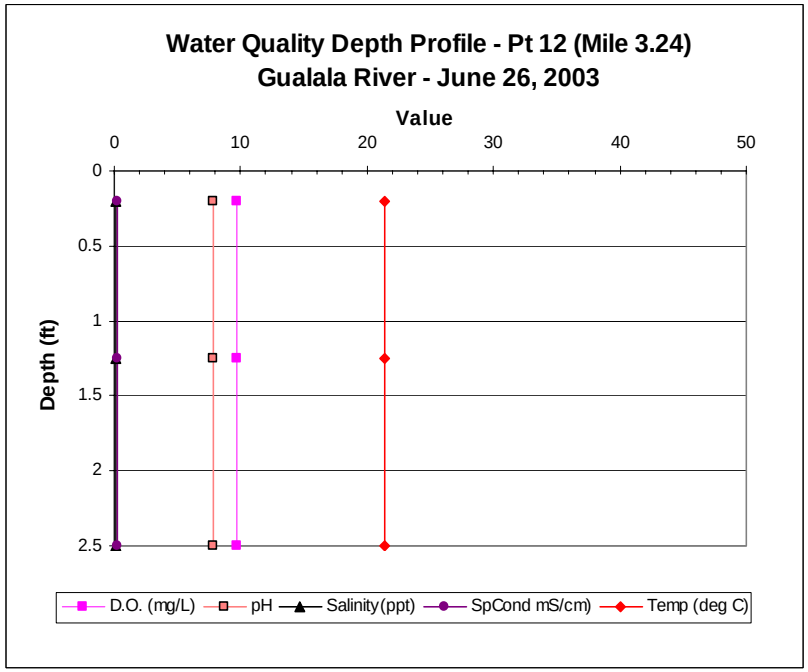

Figure 36 Depth profile of physical parameters at Point 12 of the Gualala River,July 30, 2003.

Table 28 Physical parameters at Point 12 of the Gualala River of the Gualala River, July 30, 2003.

Depth (ft)	D.O. (mg/L)	pH	Salinity (ppt)	SpCond mS/cm)	Temp (deg C)
0.2	9.76	7.87	0.1	0.217	21.42
1	9.76	7.87	0.1	0.217	21.42
2	9.76	7.87	0.1	0.217	21.42

Gualala Estuary, Regional Board Depth Profile Sampling, July 30, 2003

On July 30, 2003 the North Coast Regional Water Quality Control Board (Regional Board) used an YSI 600 XL "mini" data sonde (sonde) to sample physical-chemical parameters in the Gualala Estuary. Prior to sampling the next day, the sonde was precalibrated and programmed for discrete sampling in the late afternoon of July 29th at the Regional Board's laboratory. Field measurements were taken at various points along the length of the Gualala Estuary/Lagoon by Katharine Spivak and Elmer Dudik using Ocean Kayaks to access the sample locations shown in Figure 37. Depth profile sampling in the estuary/lagoon was first performed at twelve locations on June 26, 2003 and, for consistency, many of the same sample points were revisited during this event retaining the same sample designations.

At each Profile Point (Pt) depth profiles began at the estuary/lagoon bottom, pausing at 1-foot intervals to stabilize the sonde for an accurate measurement, ending at approximately 0.2 feet from the water surface. All points had at least one depth profile performed at the deepest location that was determined by sounding to the bottom with the sonde at various locations across the channel. Also, as shown on Figure 37, Pts 1, 2, and 4 had additional depth profiles completed near the right and left banks. Pts 5 and 7 had depth profiles completed at only the left and right banks, respectively, and Pts 8 and 9 only had profiles in the thalweg. All right and left bank depth profiles were located at the approximate mid-point between the thalweg profile and the shoreline of the wetted channel.

Physical-chemical parameters sampled included dissolved oxygen, percent oxygen saturation, salinity, specific conductivity, temperature, pH, and depth. Depth profiles began at Pt-1, approximately 0.1mile from the ocean, ending approximately 1.29 miles from the ocean at Pt-9. The end point for sampling was determined when the last two sample points were dominated completely by freshwater flows from upstream.

A persistant sandbar was in place during sampling that isolated the Gualala River from the ocean, creating a lagoon instead of true estuarine conditions. Residents have stated that the barrier sandbar usually remains in place from around the end of June until the first flushing storms of fall and winter. Stratification between more saline water and overlying, less dense freshwater that was evident at all locations from Pts1 through 9 on June 26 were absent during this event; only one small lens of saline-brackish water, shown in Figure 38 through Figure 52, and 1-15 through Table 43, below, was found on the lagoon bottom at the right bank of Pt-7, known locally as the the Mill Bend.

Figure 38 graphically illustrates the relationship between water depth, distance between points, and the five parameters of temperature, salinity, conductance, dissolved oxygen, and pH. Depth measurements shown in the table at all points were on the lagoon bottom, a depth that would likely capture any remnant pockets of more dense saline-brackish water.

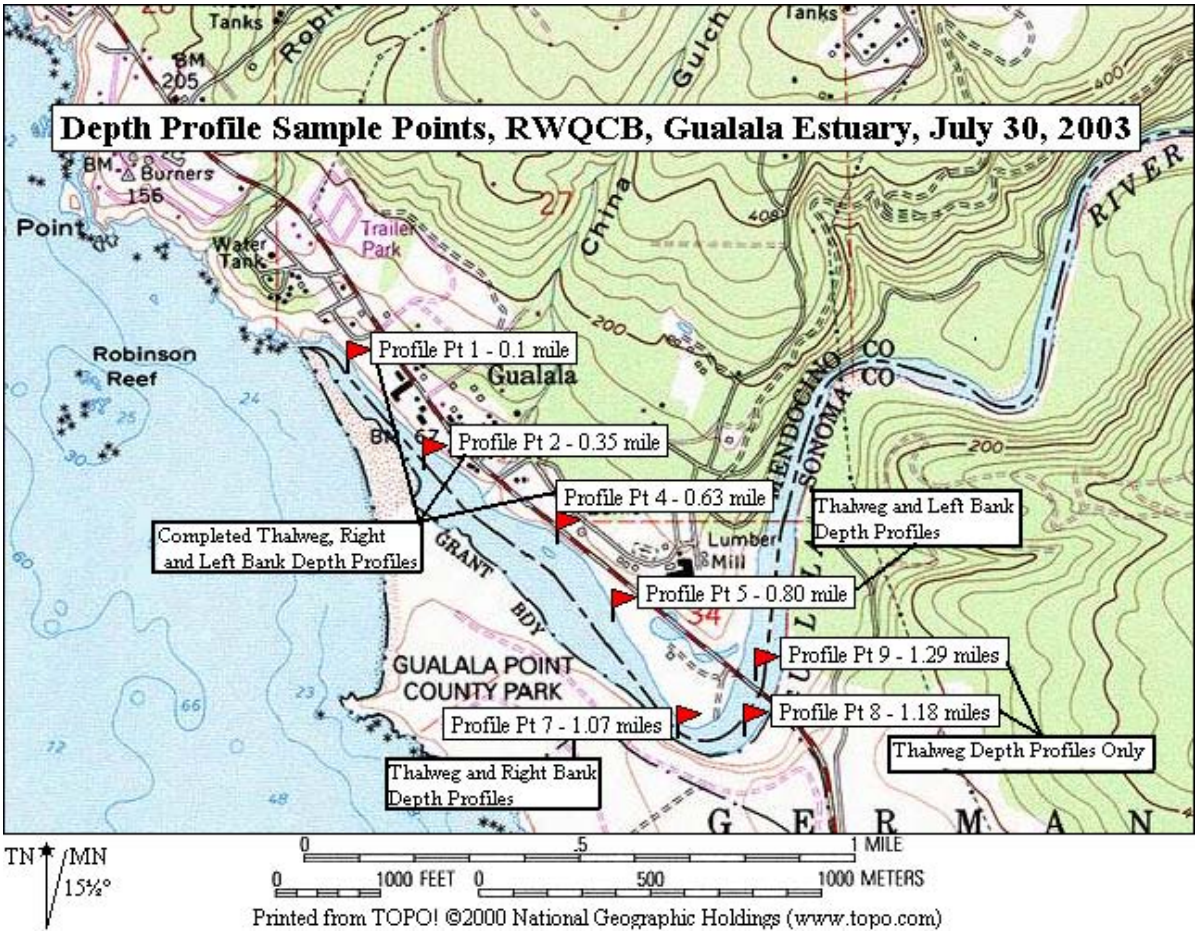

Figure 37 Regional Board Depth Profile Points, Gualala Estuary, July 30, 2003.

As shown, conductivities at all of the points, except Pt-7 at the right bank, were fairly uniform, varying only by 0.020 mS/cm from Pt-1 to Pt-9. Salinity concentrations reflect those of conductivity and are so low that the lagoon would be considered freshwater, again, except for the small remnant of saltwater at Pt-7 on the bottom. The choice was made to use mS/cm, instead of the traditional uS/cm, as a unit of measure for conductivity as it could be represented on the same graph along with the other parameters. However, except where there are localized salinity and conductivity spikes, the results are so low that they could not be represented in Figure 38. It should be noted that in the Water Quality Control Plan for the North Coast Region conductivity is expressed as uS/cm for freshwater systems. There are no numeric criteria at this time for specific conductivity (as well as the other five parameters measured) for the lower Gualala River during estuarine and/or lagoon conditions.

Table 29 shows the specific results charted in Figure 38. As mentioned, all results were taken at the bottom of the estuary-lagoon and represent only a single result for each parameter at a sample point, and are represented in Figure 39 through Figure 52, and Table 30 through Table 43.

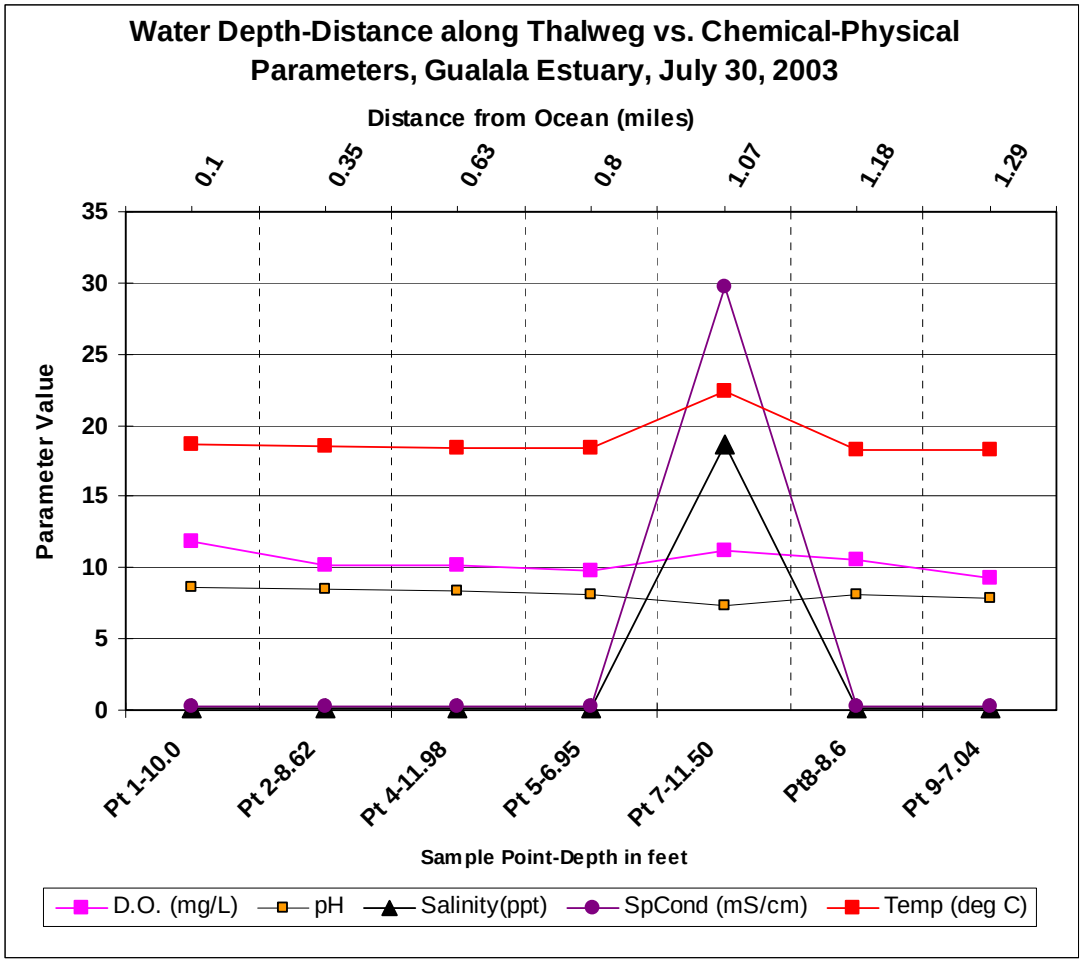

Figure 38 Regional Board physical parameters sampling along thalweg bottom, Gualala Estuary-Lagoon, July 30, 2003.

Table 29 Physical parameters along thalweg bottom, Gualala Estuary-Lagoon, July 30, 2003:

Distance from Mouth (miles)	Sample Point and Water Depth along Thalweg (ft)	Dissolved Oxygen (mg/L)	pH	Salinity (ppt)	SpCond (mS/cm)	Temp (deg C)
0.1	Pt-1-10.0	11.78	8.9	0.110	0.239	18.6
0.35	Pt-2-8.62	10.18	8.4	0.110	0.229	18.56
0.63	Pt-4-11.98	10.11	8.3	0.110	0.230	18.44
0.8	Pt-5-6.95	9.82	8.2	0.100	0.223	18.41
1.07	Pt-7-11.50	11.16	7.3	18.700	29.740	22.34
1.18	Pt-8-8.6	10.58	8.1	0.110	0.225	18.3
1.29	Pt-9-7.04	9.32	7.9	0.100	0.219	18.25

pH held steady at all of the locations, varying between 7.1 to 8.9, a difference of 1.8 standard pH units. Pt-7 along the right bank had a slight decrease in pH on the lagoon bottom where the pocket of saline water was located. Pt-7 also had the largest variance ($s^2 = 1.04$) in temperature from the top to the bottom where the temperatures on the bottom, at 11.49 feet and 1-foot above the bottom, were 22.34 ^oC (72.2 ^oF) and 20.82 ^oC (64.5 ^oF), respectively. All depths above the bottom two measurements were between 18.30 (64.9 ^oF) to 18.56 ^oC (65.4 ^oF). The depth profile at Pt-9 under the Highway 1 bridge had the next most variable temperature range ($s^2 = 0.05$). At all other locations and depths the temperature only varied (s^2 ranging from 0.002 – 0.00004) between 18.25 (64.8 ^oF) to 18.84 ^oC (65.9 ^oF). Current research for salmonid temperature tolerances suggests that

an upper temperature threshold of ~ 23.9 ^{o}C (75 ^{o}F) may be lethal to salmonids if cool water, escape refugia is not available. On this date only the bottom two samples at Pt-7 approached this threshold.

Dissolved oxygen ranged from 9.25 mg/L to 12.7 mg/L, conditions that would be considered protective of the salmonid fisheries in the lagoon-esturary. It was interesting to note that where there were small, localized increases in dissolved oxygen levels, such as at Pts 1, 7, and 8, that occurred as the bottom of the lagoon was approached, mostly between depths of 6-8-feet.

Taken collectively, except for the small pocket of salt water on the bottom at Pt-7, the results indicate that the lagoon conditions existing on the day of sampling were representative of a well mixed, fairly uniform body of fresh water. Several explanations can be hypothesized to explain this. It was noted by residents, and also surveying past weather records for the nearby Point Arena NOAA remote weather station, that the ocean and wind had been relatively calm for seven to ten days prior to sampling. These conditions coincided with a similar period of time that wave wash over the barrier beach was nonexistent, depriving the lagoon of one source of fairly oxygenated salt water. Despite periodic high and low tides, calm seas may also have minimized saltwater infiltration through the sand bar from the ocean to the lagoon. Perhaps these conditons, coupled with fairly moderate river discharges, still flowing from upstream, reached a point that the stratified, saline pockets of deeper water at all of the lower river sample points documented on June 26, 2003 were flushed out by the dominating fresh water flows to the lagoon. It would be interesting to correlate the timing of the findings for this sampling event to results from the two tidal gages located at various points in the lagoon-estuary previously installed by Kamman Hydrology & Engineering, Inc.

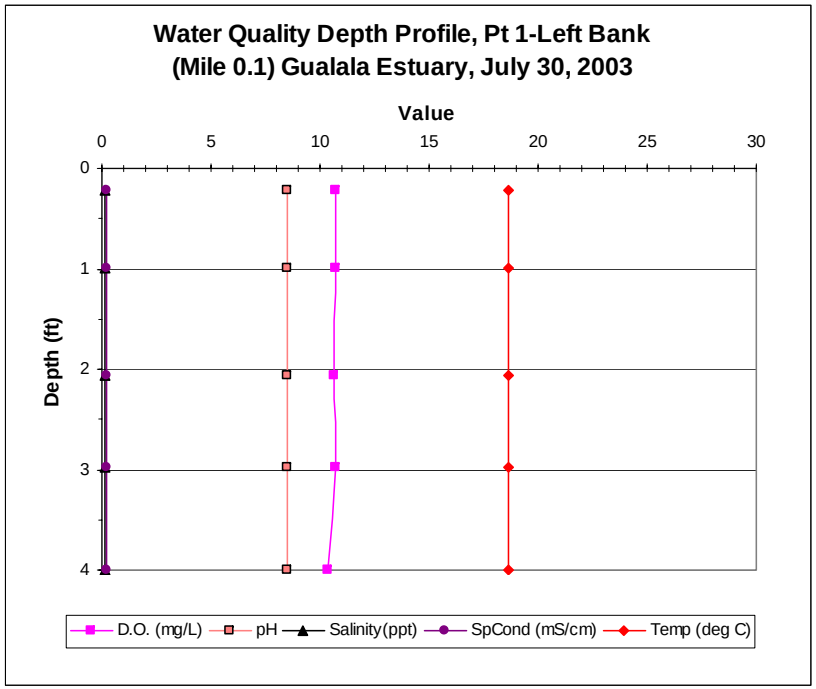

Figure 39 Depth profile of physical parameters at Point 1 near the left bank of the Gualala Lagoon, July 30, 2003.

Table 30 Physical parameters at Point 1 near the left bank of the Gualala Lagoon, July 30, 2003.

Water Depth (ft)	D.O. (mg/L)	pH	Salinity (ppt)	SpCond (mS/cm)	Temp (deg C)
4	10.33	8.5	0.11	0.239	18.64
2.98	10.68	8.5	0.11	0.239	18.66
2.06	10.67	8.5	0.11	0.239	18.66
0.99	10.68	8.5	0.11	0.239	18.65
0.21	10.7	8.5	0.11	0.239	18.65

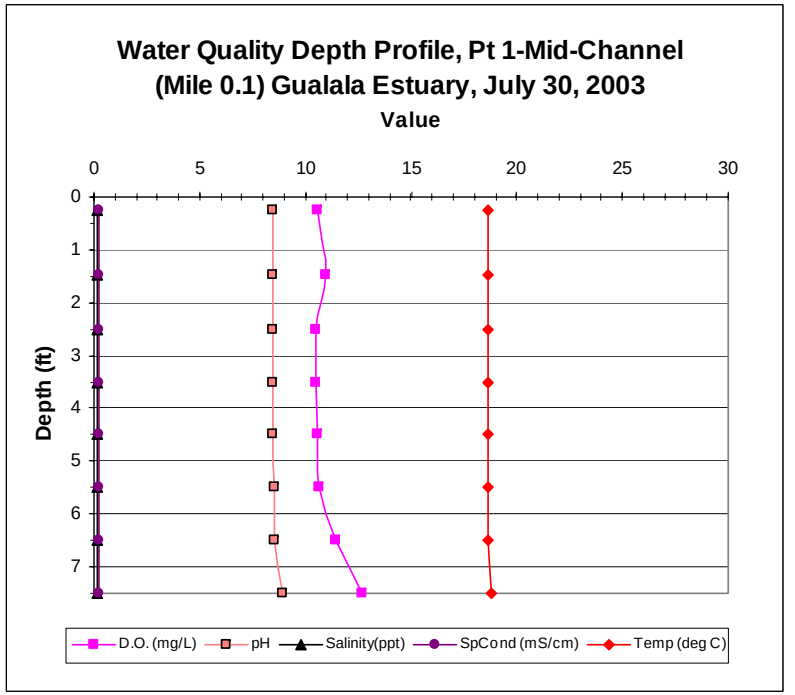

Figure 40 Depth profile of physical parameters at Point 1 of the thalweg of the Gualala Lagoon, July 30, 2003.

Table 31 Physical parameters at Point 1of the thalweg of the Gualala Lagoon, July 30, 2003.

Water Depth (ft)	D.O. (mg/L)	pH	Salinity (ppt)	SpCond (mS/cm)	Temp (deg C)
7.5	12.7	8.9	0.12	0.244	18.78
6.51	11.46	8.6	0.12	0.247	18.64
5.49	10.69	8.5	0.12	0.246	18.64
4.48	10.57	8.5	0.12	0.247	18.63
3.52	10.52	8.5	0.12	0.246	18.64
2.51	10.52	8.5	0.12	0.246	18.64
1.49	10.93	8.5	0.12	0.247	18.64
0.25	10.56	8.5	0.12	0.246	18.64

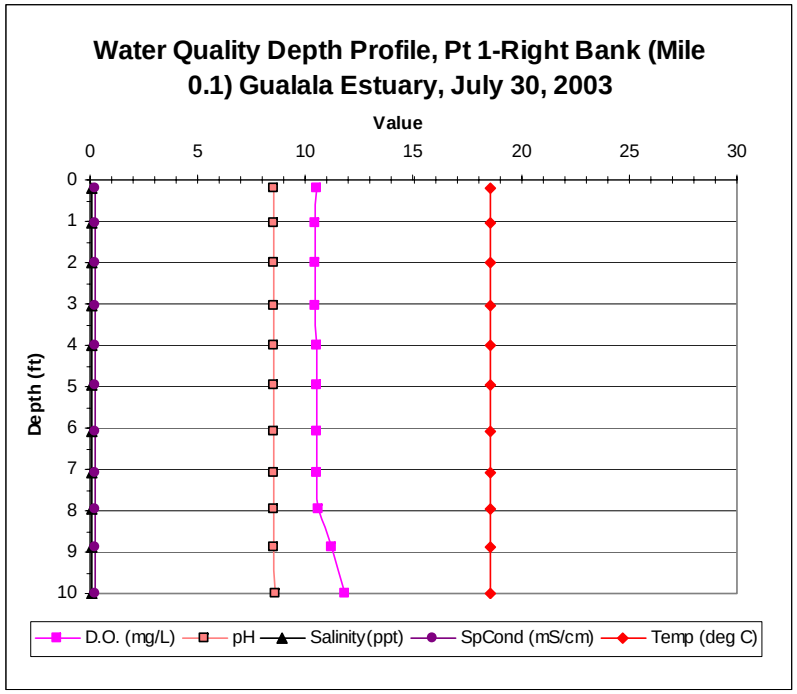

Figure 41 Depth profile of physical parameters at Point 1 near the right bank of the Gualala Lagoon, July 30, 2003.

Table 32 Physical parameters at Point 1 near the right bank of the Gualala Lagoon, July 30, 2003.

Water Depth (ft)	D.O. (mg/L)	pH	Salinity (ppt)	SpCond (mS/cm)	Temp (deg C)
10	11.78	8.6	0.11	0.239	18.6
8.86	11.22	8.5	0.11	0.238	18.58
7.95	10.57	8.5	0.11	0.236	18.57
7.06	10.5	8.5	0.11	0.235	18.57
6.06	10.48	8.5	0.11	0.235	18.57
4.97	10.49	8.5	0.11	0.236	18.57
3.98	10.48	8.5	0.11	0.236	18.58
3.02	10.47	8.5	0.11	0.236	18.57
2.01	10.47	8.5	0.11	0.236	18.58
1.02	10.47	8.5	0.11	0.237	18.59
0.21	10.48	8.5	0.11	0.238	18.58

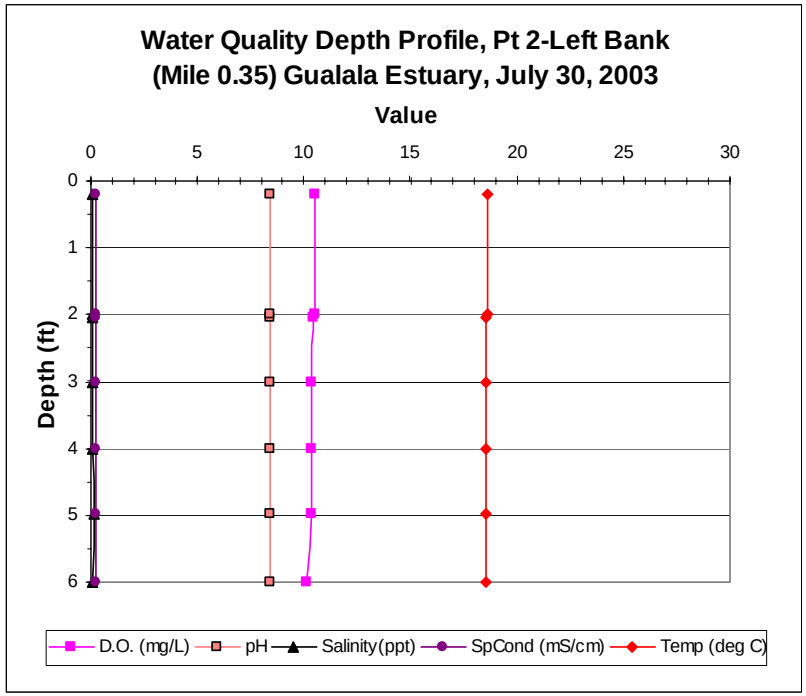

Figure 42 Depth profile of physical parameters at Point 2 near the left bank of the Gualala Lagoon, July 30, 2003.

Table 33 Physical parameters at Point 2 near the left bank of the Gualala Lagoon, July 30, 2003.

Water Depth (ft)	D.O. (mg/L)	pH	Salinity (ppt)	SpCond (mS/cm)	Temp (deg C)
6	10.1	8.39	0.11	0.23	18.55
4.98	10.37	8.4	0.12	0.232	18.57
4.02	10.35	8.4	0.11	0.23	18.57
3.01	10.39	8.4	0.11	0.23	18.58
2.04	10.42	8.4	0.11	0.23	18.58
1.98	10.51	8.42	0.11	0.23	18.6
0.21	10.55	8.42	0.11	0.23	18.6

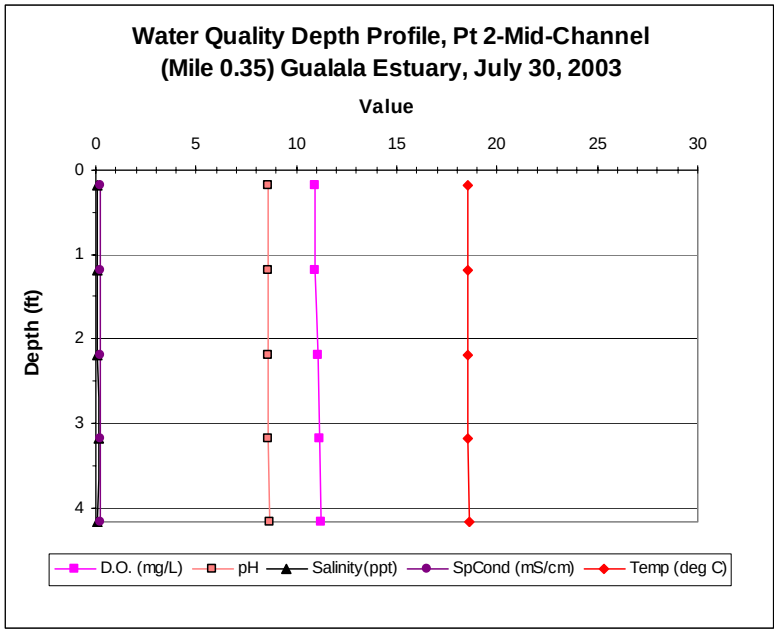

Figure 43 Depth profile of physical parameters at Point 2 of the thalweg of the Gualala Lagoon, July 30, 2003.

Table 34 Physical parameters at Point 2 of the thalweg of the Gualala Lagoon, July 30, 2003.

Water Depth (ft)	D.O. (mg/L)	pH	Salinity (ppt)	SpCond (mS/cm)	Temp (deg C)
4.17	11.2	8.65	0.11	0.229	18.61
3.18	11.18	8.57	0.12	0.23	18.58
2.19	11.06	8.57	0.11	0.229	18.57
1.18	10.96	8.56	0.11	0.229	18.56
0.18	10.94	8.57	0.11	0.229	18.57

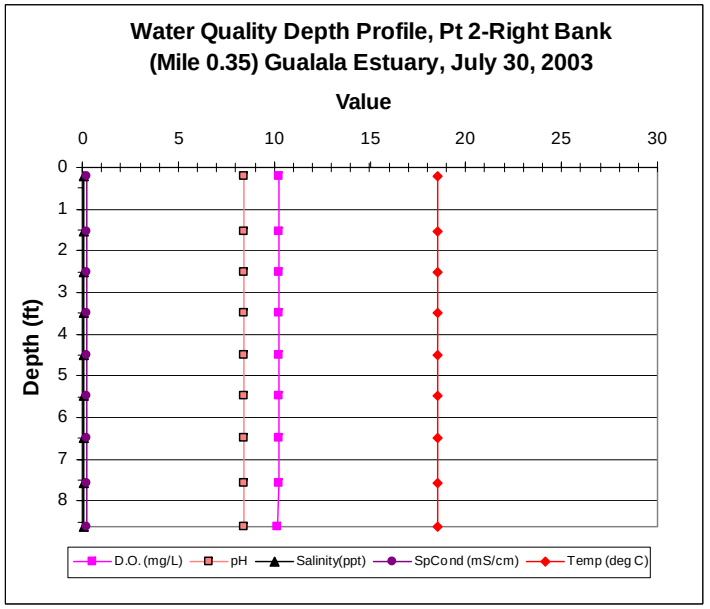

Figure 44 Depth profile of physical parameters at Point 2 near the right bank of the Gualala Lagoon, July 30, 2003.

Table 35 Physical parameters at Point 2 near the right bank of the Gualala Lagoon, July 30, 2003.

Water Depth (ft)	D.O. (mg/L)	pH	Salinity (ppt)	SpCond (mS/cm)	Temp (deg C)
8.62	10.18	8.44	0.11	0.229	18.56
7.59	10.22	8.43	0.11	0.229	18.54
6.49	10.24	8.44	0.11	0.229	18.55
5.49	10.26	8.44	0.11	0.229	18.55
4.49	10.27	8.44	0.11	0.229	18.55
3.5	10.27	8.44	0.11	0.229	18.55
2.5	10.26	8.44	0.11	0.229	18.55
1.52	10.26	8.44	0.11	0.229	18.55
0.21	10.29	8.44	0.11	0.229	18.54

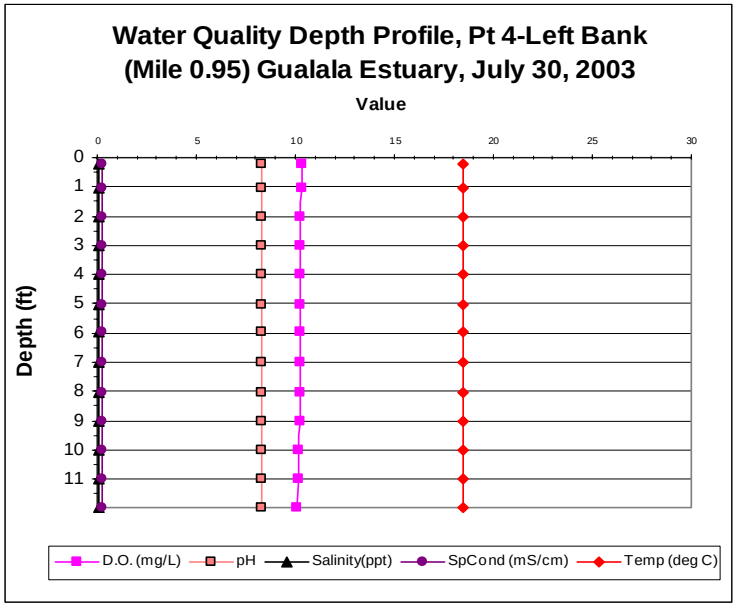

Figure 45 Depth profile of physical parameters at Point 4 near the left bank of the Gualala Lagoon, July 30, 2003.

Table 36 Physical parameters at Point 4 near the left bank of the Gualala Lagoon, July 30, 2003.

Water Depth (ft)	D.O. (mg/L)	pH	Salinity (ppt)	SpCond (mS/cm)	Temp (deg C)
11.98	10.11	8.33	0.11	0.23	18.44
11.02	10.16	8.33	0.11	0.231	18.44
10	10.21	8.33	0.12	0.232	18.45
9.04	10.23	8.33	0.11	0.23	18.46
8.03	10.24	8.33	0.11	0.23	18.45
7.02	10.25	8.33	0.11	0.23	18.45
5.98	10.27	8.33	0.11	0.23	18.45
5.02	10.25	8.33	0.11	0.23	18.45
4.02	10.25	8.33	0.11	0.23	18.45
3.01	10.25	8.33	0.11	0.23	18.45
1.0	10.27	8.33	0.11	0.23	18.45
1.02	10.3	8.34	0.11	0.23	18.46
0.21	10.3	8.34	0.11	0.23	18.46

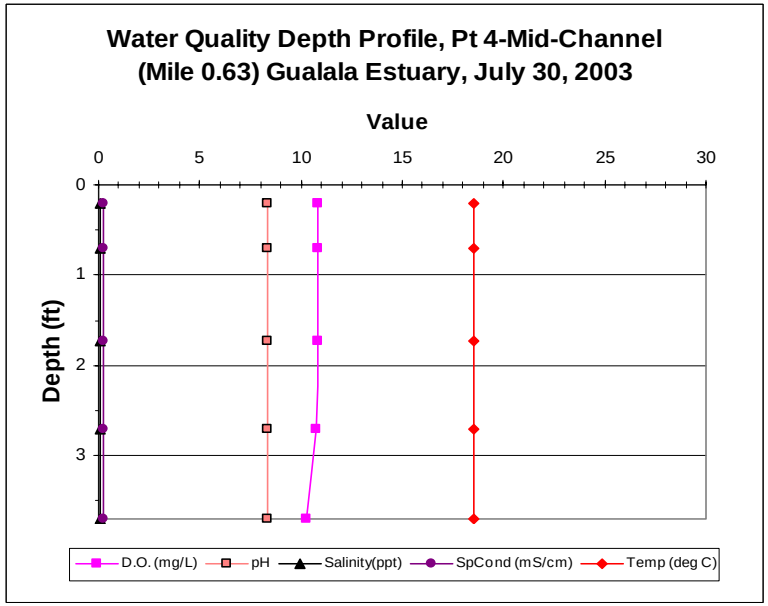

Figure 46 Depth profile of physical parameters at Point 4 at the thalweg of the Gualala Lagoon, July 30, 2003.

Table 37 Physical parameters at Point 4 at the thalweg of the Gualala Lagoon, July 30, 2003.

Water Depth (ft)	D.O. (mg/L)	pH	Salinity (ppt)	SpCond (mS/cm)	Temp (deg C)
3.7	10.3	8.37	0.11	0.226	18.5
2.7	10.76	8.38	0.11	0.226	18.53
1.73	10.8	8.37	0.11	0.226	18.52
0.7	10.79	8.36	0.11	0.226	18.52
0.2	10.81	8.36	0.11	0.226	18.53

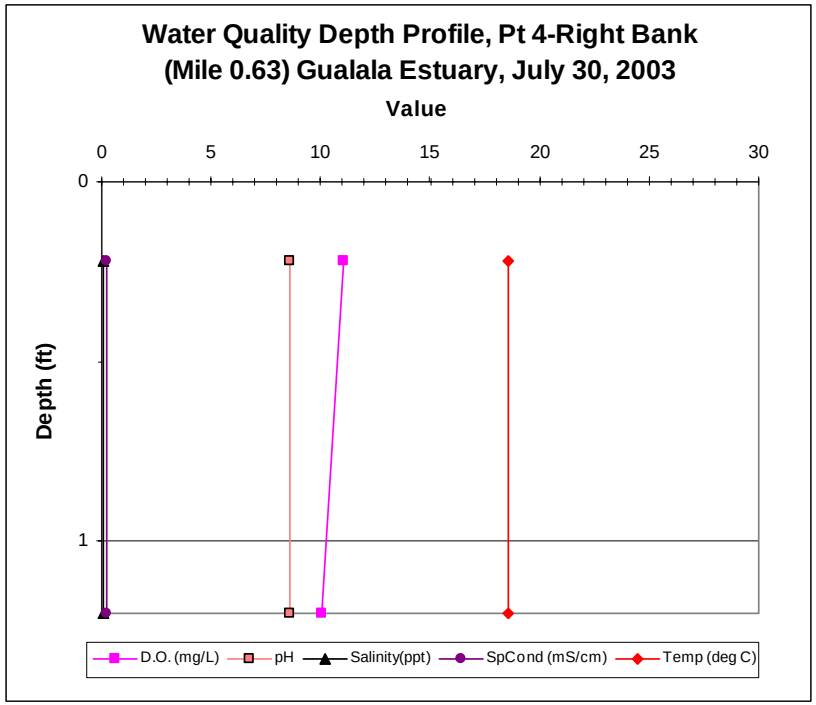

Figure 47 Depth profile of physical parameters at Point 4 near the right bank of the Gualala Lagoon, July 30, 2003.

Table 38 Physical parameters at Point 4 near the right bank of the Gualala Lagoon, July 30, 2003.

Water Depth (ft)	D.O. (mg/L)	pH	Salinity (ppt)	SpCond (mS/cm)	Temp (deg C)
1.2	10.08	8.62	0.11	0.226	18.59
0.22	11.03	8.63	0.11	0.226	18.59

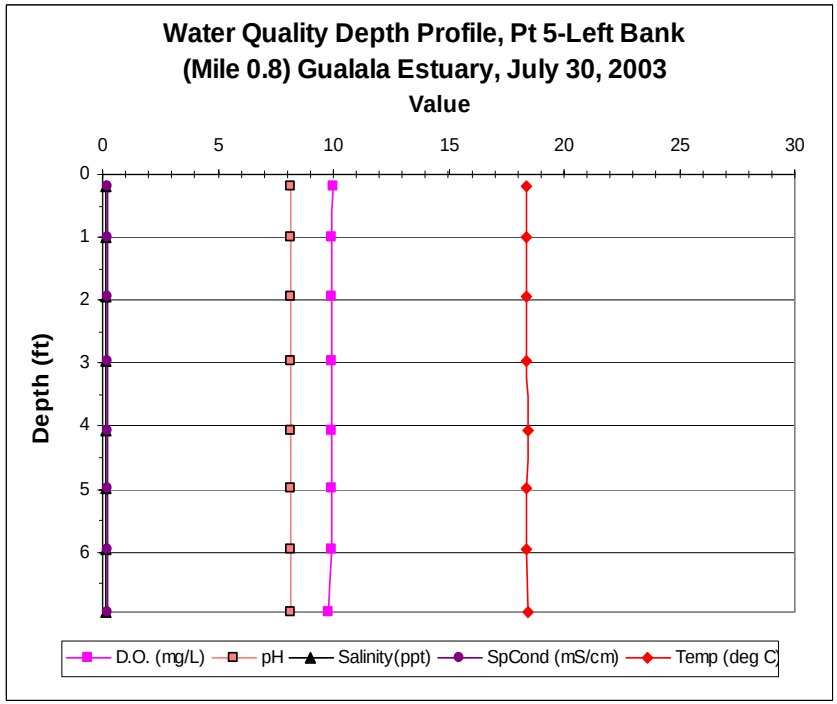

Figure 48 Depth profile of physical parameters at Point 5 near the left bank of the Gualala Lagoon, July 30, 2003.

Table 39 Physical parameters at Point 5 near the left bank of the Gualala Lagoon, July 30, 2003.

Water Depth (ft)	D.O. (mg/L)	pH	Salinity (ppt)	SpCond (mS/cm)	Temp (deg C)
6.95	9.82	8.15	0.11	0.223	18.41
5.94	9.9	8.15	0.11	0.223	18.4
4.98	9.93	8.15	0.11	0.223	18.4
4.07	9.95	8.15	0.11	0.223	18.41
2.97	9.96	8.15	0.11	0.223	18.4
1.94	9.96	8.16	0.11	0.223	18.4
0.99	9.96	8.16	0.11	0.223	18.4
0.2	9.98	8.15	0.11	0.223	18.4

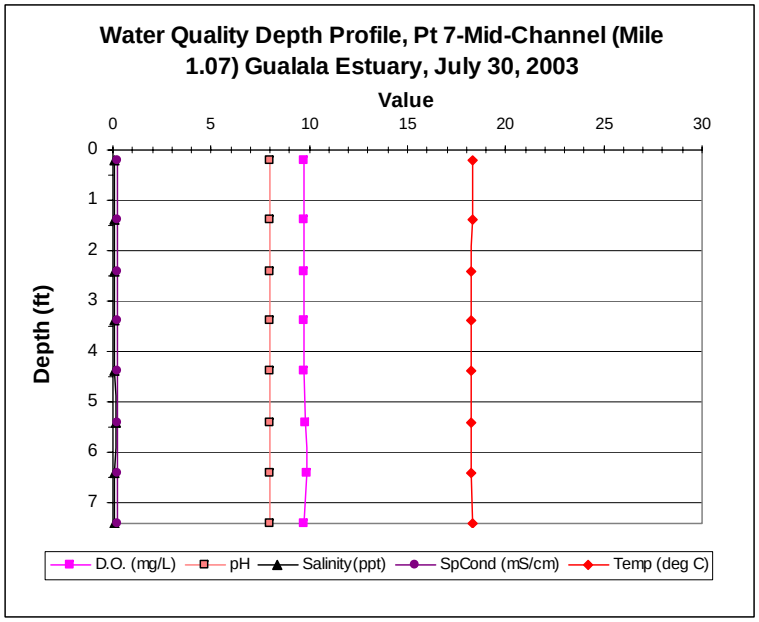

Figure 49 Depth profile of physical parameters at Point 7 at the thalweg of the Gualala Lagoon, July 30, 2003.

Table 40 Physical parameters at Point at the thalweg of the Gualala Lagoon, July 30, 2003.

Water Depth (ft)	D.O. (mg/L)	pH	Salinity (ppt)	SpCond (mS/cm)	Temp (deg C)
7.4	9.73	8.01	0.11	0.221	18.29
6.41	9.84	8.01	0.11	0.221	18.27
5.41	9.8	7.99	0.12	0.222	18.26
4.39	9.76	7.99	0.1	0.221	18.26
3.39	9.76	7.99	0.1	0.22	18.26
2.4	9.75	7.98	0.1	0.22	18.26
1.39	9.74	7.98	0.1	0.22	18.28
0.22	9.72	7.98	0.1	0.22	18.32

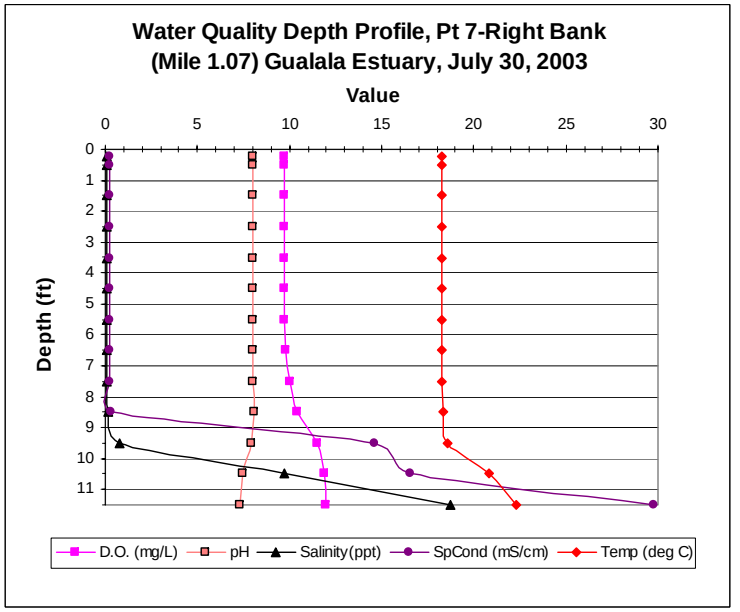

Figure 50 Depth profile of physical parameters at Point 7 near the right bank of the Gualala Lagoon, July 30, 2003.

Table 41 Physical parameters at Point 7 near the right bank of the Gualala Lagoon, July 30, 2003.

Water Depth (ft)	D.O. (mg/L)	pH	Salinity (ppt)	SpCond (mS/cm)	Temp (deg C)
11.5	11.96	7.30	18.7	29.738	22.34
10.49	11.91	7.48	9.75	16.529	20.82
9.51	11.48	7.92	0.76	14.6	18.56
8.5	10.39	8.06	0.14	0.294	18.34
7.49	9.99	8.02	0.11	0.231	18.3
6.5	9.81	8.00	0.11	0.22	18.28
5.5	9.74	7.99	0.1	0.22	18.27
4.5	9.72	7.98	0.1	0.22	18.27
3.51	9.69	7.98	0.1	0.219	18.28
2.49	9.68	7.97	0.1	0.218	18.28
1.49	9.68	7.97	0.1	0.219	18.28
0.51	9.75	7.98	0.1	0.219	18.28
0.21	9.71	7.97	0.1	0.219	18.29

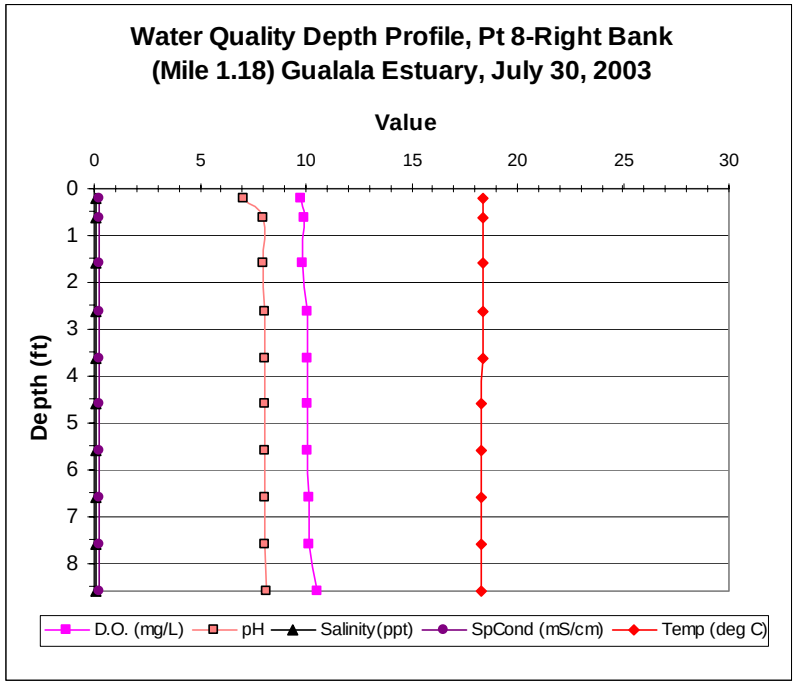

Figure 51 Depth profile of physical parameters at Point 8 near the right bank of the Gualala Lagoon, July 30, 2003.

Table 42 Physical parameters at Point 8 near the right bank of the Gualala Lagoon, July 30, 2003.

Water Depth (ft)	D.O. (mg/L)	pH	Salinity (ppt)	SpCond (mS/cm)	Temp (deg C)
8.6	10.58	8.14	0.11	0.225	18.3
7.6	10.15	8.08	0.11	0.223	18.29
6.6	10.12	8.07	0.11	0.222	18.29
5.61	10.09	8.07	0.11	0.22	18.31
4.59	10.07	8.07	0.11	0.221	18.33
3.61	10.04	8.08	0.1	0.221	18.34
2.61	10.05	8.04	0.11	0.221	18.36
1.59	9.86	8.02	0.11	0.22	18.37
0.62	9.92	8	0.11	0.22	18.4
0.19	9.75	7.09	0.11	0.22	18.4

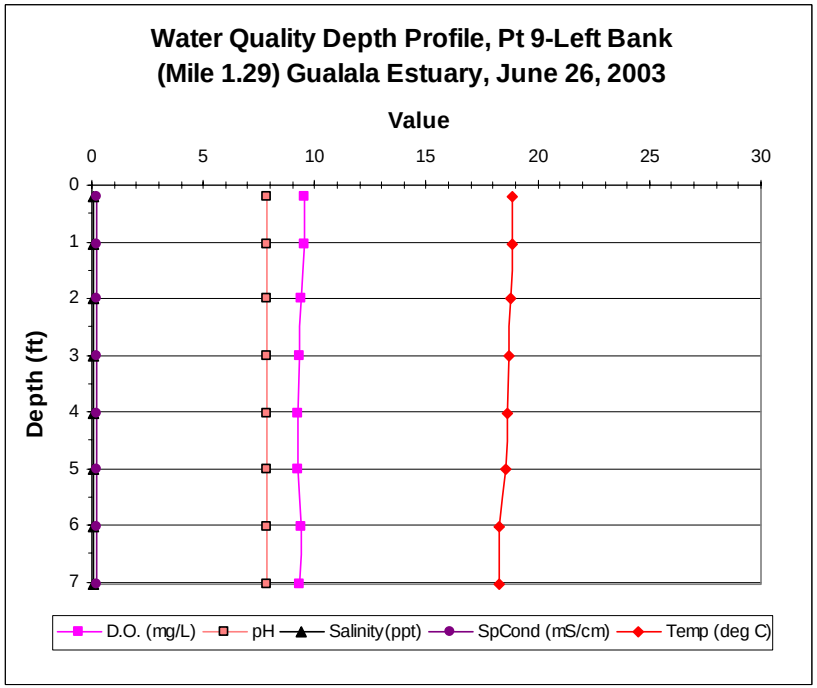

Figure 52 Depth profile of physical parameters at Point 9 near the left bank of the Gualala Lagoon, July 30, 2003.

Table 43 Physical parameters at Point 9 near the left bank of the Gualala Lagoon, July 30, 2003.

Water Depth (ft)	D.O. (mg/L)	pH	Salinity (ppt)	SpCond (mS/cm)	Temp (deg C)
7.04	9.32	7.87	0.1	0.219	18.25
6.02	9.36	7.86	0.1	0.219	18.3
5.01	9.25	7.84	0.1	0.219	18.58
4.04	9.25	7.84	0.1	0.219	18.64
3.02	9.32	7.84	0.1	0.219	18.72
2	9.4	7.86	0.1	0.219	18.78
1.05	9.51	7.87	0.1	0.218	18.84
0.19	9.56	7.87	0.1	0.218	18.84

Gualala Estuary, Regional Board Depth Profile Sampling, September 11, 2003:

On September 11, 2003 the North Coast Regional Water Quality Control Board (Regional Board) used a YSI 600 XL "mini" data sonde (sonde) to sample physical parameters in the Gualala Estuary-Lagoon. The sonde was precalibrated and programmed for discrete sampling in the late afternoon of September 10th at the Regional Board laboratory prior to sampling; dissolved oxygen was field calibrated the day of sampling. Field measurements were taken at various points along the length of the Gualala Estuary/Lagoon by Katharine Spivak and Elmer Dudik using Ocean Kayaks to access the sample locations shown in Figure 53.

Depth profile sampling in the estuary/lagoon was first performed at twelve locations on June 26, 2003 and, for consistency, many of the same sample points were revisited during this event, retaining previous sample designations. At each Profile Point (Pt) depth profiles began at the estuary/lagoon bottom, pausing at 1-foot intervals to stabilize the sonde for another measurement, ending at approximately 0.5-0.2 feet from the water surface. All points had at least one depth profile performed at the deepest location that was determined by sounding to the bottom with the sonde at various locations across the channel. Pts 1, 2, and 5 had additional depth profiles completed near the right and left banks. Pts 3 and 7 had depth profiles completed at only the left and right banks, respectively, and Pt-9 had a single profile in the thalweg. All right and left bank depth profiles were located at the approximate mid-point between the thalweg profile and the shoreline of the wetted channel.

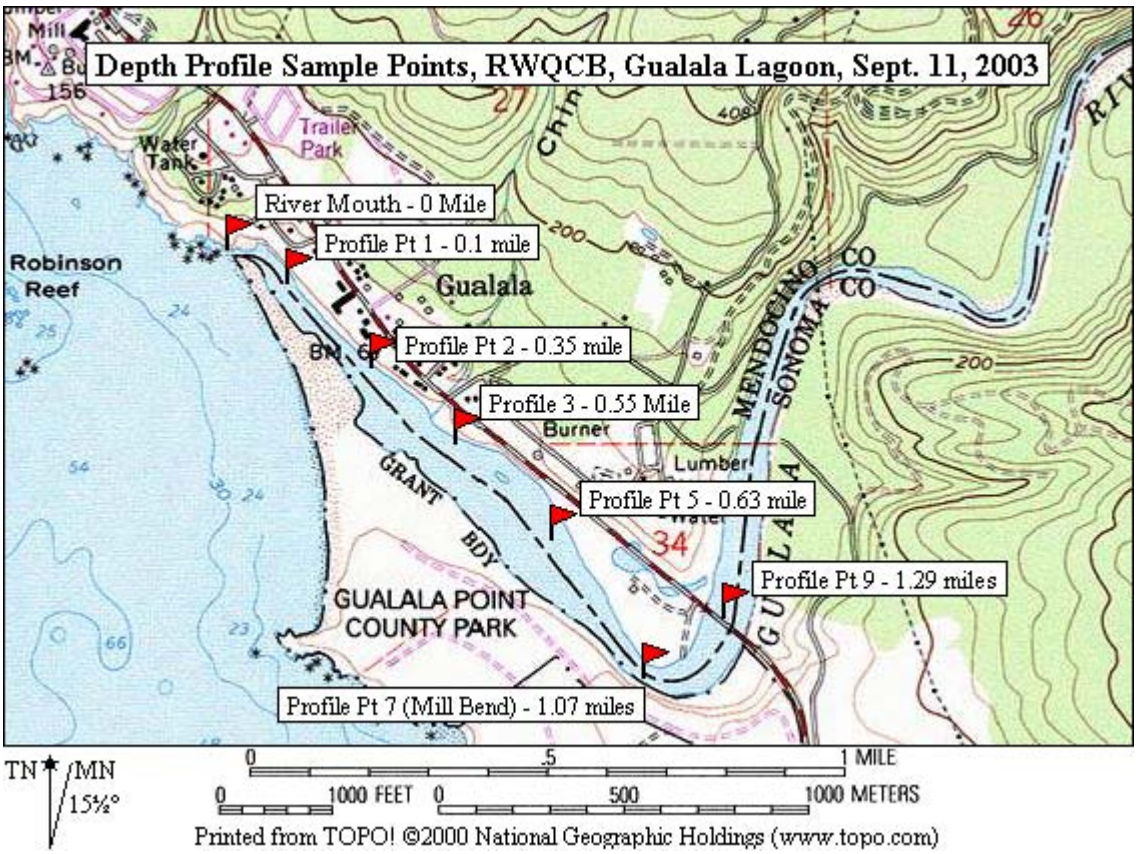

Figure 53 Regional Board Depth Profile Points, Gualala Estuary, September 11, 2003.

Physical-chemical parameters sampled included dissolved oxygen, percent oxygen saturation, salinity, specific conductivity, temperature, pH, and depth. Depth profiles began at Pt-1, approximately 528 feet from the ocean, ending approximately 1.29 miles from the ocean at Pt-9. The end point for sampling was determined when the last two sample points were dominated completely by freshwater flows from upstream.

As in several previous sampling events, a sandbar was in place at the river mouth that isolated the Gualala River from the ocean, creating a lagoon instead of true estuarine conditions. As was found during the July sampling, only one small lens of saline-brackish water, depicted in Figure 54 and Figure 66, with summary data in Table 45 and Table 58, below, was found on the lagoon bottom near the right bank of Pt-7, known locally as the the Mill Bend. It appears that this location, due to its depth, low valley slope, and its position on an outside bend of the river creates stagnant conditions isolated from low summer flows. These factors may combine to prevent denser saline water from flushing downstream during low-flow, lagoon conditions. At least one, possibly two more sampling events are scheduled if lagoon conditions persist into early Fall of 2003. It will be interesting to see if this location remains salty during the entire time period that such conditions exist.

Figure 54 graphically illustrates the relationship between water depth, distance between all of the points sampled, and the five parameters of temperature, salinity, conductance, dissolved oxygen, and pH. Depth measurements shown in the Table 44 were on the lagoon bottom, a depth that would likely capture any pockets of more dense saline-brackish water.

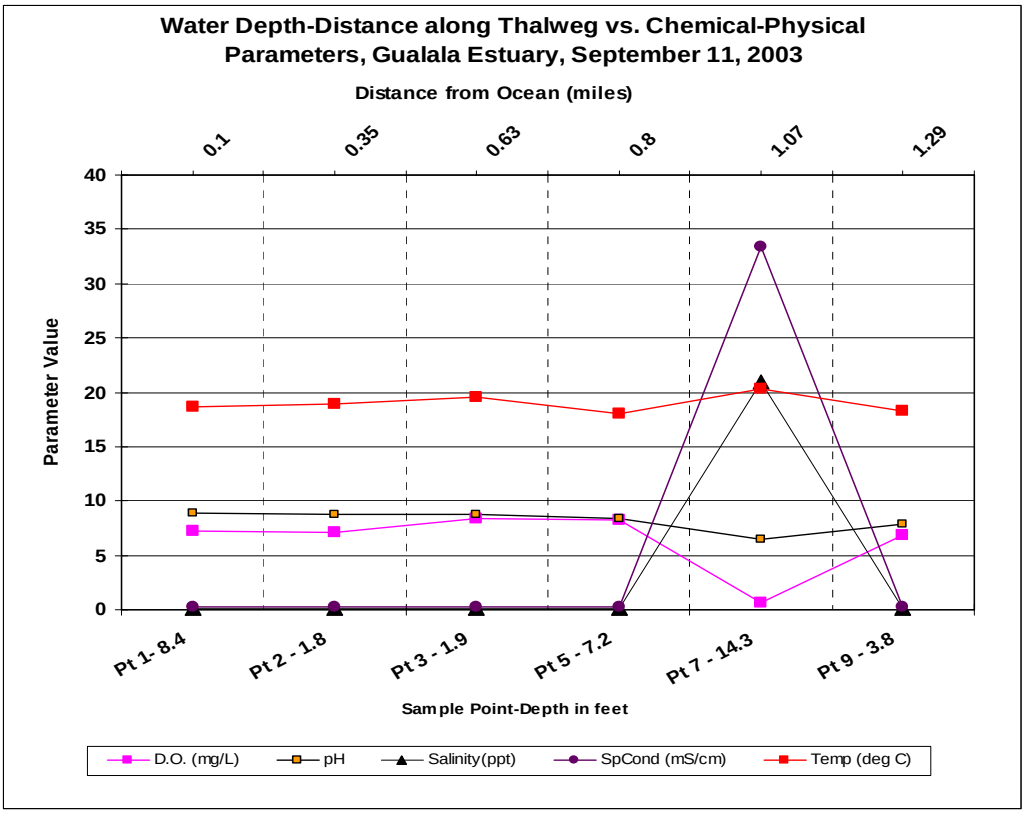

Figure 54 Regional Board physical parameters sampling along thalweg bottom, Gualala Estuary-Lagoon, September 11, 2003.

Table 44 shows the specific results charted in Figure 54. As mentioned, all results were taken at the bottom of the estuary-lagoon. For greater detail at all points sampled, individual depth profiles and summary data for each point are represented in Figure 55 through Figure 67, and Table 45 through Table 58.

Table 44 Physical parameters along thalweg bottom, Gualala Estuary-Lagoon, September 11, 2003.

Sample Point - Distance from Mouth (miles)	Water Depth along Thalweg (ft)	D.O. (mg/L)	pH	Salinity (ppt)	SpCond (mS/cm)	Temp (deg C)
Pt 1- (0.1)	8.4	7.26	8.9	0.12	0.249	18.6
Pt 2 – (0.35)	1.8	7.05	8.8	0.12	0.250	18.9
Pt 3 – (0.63)	1.9	8.44	8.8	0.12	0.256	19.6
Pt 5 – (0.8)	7.2	8.30	8.4	0.12	0.257	18.0
Pt 7 – (1.07)	14.3	0.61	6.5	20.92	33.378	20.3
Pt 9 – (1.29)	3.8	6.80	7.9	0.11	0.240	18.3

As shown, conductivities at all of the points, except Pt-7 near the right bank, were fairly uniform, with conductivity varying by only 0.017 mS/cm from Pt-1 to Pt-9. Salinity concentrations reflect those of conductivity and are so low that the lagoon would be considered freshwater on this date, again, except for the small remnant of saltwater at Pt-7 on the bottom. The choice was made to use mS/cm, instead of the traditional uS/cm, as a unit of measure for conductivity as it could easily be represented on the same graph along with the other parameters. However, even for this sampling event conductivities-salinities are so low that they could not be represented in Figure 54, except where there are localized spikes. It should be noted that in the Water Quality Control Plan for the North Coast Region conductivity is expressed as uS/cm for freshwater systems. There are no numeric criteria at this time for specific conductivity (as well as the other four parameters measured) for the lower Gualala River during estuarine and/or lagoon conditions.

At all of the locations, again except along the right bank at Pt-7, pH held steady varying between 7.9 to 8.9, a difference of 1.0 standard pH unit. Pt-7 along the right bank had an pH of 6.5 on the lagoon bottom where the pocket of saline water was located.

Pt-7, above, also had the largest range in temperature from the top to the bottom, where the bottom temperatures at 14.3 feet and 2-feet above the bottom, were 20.30 ^{o}C (68.54 ^{o}F) and 19.7 ^{o}C (67.46 ^{o}F), respectively. At all depths above the bottom two measurements temperatures were between 18.40 (65.1 ^{o}F) to 19.9 ^{o}C (67.8 ^{o}F). However, Pt-3 with a temperature range of 17.8 – 19.7 had the largest spread in temperature distributions with a variance of $s^2 = 0.58$, while Pt-7 had an $s^2 = 0.31$. For all other locations and depths, except Pt-7 along the right bank, the water temperature ranged between 17.8 (64.0 ^{o}F) to 19.9 ^{o}C (67.8 ^{o}F). Current research for salmonid temperature tolerances suggests that an upper temperature threshold of ~ 23.9 ^{o}C (75 ^{o}F) may be lethal to salmonids if cool water, escape refugia is not available. On this date only the bottom sample at the right bank of Pt-7 approached this threshold but, at 20.3 ^{o}F, was 3.6 ^{o}F below it.

Dissolved oxygen levels at all locations were lower than for previous sample events, ranging from 0.61mg/L on the lagoon bottom at Pt-7 near the right bank, to two identical maximum results of 8.66 mg/L; one measurement was 5.6 feet from the bottom along the left bank at Pt-7 and the other was 0.3 feet below the surface along the right bank at Pt-5. With dissolved oxygen levels at 0.61 mg/L, hypoxic, approaching anoxic conditions were present at Pt-7 that probably only provided habitat for

anaerobes. Results showed that during the four previous sampling events (February 19, May 30, June 26, and July 30, 2003) the lowest dissolved oxygen result was 2.1 mg/L at river mile 0.50 during the May 30 time period, while the maximum was 16.4 mg/L at Pt-7 approximately 4-feet below the water surface during the June 26 sample period.

Dissolved oxygen levels may be lower due to several factors, some of which could be related to decreasing photoperiodicity from shortening day lengths that would depress primary productivity by aquatic plants, such as algae and large populations of *Ruppia maritima* (Ditch Grass), an aquatic seed producing plant observed in the lagoon. It was also noted that extensive mats of algae along the estuary bottom were decomposing, probably from bacterial activity, resulting in increased carbon dioxide levels from respiring bacteria that could be outpacing oxygen production by the remaining healthy algal populations. Other factors resulting in depressed dissolved oxygen levels as lagoon conditions persist may also be attributed to lower summer freshwater inputs from upstream. This, coupled with a lack of marine water intrusion, either through the sandbar and/or direct tidal influence due to nonexistent estuary conditions, may be resulting in decreased mixing of more oxygen rich waters from both sources to the lagoon. It is not known if windspeeds were low or calm before this sampling event but, if so, surface water agitation from wind turbulence that could provide enhanced levels of dissolved oxygen to waters of the lagoon may have been depressed. Windless conditions could also result in reduced sea wave height and power resulting in less or no wave-wash over the sandbar, another source of oxygenated sea water to the lagoon, conditions that were observed during the February and June sampling events.

Similar to the sample results from July 30, even though average dissolved oxygen levels were lower, results from this event tend to portray a well mixed, fairly uniform body of fresh water. The exception was again near the right bank at Pt-7, the Mill Bend, on the lagoon bottom where a stagnant pocket of water with hypoxic dissolved oxygen concentrations and moderately high salinity and specific conductivity levels are persisting.

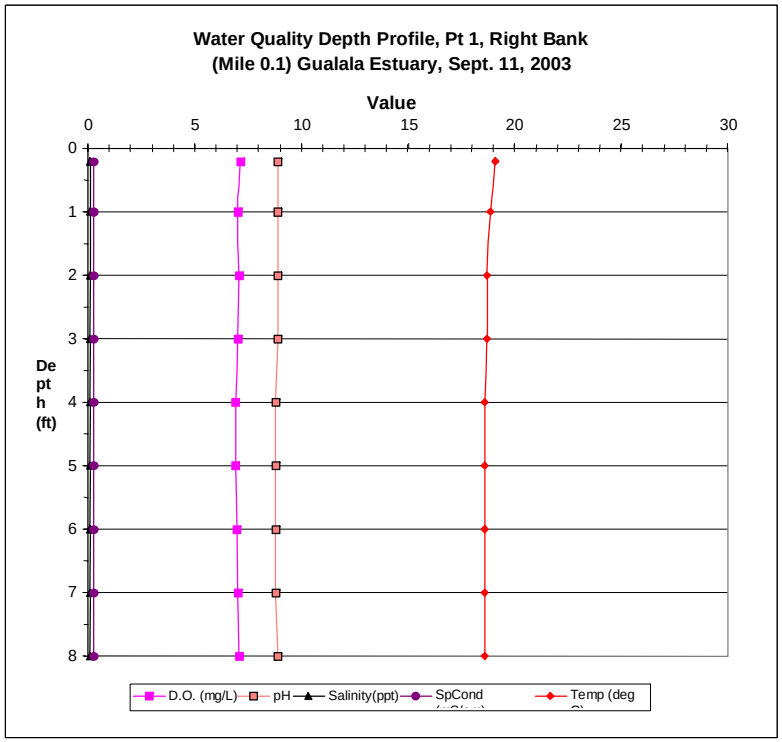

Figure 55 Depth profile of physical parameters at Pt-1 near the left bank of the Gualala Lagoon, September 11, 2003.

Table 45 Physical parameters at Pt-1 – left bank near the left bank of the Gualala Lagoon, September 11, 2003.

Water Depth along Thalweg (ft)	D.O. (mg/L)	pH	Salinity(ppt)	SpCond (mS/cm)	Temp (deg C)
8.3	7.13	8.9	0.12	0.25	18.58
7.2	7.11	8.8	0.12	0.25	18.56
6.2	7.05	8.8	0.12	0.25	18.57
5.2	7.03	8.8	0.12	0.249	18.56
4.2	7.02	8.8	0.12	0.25	18.6
3.2	7.05	8.9	0.12	0.25	18.67
2.2	7.09	8.9	0.12	0.251	18.79
1.2	7.12	8.9	0.12	0.251	18.9
0.2	7.19	8.9	0.12	0.251	19

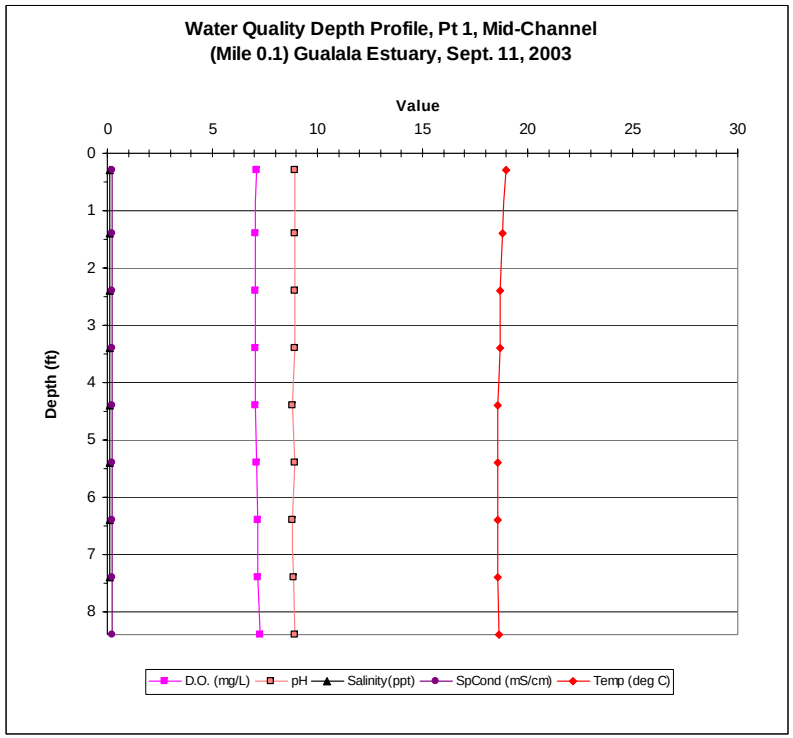

Figure 56 Depth profile of physical parameters at Pt-1 of the thalweg of the Gualala Lagoon, September 11, 2003.

Table 46 Physical parameters at Pt-1 of the thalweg of the Gualala Lagoon, September 11, 2003.

Water Depth along Thalweg (ft)	D.O. (mg/L)	pH	Salinity(ppt)	SpCond (mS/cm)	Temp (deg C)
8.4	7.26	8.9	0.12	0.249	18.62
7.4	7.17	8.9	0.12	0.249	18.6
6.4	7.14	8.8	0.12	0.249	18.6
5.4	7.1	8.9	0.12	0.249	18.6
4.4	7.04	8.8	0.12	0.249	18.6
3.4	7.02	8.9	0.12	0.249	18.7
2.4	7.03	8.9	0.12	0.249	18.7
1.4	7.06	8.9	0.12	0.249	18.8
0.3	7.1	8.9	0.12	0.251	19

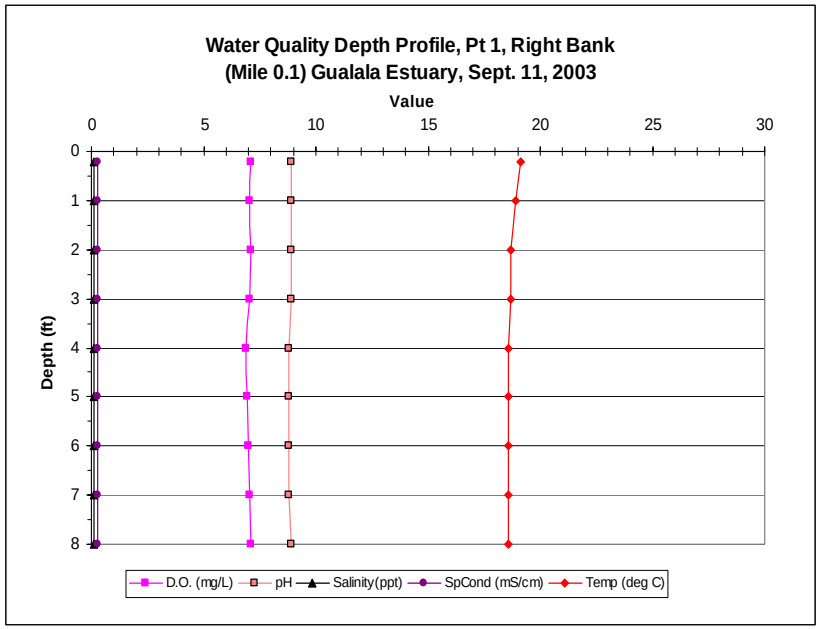

Figure 57 Depth profile of physical parameters at Pt-1 near the right bank of the Gualala Lagoon, September 11, 2003.

Table 47 Physical parameters at Pt-1 near the right bank of the Gualala Lagoon, September 11, 2003.

Water Depth along Thalweg (ft)	D.O. (mg/L)	pH	Salinity(ppt)	SpCond (mS/cm)	Temp (deg C)
8	7.08	8.9	0.12	0.249	18.6
7	7.03	8.8	0.12	0.249	18.6
6	7.01	8.8	0.12	0.249	18.6
5	6.96	8.8	0.12	0.249	18.6
4	6.91	8.8	0.12	0.249	18.6
3	7.03	8.9	0.12	0.258	18.7
2	7.09	8.9	0.12	0.25	18.7
1	7.07	8.9	0.12	0.25	18.9
0.2	7.13	8.9	0.12	0.251	19.1

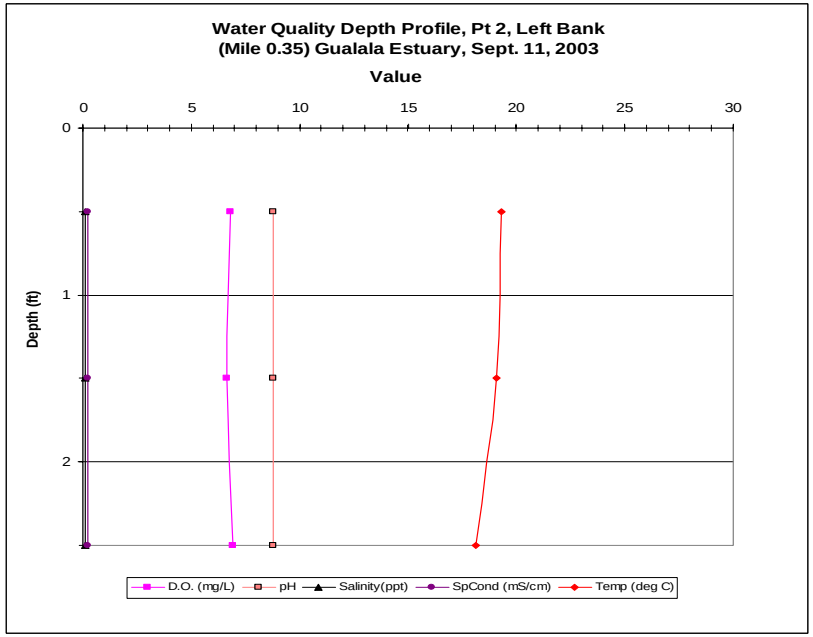

Figure 58 Depth profile of physical parameters at Pt-2 near the left bank of the Gualala Lagoon, September 11, 2003.

Table 48 Physical parameters at Pt-2 near the left bank of the Gualala Lagoon, September 11, 2003.

Water Depth along Thalweg (ft)	D.O. (mg/L)	pH	Salinity (ppt)	SpCond (mS/cm)	Temp (deg C)
2.5	6.91	8.8	0.12	0.252	18.1
1.5	6.64	8.8	0.12	0.25	19.1
0.5	6.8	8.8	0.12	0.249	19.3

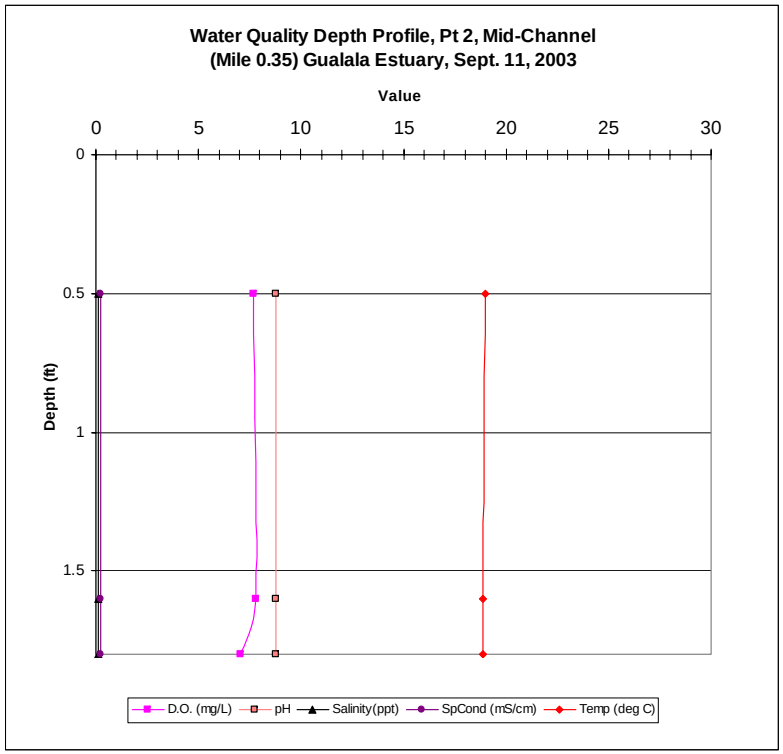

Figure 59 Depth profile of physical parameters at Pt-2 of the thalweg of the Gualala Lagoon, September 11, 2003.

Table 49 Physical parameters at Pt-1 of the thalweg of the Gualala Lagoon, September 11, 2003.

Water Depth along Thalweg (ft)	D.O. (mg/L)	pH	Salinity (ppt)	SpCond (mS/cm)	Temp (deg C)
1.8	7.05	8.8	0.12	0.25	18.9
1.6	7.82	8.8	0.12	0.25	18.9
0.5	7.7	8.8	0.12	0.249	19

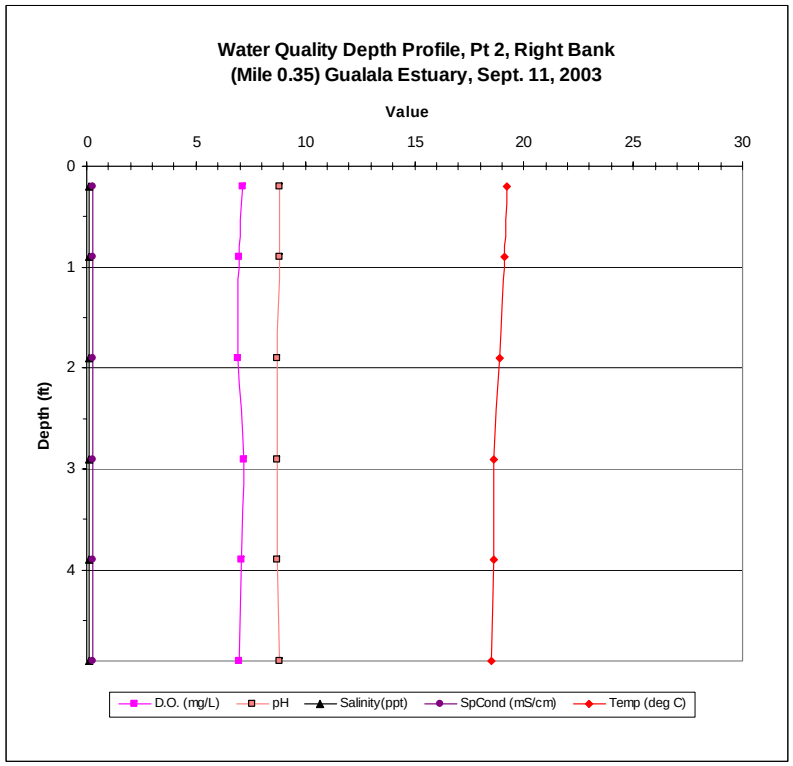

Figure 60 Depth profile of physical parameters at Pt-2 near the right bank of the Gualala Lagoon, September 11, 2003.

Table 50 Physical parameters at Pt-2 near the right bank of the Gualala Lagoon, September 11, 2003.

Water Depth along Thalweg (ft)	D.O. (mg/L)	pH	Salinity (ppt)	SpCond (mS/cm)	Temp (deg C)
4.9	6.96	8.8	0.12	0.252	18.5
3.9	7.06	8.7	0.12	0.252	18.6
2.9	7.16	8.7	0.12	0.254	18.6
1.9	6.9	8.7	0.12	0.252	18.9
0.9	6.95	8.8	0.12	0.25	19.1
0.2	7.13	8.8	0.12	0.249	19.2
0.6	6.7	8.5	0.12	0.259	19.2

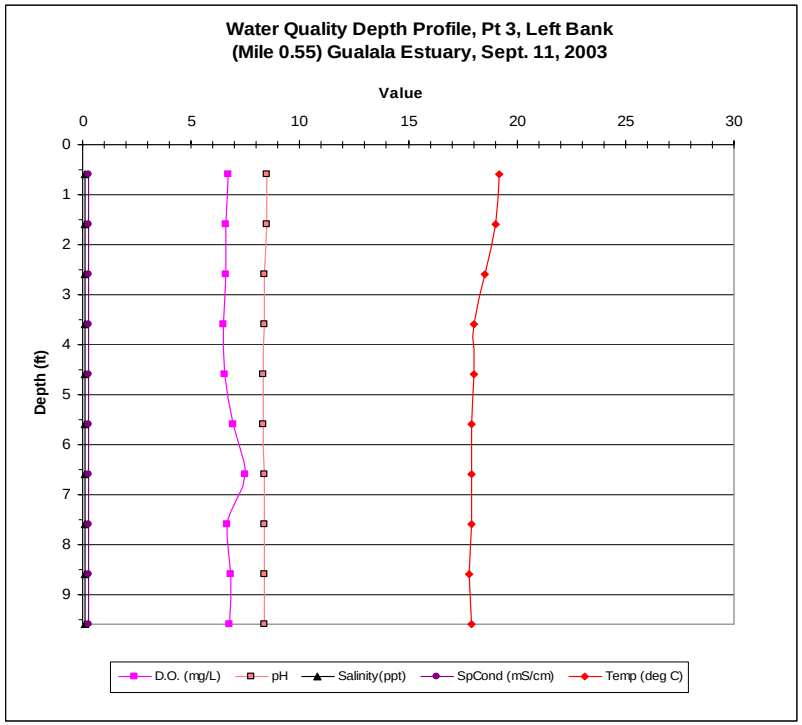

Figure 61 Depth profile of physical parameters at Pt-3 near the left bank of the Gualala Lagoon, September 11, 2003.

Table 51 Physical parameters at Pt-3 near the left bank of the Gualala Lagoon, September 11, 2003.

Water Depth along Thalweg (ft)	D.O. (mg/L)	pH	Salinity (ppt)	SpCond (mS/cm)	Temp (deg C)
9.6	6.77	8.4	0.12	0.259	17.9
8.6	6.82	8.4	0.12	0.259	17.8
7.6	6.65	8.4	0.12	0.259	17.9
6.6	7.49	8.4	0.12	0.259	17.9
5.6	6.95	8.3	0.12	0.259	17.9
4.6	6.54	8.3	0.12	0.259	18
3.6	6.49	8.4	0.12	0.259	18
2.6	6.6	8.4	0.12	0.259	18.5
1.6	6.62	8.5	0.12	0.259	19

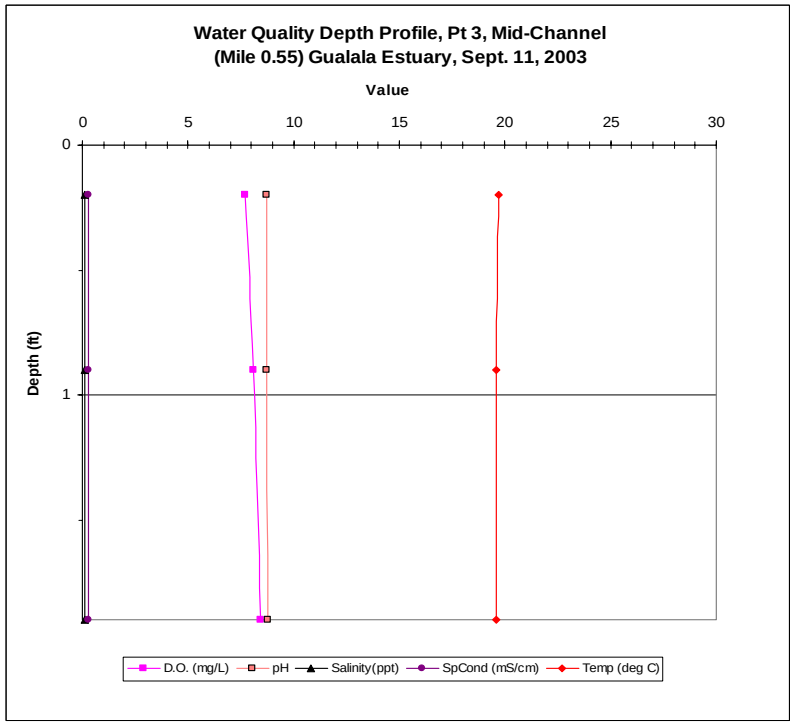

Figure 62 Depth profile of physical parameters at Pt-3 at the thalweg of the Gualala Lagoon, September 11, 2003.

Table 52 Physical parameters at Pt-3 at the thalweg of the Gualala Lagoon, September 11, 2003.

Water Depth along Thalweg (ft)	D.O. (mg/L)	pH	Salinity (ppt)	SpCond (mS/cm)	Temp (deg C)
1.9	8.44	8.8	0.12	0.256	19.6
0.9	8.1	8.7	0.12	0.256	19.6
0.2	7.69	8.7	0.12	0.257	19.7

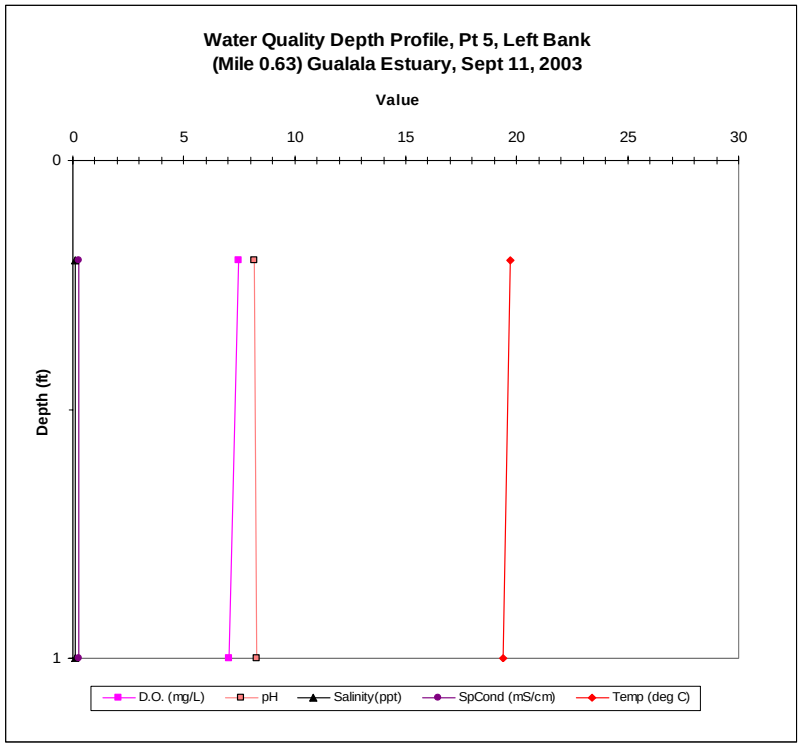

Figure 63 Depth profile of physical parameters at Pt-5 near the left bank of the Gualala Lagoon, September 11, 2003.

Table 53 Physical parameters at Pt-5 near the left bank of the Gualala Lagoon, September 11, 2003.

Water Depth along Thalweg (ft)	D.O. (mg/L)	pH	Salinity (ppt)	SpCond (mS/cm)	Temp (deg C)
1	7.06	8.3	0.12	0.254	19.4
0.2	7.45	8.2	0.12	0.255	19.7

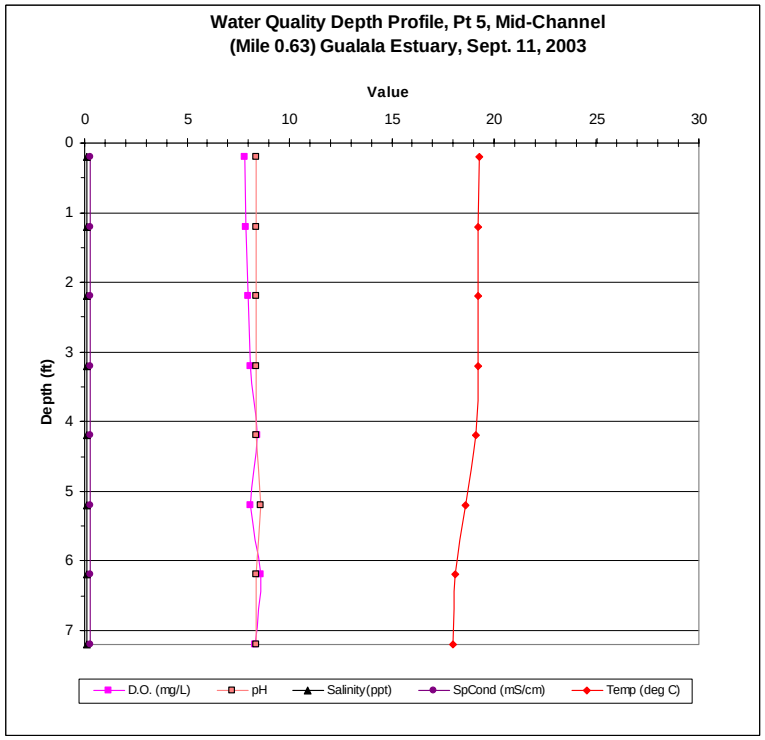

Figure 64 Depth profile of physical parameters at Pt-5 in the thalweg of the Gualala Lagoon, September 11, 2003.

Table 54 Physical parameters at Pt-5 in the thalweg of the Gualala Lagoon, September 11, 2003.

Water Depth along Thalweg (ft)	D.O. (mg/L)	pH	Salinity (ppt)	SpCond (mS/cm)	Temp (deg C)
7.2	8.3	8.4	0.12	0.257	18
6.2	8.6	8.4	0.12	0.257	18.1
5.2	8.09	8.6	0.12	0.256	18.6
4.2	8.42	8.4	0.12	0.252	19.1
3.2	8.12	8.4	0.12	0.254	19.2
2.2	7.97	8.4	0.12	0.254	19.2
1.2	7.88	8.4	0.12	0.254	19.2
0.2	7.82	8.4	0.12	0.255	19.3

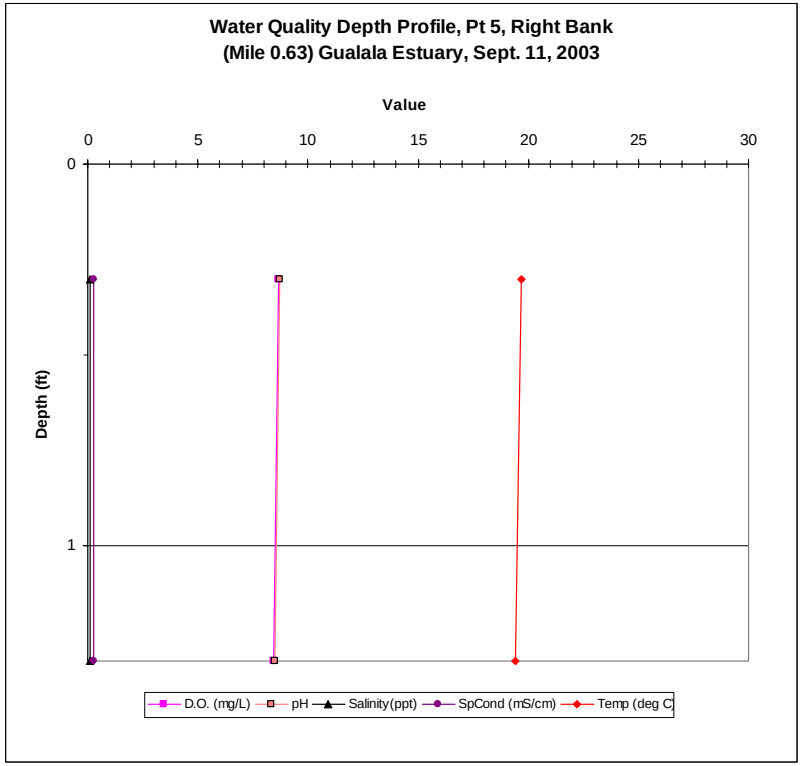

Figure 65 Depth profile of physical parameters at Pt-5 near the right bank of the Gualala Lagoon, September 11, 2003.

Table 55 Physical parameters at Pt-5 near the right bank of the Gualala Lagoon, September 11, 2003.

Water Depth along Thalweg (ft)	D.O. (mg/L)	pH	Salinity (ppt)	SpCond (mS/cm)	Temp (deg C)
1.3	8.45	8.5	0.12	0.254	19.4
0.3	8.66	8.7	0.12	0.255	19.7

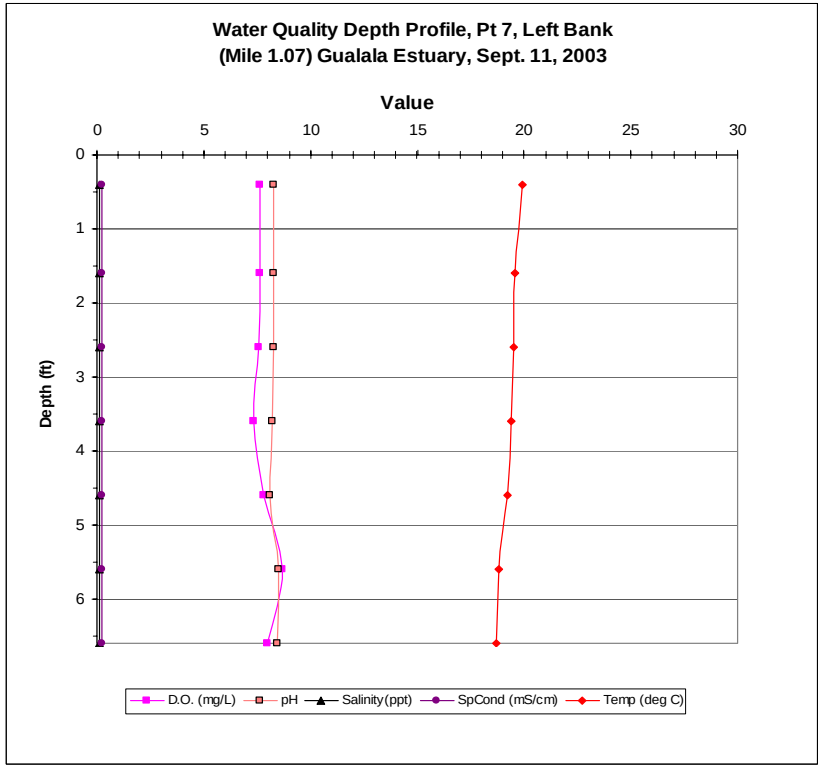

Figure 66 Depth profile of physical parameters at Pt-7 near the left bank of the Gualala Lagoon, September 11, 2003.

Table 56 Physical parameters at Pt-7 near the left bank of the Gualala Lagoon, September 11, 2003.

Water Depth along Thalweg (ft)	D.O. (mg/L)	pH	Salinity (ppt)	SpCond (mS/cm)	Temp (deg C)
6.6	7.96	8.42	0.12	0.243	18.7
5.6	8.66	8.5	0.12	0.244	18.8
4.6	7.78	8.1	0.12	0.247	19.2
3.6	7.34	8.2	0.12	0.25	19.4
2.6	7.55	8.3	0.12	0.251	19.5
1.6	7.61	8.3	0.12	0.251	19.6
0.4	7.62	8.3	0.12	0.248	19.9

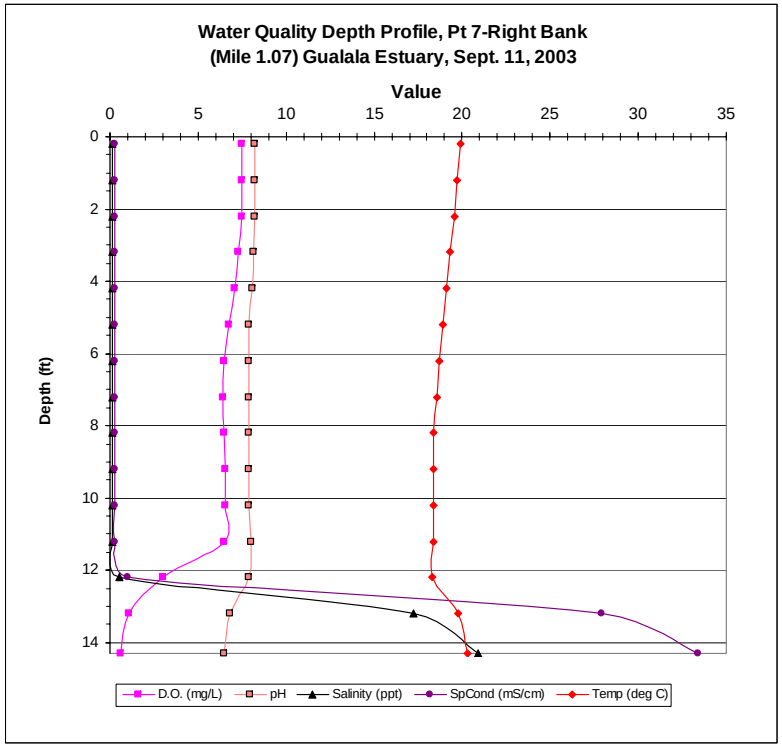

Figure 67 Depth profile of physical parameters at Pt-7 near the right bank in the thalweg of the Gualala Lagoon, September 11, 2003.

Table 57 Physical parameters at Pt-7 near the right bank in the thalweg of the Gualala Lagoon, September 11, 2003

Water Depth along Thalweg (ft)	D.O. (mg/L)	pH	Salinity (ppt)	SpCond (mS/cm)	Temp (deg C)
14.3	0.61	6.5	20.92	33.378	20.3
13.2	1.04	6.8	17.2	27.923	19.8
12.2	2.98	7.9	0.51	1.023	18.3
11.2	6.49	8	0.12	0.252	18.4
10.2	6.54	7.9	0.12	0.245	18.4
9.2	6.52	7.9	0.12	0.246	18.4
8.2	6.48	7.9	0.12	0.244	18.4
7.2	6.44	7.9	0.12	0.243	18.6
6.2	6.49	7.88	0.12	0.245	18.7
5.2	6.73	7.9	0.12	0.246	18.9
4.2	7.05	8.1	0.12	0.249	19.1
3.2	7.26	8.18	0.12	0.251	19.3
2.2	7.49	8.2	0.12	0.252	19.6
1.2	7.51	8.2	0.12	0.252	19.7
0.2	7.5	8.2	0.12	0.25	19.9

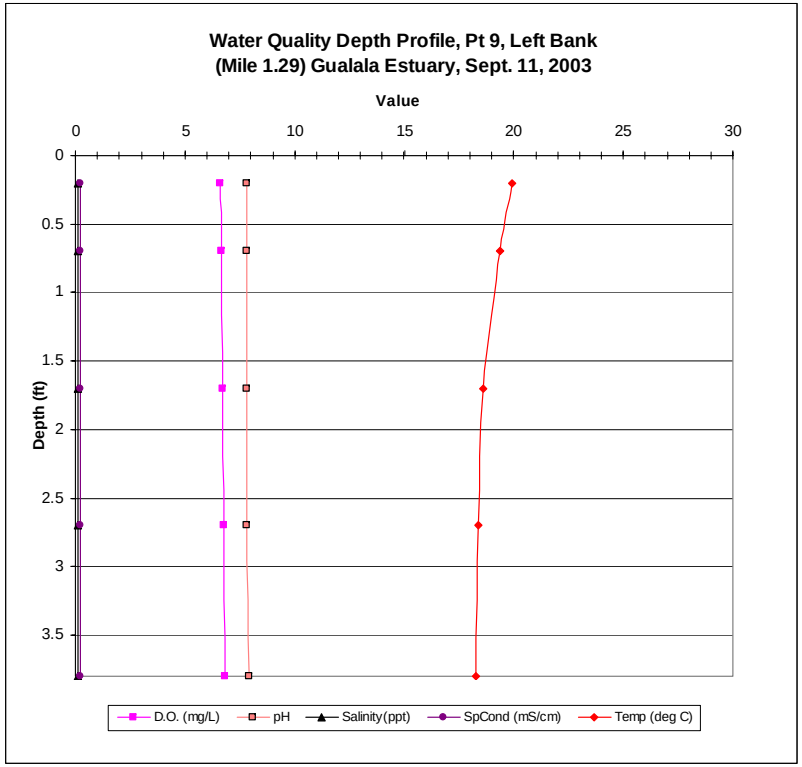

Table 58 Physical parameters at Pt-9 near the left bank in the thalweg of the Gualala Lagoon, September 11, 2003.

Water Depth along Thalweg (ft)	D.O. (mg/L)	pH	Salinity (ppt)	SpCond (mS/cm)	Temp (deg C)
3.8	6.8	7.9	0.11	0.24	18.3
2.7	6.76	7.8	0.11	0.24	18.4
1.7	6.74	7.8	0.11	0.24	18.6
0.7	6.65	7.8	0.11	0.24	19.4
0.2	6.63	7.8	0.11	0.24	19.9

Gualala Estuary, Regional Water Board Depth Profile Sampling, October 23, 2003

On October 23, 2003 the Regional Water Board used an YSI 600 XL data sonde (sonde) to sample physical parameters in the Gualala Estuary (estuary). The sonde was precalibrated and programmed for discrete sampling in the late afternoon of October 22 at the Regional Water Board laboratory prior to sampling the next day. Measurements were taken at various points along the length of the estuary by Cynthia LeDoux-Bloom, Department of Fish and Game, and Katharine Spivak and Elmer Dudik of the Regional Water Board. Ocean Kayaks were used to access the sample locations shown in Figure 68. At each profile point (Pt) depth profiles were conducted in the approximate thalweg of the channel from the estuary bottom, pausing at 1-foot intervals to stabilize the sonde for another measurement, ending between approximately 0.2-0.5 feet from the water surface. At most points additional sample profiles at varying distances, depending on depth and bottom features, were also measured near the left and right banks relative to their associated thalweg point profiles. Left and right banks were determined facing upstream. Physical-chemical parameters recorded included dissolved oxygen, salinity, specific conductivity, temperature, pH, and depth.

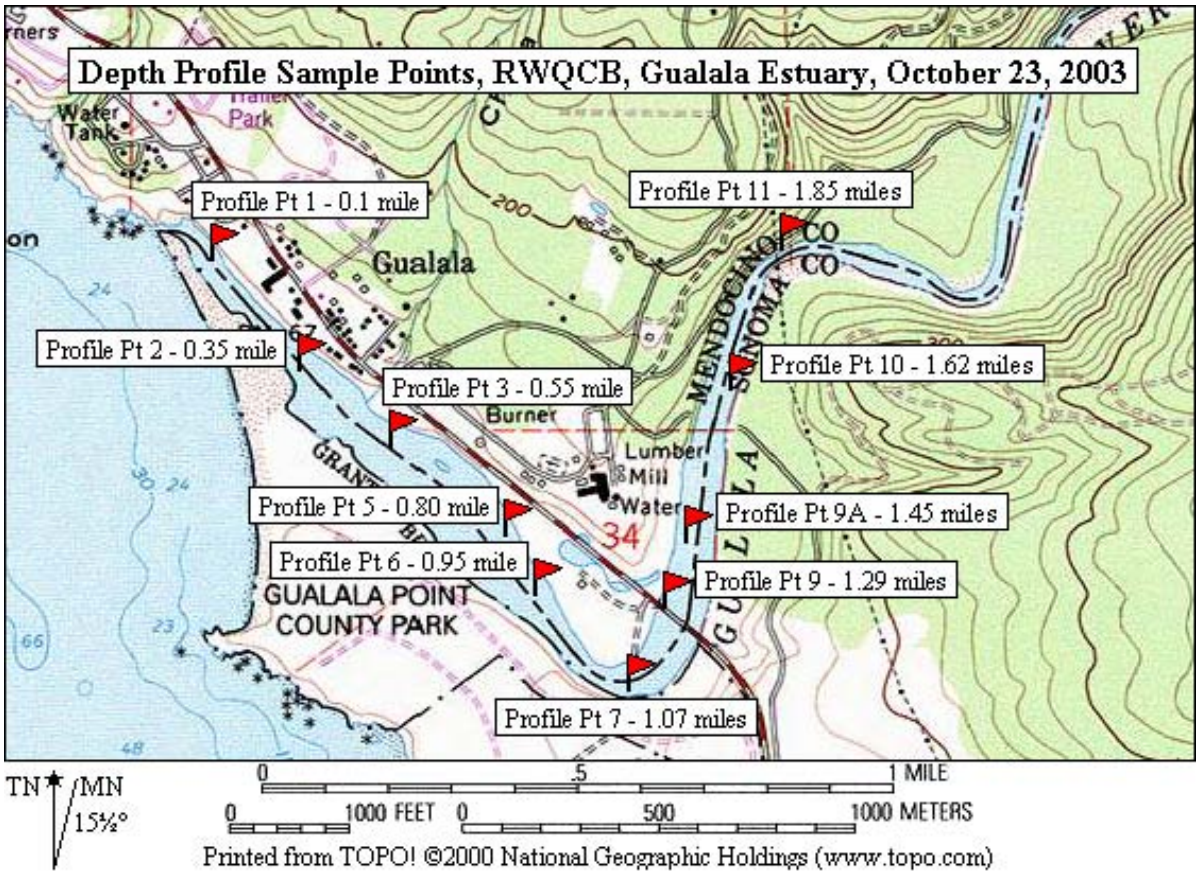

Figure 68 Regional Water Board depth profile points, Gualala Estuary, October 23, 2003.

Depth profiles began at Pt 1, approximately 0.1 mile from the ocean, ending at Pts 9A, 10, and 11, locations that were dominated completely by freshwater flows from upstream. Pts 10 and 11 are approximately 1.62 and 1.85 miles, respectively, from the ocean. For consistency between sampling events throughout the 2003 sampling period, all sample points are numbered relative to the June 26, 2003 sampling date when depth profiling was first completed in the estuary by the Regional Water Board. It

should be noted that some locations were not resampled due to changed estuary conditions and, therefore, are not depicted in Figure 68. Also, during this sampling event at Pt-9, a slight detection of saline water was recorded so a new sample point, Pt-9A, was addded to assure Pt-9 was the furthest upstream occurrence of salty water.

A sandbar was in place during sampling, isolating the Gualala River from the ocean, creating a lagoon, instead of true estuarine conditions. Sonde results showed that a sharp transition and stratification between overlying, less dense freshwater and deeper, saltier water, referred to as a pycnocline, were largely absent during this event. However, all sites from Pt-9 to Pt-1did have specific conductivity and salinity results higher than that of freshwater, but the transiton from less dense surface water to deeper, saltier water was much more gradual. Only at Pt-7 approximately 9-10 feet from the water's surface was there an evident pycnocline with an area of highly stratified saltier water below it. During the last sampling event on September 11, Pt-7 at the bottom near the right bank was the only location with any measureable salinity and accompanying spikes in specific conductance. It was noted that the sandbar between the ocean and the lagoon had several locations where high waves washed over, leaving behind sand deltas and erosional channels to the lagoon from the wave activity. The Notice to Mariners broadcast by NOAA on the internet, warned of high seas from October 12-19 (NOAA, 2003). Average wave heights at the Point Arena sea buoy reached 6.6 meters (~21.8 feet) on October 12 and 13, with a maximum wave height of 6.9 meters (~22.8 feet) measured on October 13. Ocean waves of this magnitude traveling toward shore likely easily washed over the sand bar and probably were the source of the increased salinity and specific conductity levels lingering in the lagoon during this sampling period. This assumption, in addition to the remnant visual evidence mentioned above, was verified during subsequent conversations with local residents who observed that the sand bar did not breach between the ocean and the lagoon prior to October 23 but that wave –wash over the sandbar continued for several days after October 12 and 13.

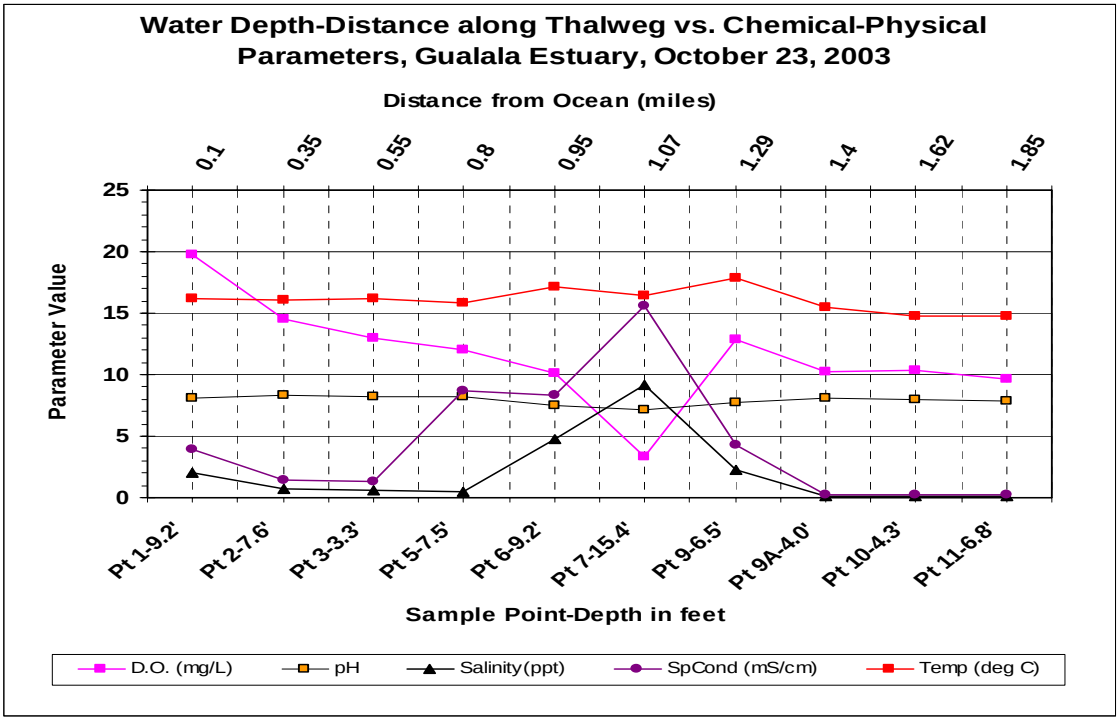

Figure 69 Regional Water Board physical parameters sampling along thalweg, Gualala Estuary-Lagoon, June 26, 2003

Figure 69 , above, graphically illustrates the relationship between water depth, distance between points, and the five parameters of temperature, salinity, conductance, dissolved oxygen, and pH. Table 59 is the raw data used to synthesize Figure 69 and both depict only a single sampling effort for each point at or near the thalweg of the lagoon bottom. Figure 70 through Figure 97, and Table 60 through Table 86 at the end of the report are the field data collected at each sample point at 1-foot depth increments.

Table 59 Regional Water Board physical parameters sampling along thalweg, Gualala Estuary-Lagoon, October 23, 2003

Distance from Mouth (miles)	Profile Point-Water Depth along Thalweg (ft)	Dissolved Oxygen (mg/L)	pH	Salinity (ppt)	Specific Conductance (mS/cm)	Temperature (deg C)
0.1	Pt 1-9.2'	19.7	8.1	2.05	3.903	16.2
0.35	Pt 2-7.6'	14.6	8.3	0.70	1.391	16.0
0.55	Pt 3-3.3'	13.0	8.2	0.65	1.302	16.2
0.8	Pt 5-7.5'	12.0	8.3	0.43	8.650	15.9
0.95	Pt 6-9.2'	10.1	7.5	4.77	8.354	17.2
1.07	Pt 7-15.4'	3.3	7.1	9.16	15.615	16.4
1.29	Pt 9-6.5'	12.9	7.8	2.31	4.273	17.8
1.4	Pt 9A-4.0'	10.3	8.0	0.12	0.251	15.5
1.62	Pt 10-4.3'	10.3	8.0	0.11	0.224	14.7
1.85	Pt 11-6.8'	9.6	7.8	0.11	0.222	14.7

Specific conductivity at the three upstream points ranged from 0.222 to 0.251 mS/cm, (222 and 251 uS/cm) while salinity was consistently < 0.12 ppt; both of these results at the three stations represent freshwater conditions. These values were so low for both parameters that they could not be shown in Figure 69 due to the choice of using mS/Cm as a unit of measure that could be presented along with the other parameters on the same graphs. In “drinkable” water, that is water that is preferred by humans, the measurement of salinity and other dissolved mineral constituents is generally expressed as total dissolved solids, and reported as parts per million (ppm) or the equivalent milligrams per liter (mg/L). Since, for investigative purposes and uniformity between researchers, salinity in this report is converted to parts per thousand (ppt). Hence, as an example, 500 mg/l = 0.5 ppt. The salinity of drinking-quality water ranges from 0 to 3.0 ppt. Humans prefer water containing less than 0.5 ppt, but many water supplies contain as much as 1.0 ppt salinity (or its equivalent in total dissolved solids). Water containing up to 3.0 ppt can be consumed by livestock or used for crop irrigation (EPA, 2003). There are no drinking water standards that include salinity and specific conductivity numeric criteria for estuaries, including the Gualala Estuary, in the Basin Plan because of their tidal connectivity with the ocean, making them a poor source of drinking water for human use. There are also no numeric criteria in the Basin Plan at this time for the other three parameters of temperature, pH, and dissolved oxygen measured for the lower Gualala River during estuarine and/or lagoon conditions. It should be noted that in the Water Quality Control Plan for the North Coast Region (Basin Plan) conductivity is expressed as uS/cm.

For all points the average salinity and specific conductivity were 0.91 ppt and 1.95 mS/cm (195 uS/cm), respectively. Salinity ranged from 0.11-9.16 ppt and conductivity was between 0.221-15.615 mS/cm (221-15,615 uS/cm). Compared to the three upstream sites at Pt-9A, 10, and 11, Pts 9-1 which are all downstream from Pt-9A, salinity and specific conductivity, depending on depth, were elevated to varying degrees ranging from slightly brackish to marginally saltier conditions. Pt-7, as in previous sampling efforts, had the highest salinity and conductivity results.

At all points pH was consistently between 7.11 to 8.93, a difference of only 1.82 standard pH units, while the average pH was 8.13. There were very small, localized variances that generally were at those depths coinciding with the transition between fresher surface water and underlying, saltier water as the lagoon bottom was approached.

Dissolved oxygen concentrations remained moderate to high at all points except at Pt-7 approximately 10 feet from the right bank, where from 9.4 feet below the surface to the lagoon bottom at 15.4 feet dissolved oxygen ranged from 7.69 to 3.29 mg/L, respectively. Pt-7, again on the lagoon bottom but at 9.3 feet deep, and 30 feet from the right bank, had the next lowest dissolved oxygen concentration at 7.78 mg/l. At all other points dissolved oxygen concentrations ranged from 9.27 to 21.02 mg/l, with an overall average of 11.91 mg/l, all levels that would be supportive to the survival of salmonids and other aquatic vertebrates requiring adequately oxygenated waters.

Water temperatures ranged from 14.71 ^{0}C at Pt-11 to 17.95 ^{0}C at Pt-3; the average temperature at all locations and depths was 16.14 ^{0}C. Perhaps because of persistant overcast conditions and possibly cooler water from upstream sources, temperatures were depressed compared to several previous sampling efforts. For example during May, June, July, and September, maximum water temperatures were all above 18.40 ^{0}C with a high of 22.34 ^{0}C reached during July.

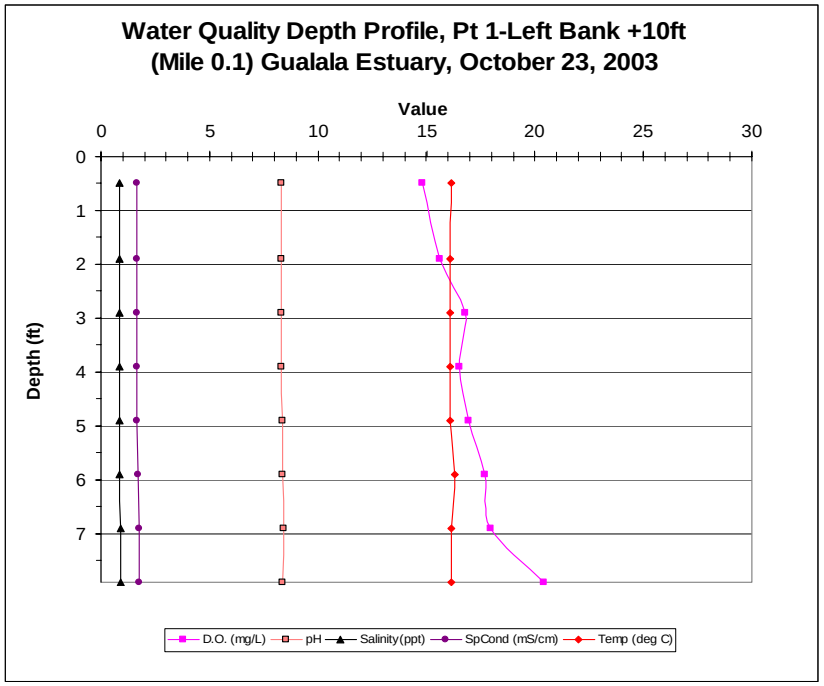

Figure 70 Depth profile of physical parameters at Pt-1 approximately 10 feet from the left bank of the Gualala Lagoon, October 23, 2003.

Table 60 Physical parameters at Pt-1 approximately 10 feet from the left bank of the Gualala Lagoon, October 23, 2003

Water Depth (ft)	D.O. (mg/L)	pH	Salinity (ppt)	SpCond (mS/cm)	Temp (deg C)
0.5	14.81	8.3	0.83	1.631	16.12
1.9	15.6	8.3	0.83	1.631	16.11
2.9	16.77	8.3	0.83	1.63	16.1
3.9	16.54	8.3	0.83	1.63	16.1
4.9	16.97	8.4	0.83	1.638	16.1
5.9	17.7	8.4	0.86	1.69	16.31
6.9	17.97	8.4	0.89	1.744	16.14
7.9	20.41	8.4	0.91	1.773	16.16

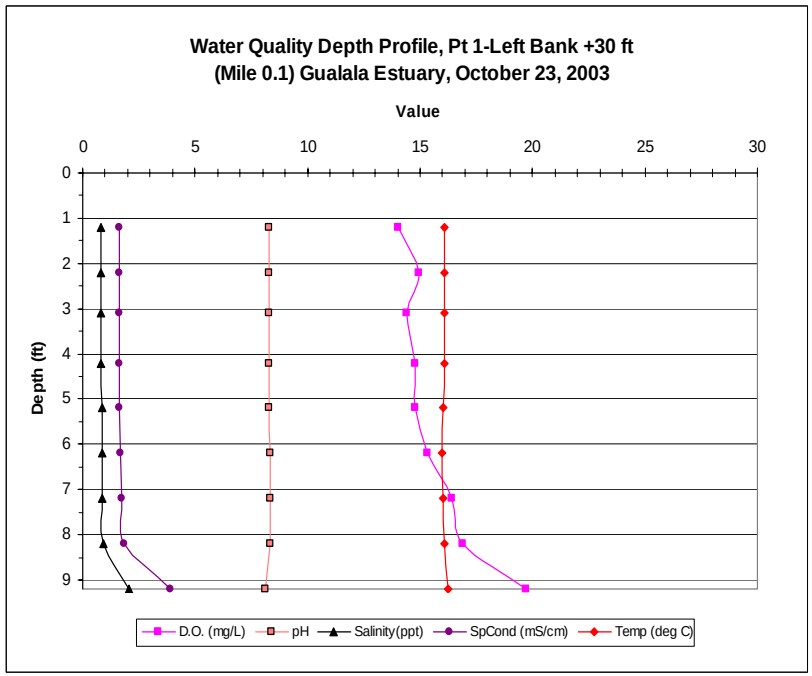

Figure 71 Depth profile of physical parameters at Pt-1 approximately 30 feet from the left bank of the Gualala Lagoon, October 23, 2003.

Table 61 Physical parameters at Pt-1 approximately 30 feet from the left bank of the Gualala Lagoon, October 23, 2003.

Water Depth (ft)	D.O. (mg/L)	pH	Salinity (ppt)	SpCond (mS/cm)	Temp (deg C)
1.2	14	8.3	0.83	1.632	16.09
2.2	14.97	8.3	0.83	1.632	16.09
3.1	14.4	8.3	0.83	1.631	16.1
4.2	14.78	8.31	0.83	1.64	16.07
5.2	14.79	8.31	0.84	1.646	16.05
6.2	15.32	8.32	0.86	1.7	15.98
7.2	16.43	8.33	0.88	1.734	16.03
8.2	16.87	8.32	0.94	1.84	16.07
9.2	19.72	8.13	2.05	3.903	16.24

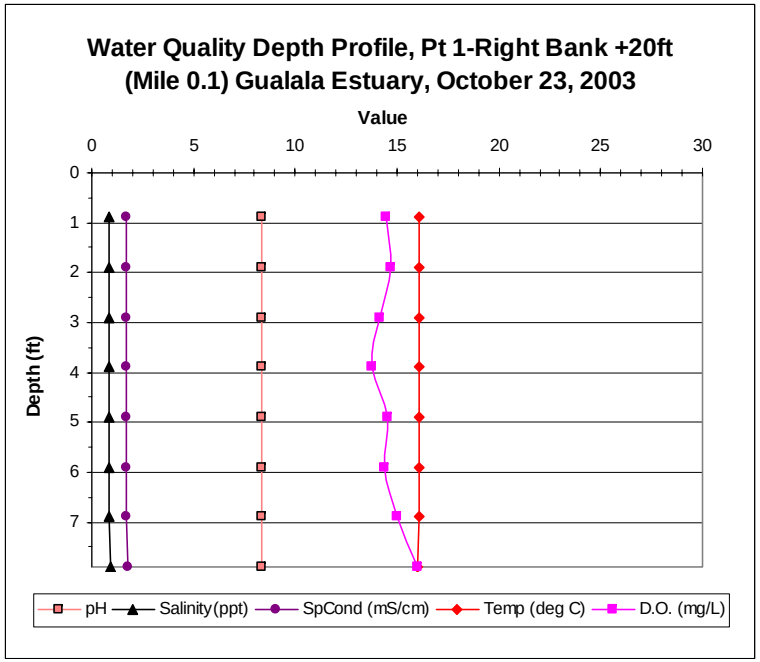

Figure 72 Depth profile of physical parameters at Pt-1 approximately 20 feet from the right bank of the Gualala Lagoon, October 23, 2003.

Table 62 Physical parameters at Pt-1 approximately 20 feet from the right bank of the Gualala Lagoon, October 23, 2003

Water Depth (ft)	D.O. (mg/L)	pH	Salinity (ppt)	SpCond (mS/cm)	Temp (deg C)
0.9	14.45	8.33	0.85	1.671	16.1
1.9	14.67	8.33	0.85	1.67	16.1
2.9	14.14	8.33	0.85	1.676	16.07
3.9	13.79	8.33	0.85	1.677	16.07
4.9	14.55	8.33	0.85	1.677	16.07
5.9	14.42	8.33	0.85	1.676	16.06
6.9	15	8.33	0.86	1.699	16.06
7.9	16	8.32	0.89	1.748	16.03

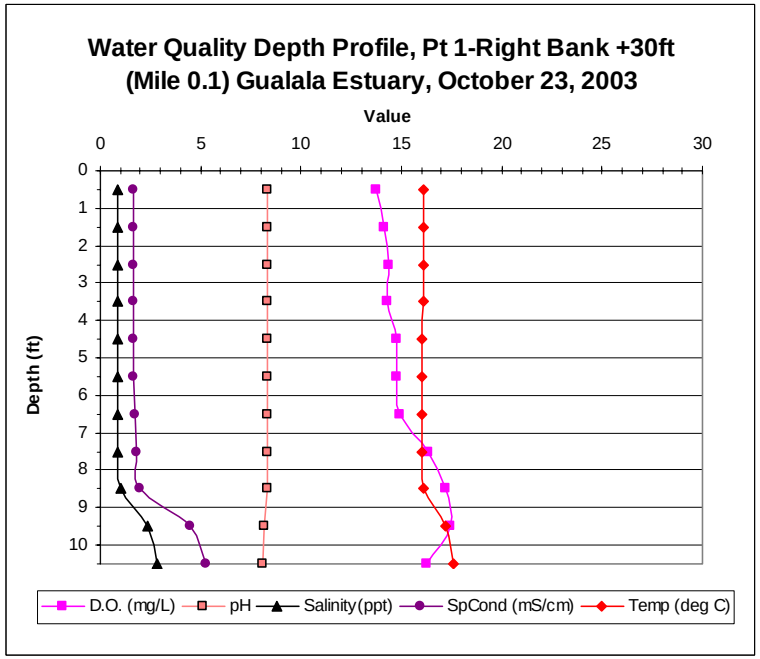

Figure 73 Depth profile of physical parameters at Pt-1 approximately 30 feet from the right bank of the Gualala Lagoon, October 23, 2003.

Table 63 Physical parameters at Pt-1 approximately 30 feet from the right bank of the Gualala Lagoon, October 23, 2003

Water Depth (ft)	D.O. (mg/L)	pH	Salinity (ppt)	SpCond (mS/cm)	Temp (deg C)
0.5	13.77	8.3	0.84	1.651	16.07
1.5	14.15	8.3	0.84	1.649	16.07
2.5	14.35	8.3	0.84	1.649	16.07
3.5	14.32	8.3	0.84	1.651	16.07
4.5	14.75	8.3	0.85	1.67	16.04
5.5	14.74	8.3	0.85	1.681	16.03
6.5	14.93	8.3	0.86	1.693	16.01
7.5	16.3	8.4	0.9	1.771	16.0
8.5	17.22	8.4	1	1.972	16.11
9.5	17.42	8.2	2.39	4.451	17.19
10.5	16.27	8.1	2.84	5.254	17.6

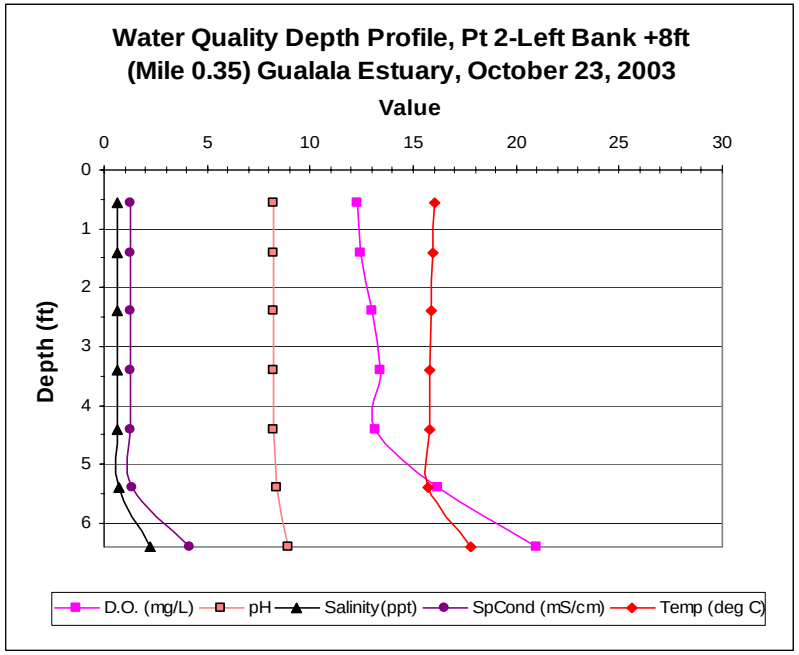

Figure 74 Depth profile of physical parameters at Pt-2 approximately 8 feet from the left bank of the Gualala Lagoon, October 23, 2003.

Table 64 Physical parameters at Pt-2 approximately 8 feet from the left bank of the Gualala Lagoon, October 23, 2003.

Water Depth (ft)	D.O. (mg/L)	pH	Salinity (ppt)	SpCond (mS/cm)	Temp (deg C)
0.55	12.27	8.24	0.66	1.309	16.06
1.4	12.46	8.21	0.65	1.297	15.99
2.4	13.01	8.2	0.65	1.286	15.89
3.4	13.4	8.18	0.64	1.278	15.8
4.4	13.2	8.19	0.64	1.277	15.77
5.4	16.22	8.38	0.68	1.355	15.68
6.4	21.02	8.93	2.22	4.142	17.82

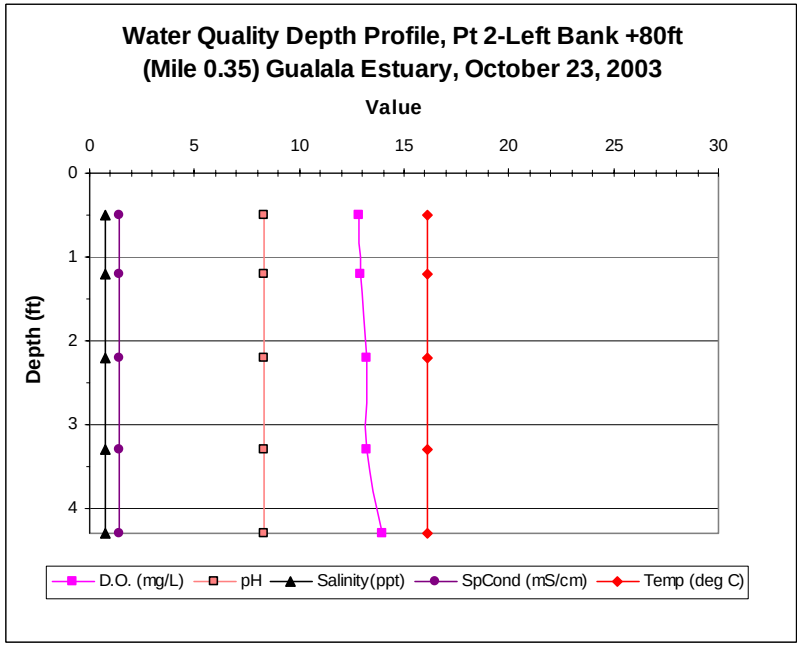

Figure 75 Depth profile of physical parameters at Pt-2 approximately 80 feet from the left bank of the Gualala Lagoon, October 23, 2003.

Table 65 Physical parameters at Pt-2 approximately 80 feet from the left bank of the Gualala Lagoon, October 23, 2003

Water Depth (ft)	D.O. (mg/L)	pH	Salinity (ppt)	SpCond (mS/cm)	Temp (deg C)
0.5	12.82	8.3	0.71	1.402	16.08
1.2	12.92	8.3	0.71	1.403	16.13
2.2	13.22	8.3	0.71	1.4	16.14
3.3	13.19	8.3	0.71	1.402	16.14
4.3	13.98	8.3	0.71	1.4	16.15

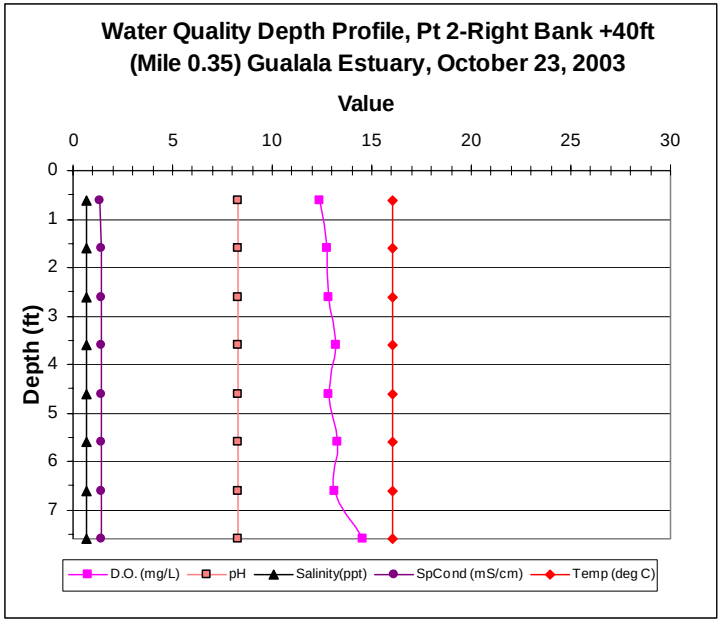

Figure 76 Depth profile of physical parameters at Pt-2 approximately 40 feet from the right bank of the Gualala Lagoon, October 23, 2003.

Table 66 Physical parameters at Pt-2 approximately 40 feet from the right bank of the Gualala Lagoon, October 23, 2003

Water Depth (ft)	D.O. (mg/L)	pH	Salinity (ppt)	SpCond (mS/cm)	Temp (deg C)
0.6	12.41	8.27	0.7	1.378	16.04
1.6	12.75	8.28	0.7	1.381	16.04
2.6	12.8	8.28	0.7	1.385	16.05
3.6	13.22	8.28	0.7	1.387	16.05
4.6	12.82	8.28	0.7	1.389	16.05
5.6	13.27	8.28	0.7	1.391	16.05
6.6	13.1	8.28	0.7	1.397	16.07
7.6	14.58	8.28	0.7	1.391	16.04

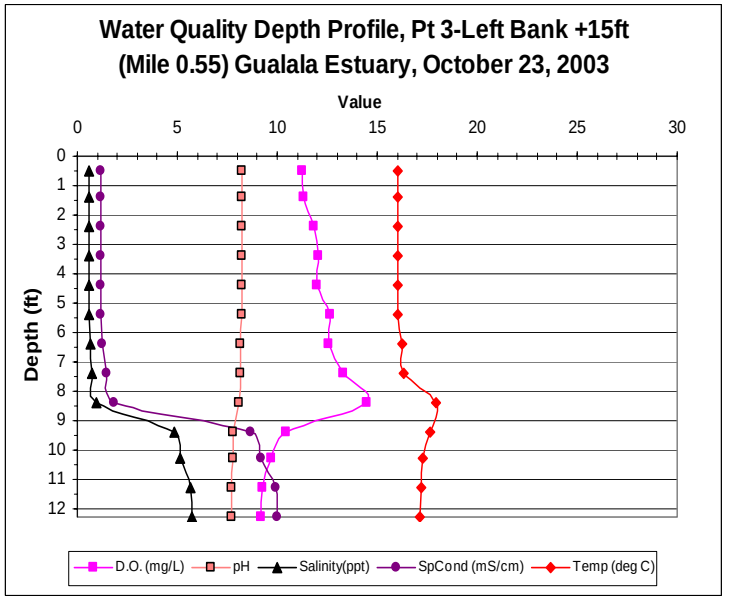

Figure 77 Depth profile of physical parameters at Pt-3 approximately 15 feet from the left bank of the Gualala Lagoon, October 23, 2003.

Table 67 Physical parameters at Pt-3 approximately 15 feet from the left bank of the Gualala Lagoon, October 23, 2003.

Water Depth (ft)	D.O. (mg/L)	pH	Salinity (ppt)	SpCond (mS/cm)	Temp (deg C)
0.5	11.26	8.2	0.58	1.171	16.05
1.4	11.31	8.2	0.59	1.17	16.04
2.4	11.86	8.2	0.59	1.171	16.04
3.4	12.05	8.2	0.59	1.171	16.04
4.4	11.98	8.2	0.59	1.175	16.04
5.4	12.67	8.2	0.59	1.187	16.06
6.4	12.61	8.19	0.63	1.274	16.22
7.4	13.34	8.14	0.73	1.45	16.31
8.4	14.5	8.06	0.94	1.874	17.95
9.4	10.46	7.76	4.84	8.671	17.66
10.3	9.73	7.78	5.15	9.204	17.28
11.3	9.27	7.73	5.64	9.962	17.22
12.3	9.21	7.71	5.7	10	17.11

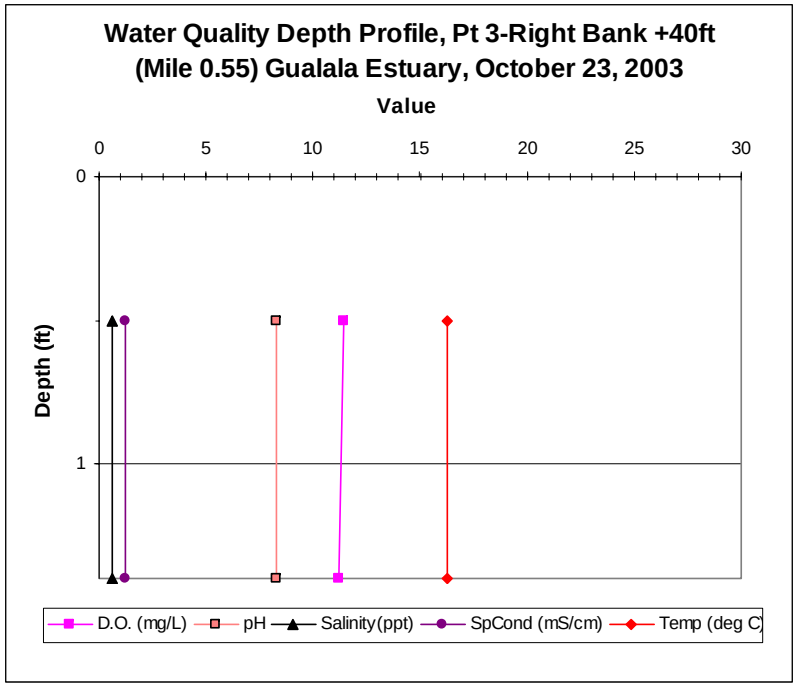

Figure 78 Depth profile of physical parameters at Pt-3 approximately 40 feet from the right bank of the Gualala Lagoon, October 23, 2003.

Table 68 Physical parameters at Pt-3 approximately 40 feet from the right bank of the Gualala Lagoon, October 23, 2003

Water Depth (ft)	D.O. (mg/L)	pH	Salinity (ppt)	SpCond (mS/cm)	Temp (deg C)
0.5	11.47	8.26	0.62	1.244	16.23
1.4	11.2	8.27	0.62	1.244	16.23

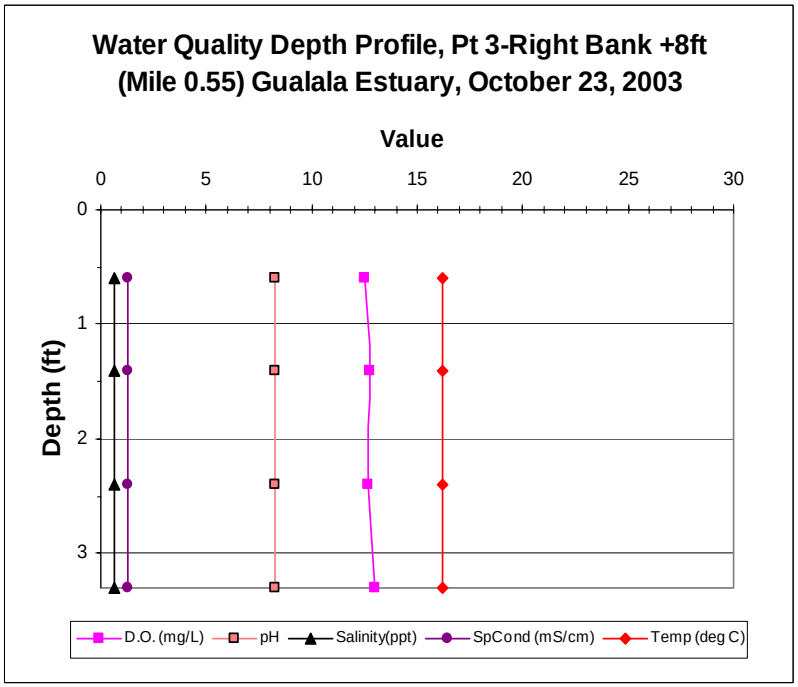

Figure 79 Depth profile of physical parameters at Pt-3 approximately 8 feet from the right bank of the Gualala Lagoon, October 23, 2003.

Table 69 Physical parameters at Pt-3 approximately 8 feet from the right bank of the Gualala Lagoon, October 23, 2003.

Water Depth (ft)	D.O. (mg/L)	pH	Salinity (ppt)	SpCond (mS/cm)	Temp (deg C)
0.6	12.52	8.23	0.66	1.306	16.21
1.4	12.76	8.23	0.66	1.306	16.21
2.4	12.7	8.23	0.65	1.303	16.20
3.3	13	8.23	0.65	1.302	16.20

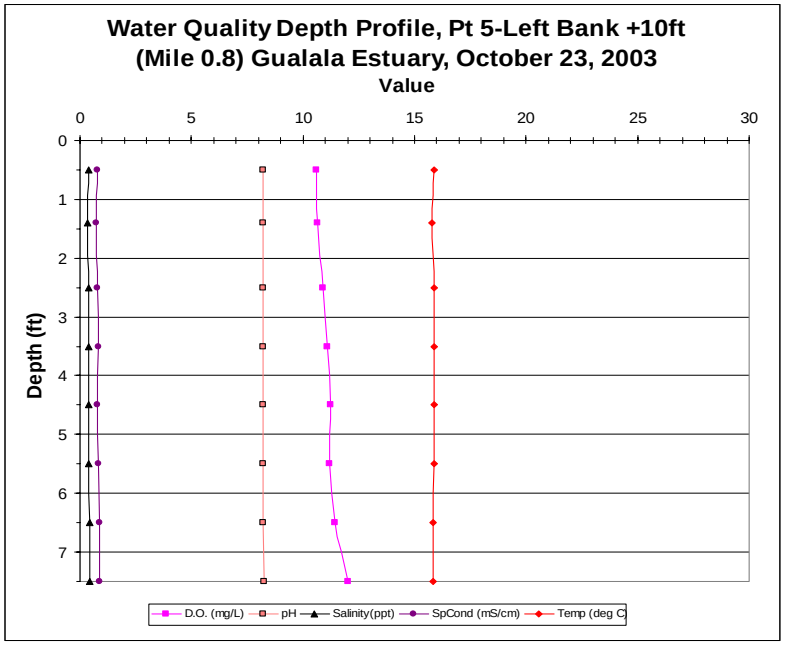

Figure 80 Depth profile of physical parameters at Pt-5 approximately 10 feet from the left bank of the Gualala Lagoon, October 23, 2003.

Table 70 Physical parameters at Pt-5 approximately 10 feet from the left bank of the Gualala Lagoon, October 23, 2003

Water Depth (ft)	D.O. (mg/L)	pH	Salinity (ppt)	SpCond (mS/cm)	Temp (deg C)
0.5	10.58	8.2	0.39	0.786	15.89
1.4	10.65	8.19	0.36	0.736	15.8
2.5	10.92	8.21	0.38	0.765	15.86
3.5	11.07	8.21	0.4	0.807	15.86
4.5	11.25	8.22	0.39	0.796	15.87
5.5	11.2	8.22	0.4	0.814	15.89
6.5	11.42	8.23	0.43	0.863	15.85
7.5	12.03	8.25	0.43	0.865	15.85

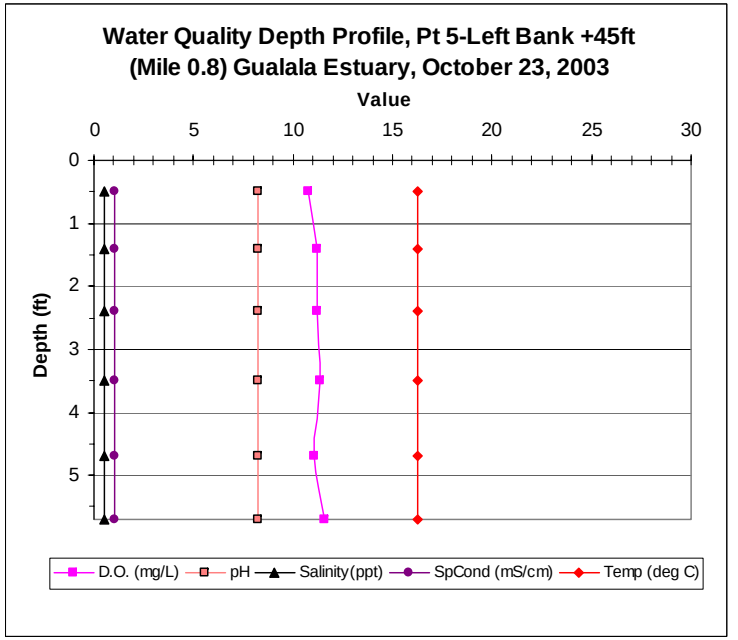

Figure 81 Depth profile of physical parameters at Pt-5 approximately 45 feet from the left bank of the Gualala Lagoon, October 23, 2003.

Table 71 Physical parameters at Pt-5 approximately 45 from the left bank of the Gualala Lagoon, October 23, 2003.

Water Depth (ft)	D.O. (mg/L)	pH	Salinity (ppt)	SpCond (mS/cm)	Temp (deg C)
0.5	10.8	8.22	0.51	1.02	16.24
1.4	11.2	8.22	0.51	1.029	16.24
2.4	11.24	8.22	0.51	1.028	16.24
3.5	11.37	8.22	0.52	1.036	16.26
4.7	11.08	8.22	0.52	1.036	16.26
5.7	11.55	8.22	0.52	1.038	16.26

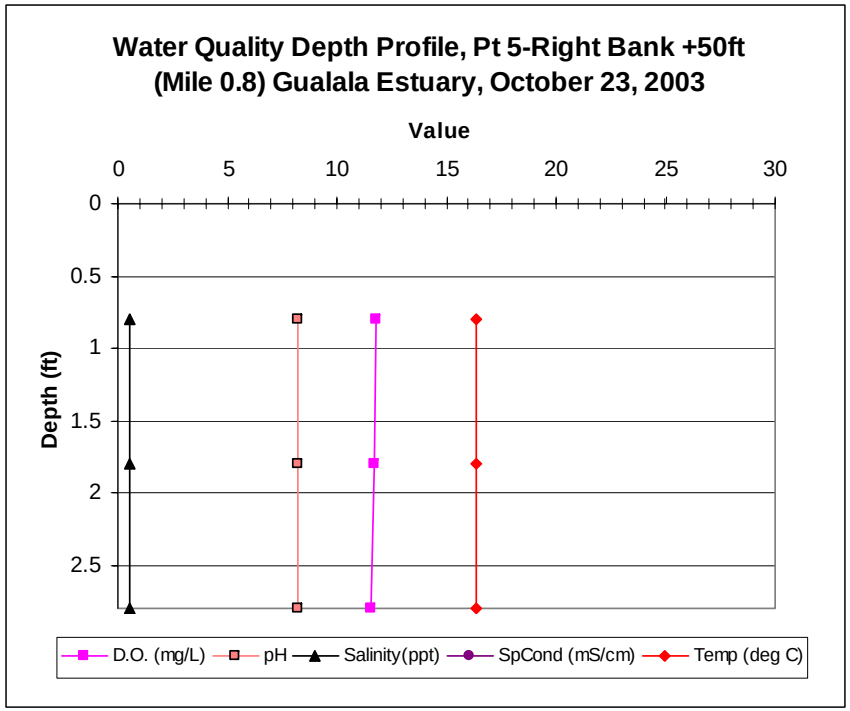

Figure 82 Depth profile of physical parameters at Pt-5 approximately 50 feet from the right bank of the Gualala River, October 23, 2003.

Table 72 Physical parameters at Pt-5 approximately 50 feet from the right bank of the Gualala River, October 23, 2003

Water Depth (ft)	D.O. (mg/L)	pH	Salinity (ppt)	SpCond (mS/cm)	Temp (deg C)
0.8	11.75	8.25	0.56	1.122	16.35
1.8	11.7	8.25	0.56	1.121	16.35
2.8	11.56	8.24	0.56	1.122	16.35

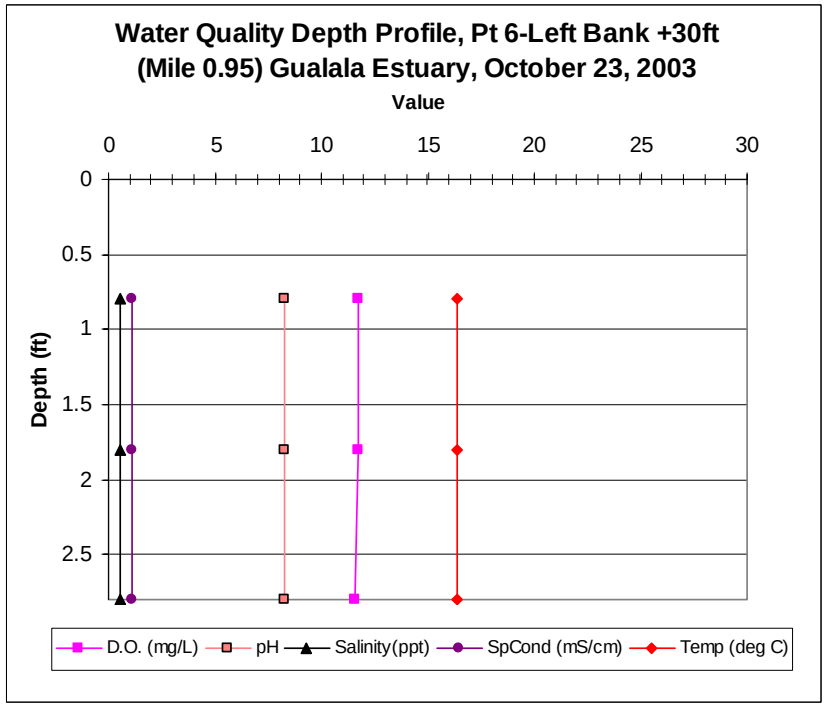

Figure 83 Depth profile of physical parameters at Pt-6 approximately 30 feet from the left bank of the Gualala Lagoon, October 23, 2003.

Table 73 Physical parameters at Pt-6 approximately 30 feet from the left bank of the Gualala Lagoon, October 23, 2003

Water Depth (ft)	D.O. (mg/L)	pH	Salinity (ppt)	SpCond (mS/cm)	Temp (deg C)
0.5	14.81	8.3	0.83	1.631	16.12
1.9	15.6	8.3	0.83	1.631	16.11
2.9	16.77	8.3	0.83	1.63	16.1
3.9	16.54	8.3	0.83	1.63	16.1
4.9	16.97	8.4	0.83	1.638	16.1
5.9	17.7	8.4	0.86	1.69	16.31
6.9	17.97	8.4	0.89	1.744	16.14
7.9	20.41	8.4	0.91	1.773	16.16

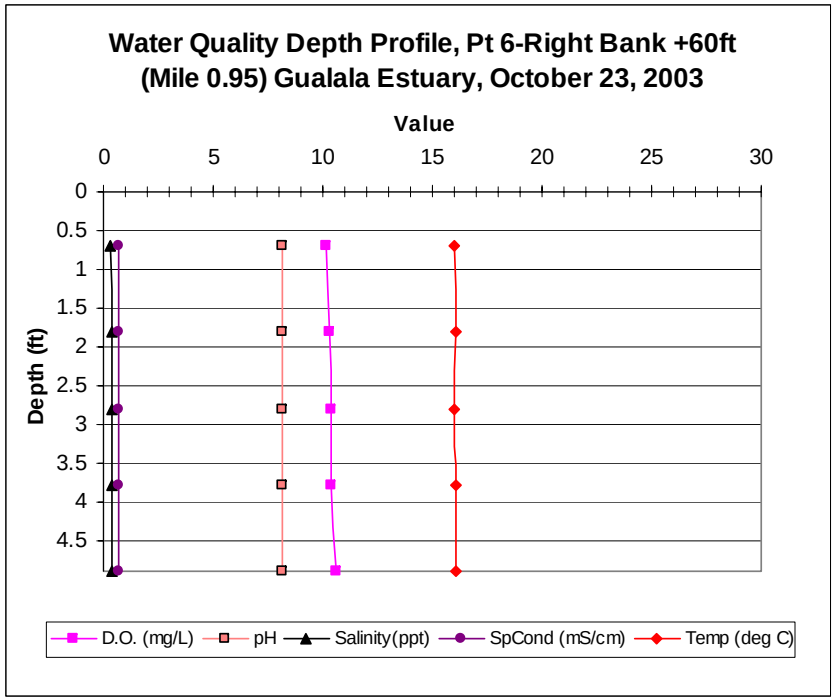

Figure 84 Depth profile of physical parameters at Pt-6, approximately 60 feet from the right bank of the Gualala Lagoon, October 23, 2003.

Table 74 Physical parameters at Pt-6 approximately 60 feet from the right bank of the Gualala Lagoon, October 23, 2003

Water Depth (ft)	D.O. (mg/L)	pH	Salinity (ppt)	SpCond (mS/cm)	Temp (deg C)
0.7	10.18	8.16	0.34	0.712	16.03
1.8	10.33	8.16	0.35	0.712	16.05
2.8	10.42	8.16	0.35	0.712	16.03
3.8	10.42	8.16	0.35	0.712	16.05
4.9	10.62	8.17	0.35	0.712	16.07

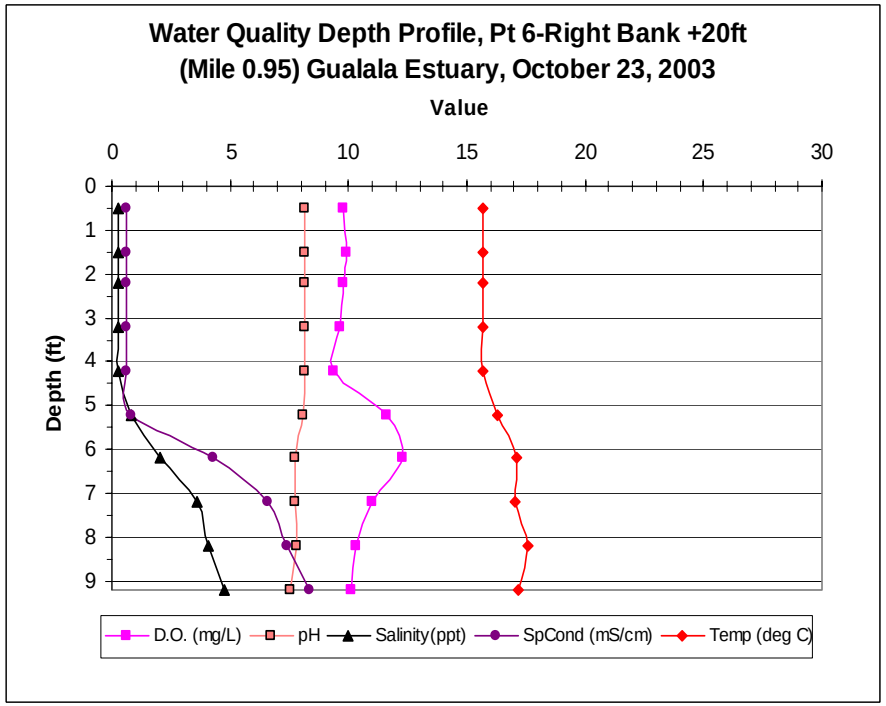

Figure 85 Depth profile of physical parameters at Pt-6 approximately 20 feet from the right bank of the Gualala Lagoon, October 23, 2003.

Table 75 Physical parameters at Pt-6 approximately 20 feet from the right bank of the Gualala Lagoon, October 23, 2003

Water Depth (ft)	D.O. (mg/L)	pH	Salinity (ppt)	SpCond (mS/cm)	Temp (deg C)
0.5	9.8	8.12	0.29	0.588	15.67
1.5	9.9	8.12	0.28	0.584	15.67
2.2	9.78	8.12	0.28	0.582	15.67
3.2	9.61	8.12	0.28	0.583	15.68
4.2	9.38	8.12	0.3	0.62	15.71
5.2	11.62	8.1	0.8	0.831	16.31
6.2	12.27	7.74	2.04	4.25	17.09
7.2	10.98	7.74	3.6	6.58	17.04
8.2	10.29	7.78	4.08	7.37	17.56
9.2	10.1	7.54	4.77	8.354	17.18

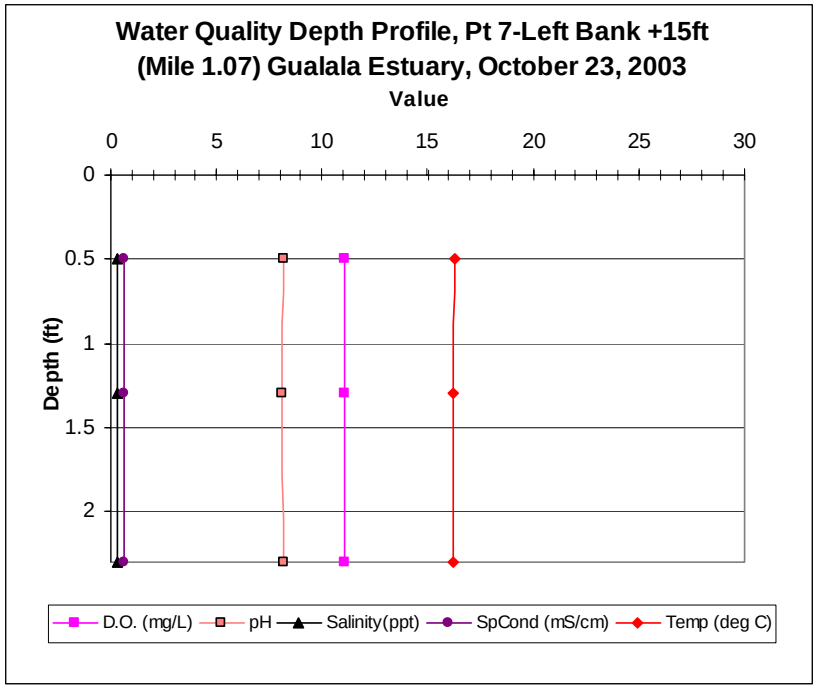

Figure 86 Depth profile of physical parameters at Pt-7 approximately 15 feet from the left bank of the Gualala Lagoon, October 23, 2003.

Table 76 Physical parameters at Pt-7 approximately 15 feet from the left bank of the Gualala Lagoon, October 23, 2003

Water Depth (ft)	D.O. (mg/L)	pH	Salinity (ppt)	SpCond (mS/cm)	Temp (deg C)
0.5	11.09	8.16	0.31	0.634	16.28
1.3	11.05	8.14	0.31	0.636	16.19
2.3	11.04	8.15	0.3	0.6	16.19

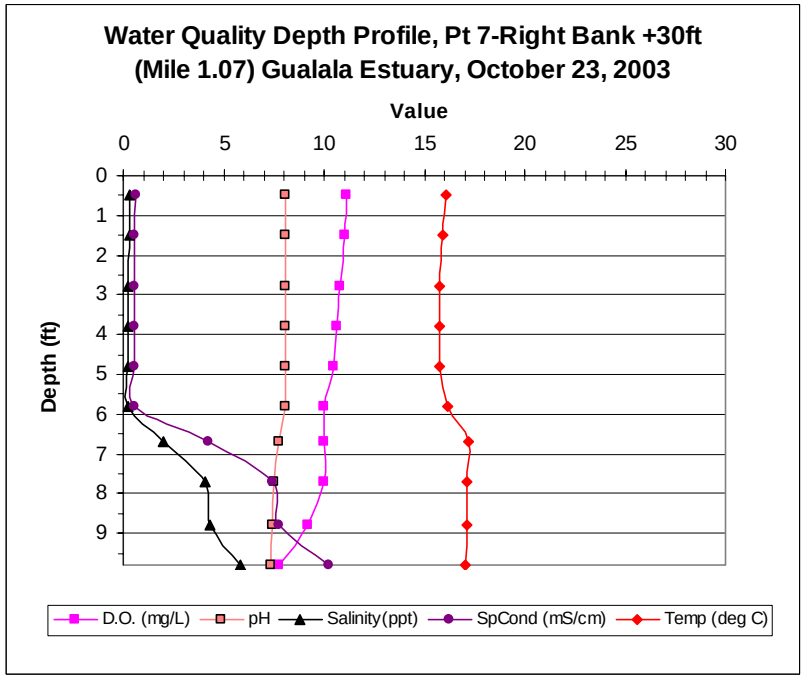

Figure 87 Depth profile of physical parameters at Pt-7 approximately 30 feet from the right bank of the Gualala Lagoon, October 23, 2003.

Table 19 Physical parameters at Pt-7 approximately 30 feet from the right bank of the Gualala Lagoon, October 23, 2003.

Water Depth (ft)	D.O. (mg/L)	pH	Salinity (ppt)	SpCond (mS/cm)	Temp (deg C)
0.5	11.14	8.12	0.3	0.616	16.04
1.5	11	8.1	0.28	0.577	15.89
2.8	10.82	8.09	0.27	0.542	15.78
3.8	10.67	8.08	0.26	0.524	15.72
4.8	10.49	8.07	0.25	0.524	15.72
5.8	9.99	8.05	0.26	0.532	16.17
6.7	9.99	7.74	2	4.279	17.21
7.7	9.98	7.5	4.09	7.411	17.09
8.8	9.2	7.43	4.33	7.77	17.09
9.8	7.78	7.34	5.82	10.264	17.07

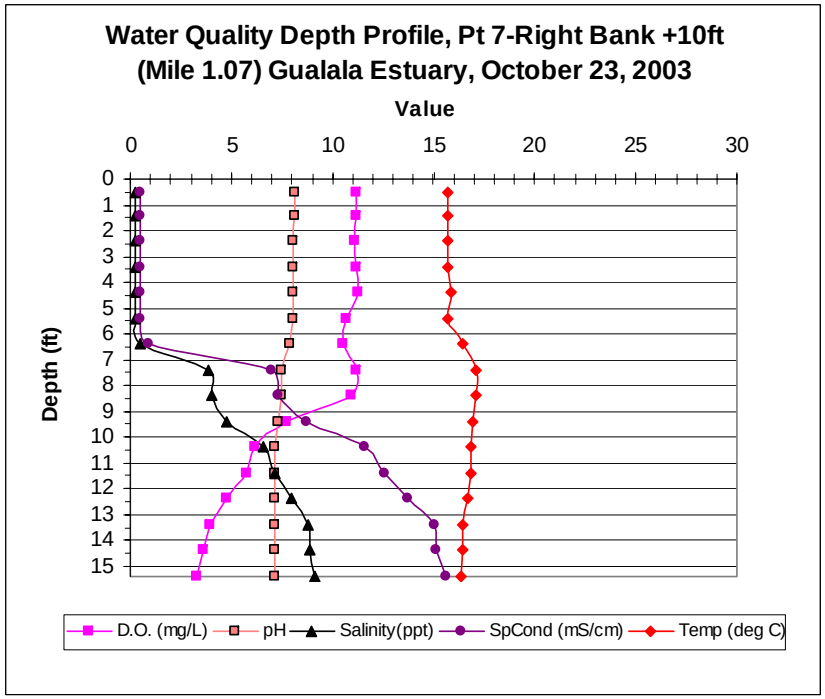

Figure 88 Depth profile of physical parameters at Pt-7 approximately 10 feet from the right bank of the Gualala Lagoon, October 23, 2003.

Table 77 Physical parameters at Pt-7 approximately 10 feet from the right bank of the Gualala Lagoon, October 23, 2003

Water Depth (ft)	D.O. (mg/L)	pH	Salinity (ppt)	SpCond (mS/cm)	Temp (deg C)
0.5	11.17	8.11	0.24	0.5	15.66
1.4	11.18	8.1	0.24	0.5	15.66
2.4	11.12	8.09	0.24	0.499	15.66
3.4	11.19	8.09	0.24	0.503	15.66
4.4	11.23	8.08	0.24	0.508	15.89
5.4	10.67	8.06	0.25	0.513	15.69
6.4	10.48	7.85	0.46	0.927	16.41
7.4	11.18	7.49	3.86	7.016	17.12
8.4	10.95	7.46	4.02	7.284	17.09
9.4	7.69	7.29	4.77	8.74	16.94
10.4	6.14	7.19	6.61	11.591	16.88
11.4	5.74	7.17	7.16	12.612	16.81
12.4	4.79	7.13	7.94	13.717	16.67
13.4	3.91	7.11	8.8	15.044	16.47
14.4	3.63	7.11	8.86	15.14	16.45
15.4	3.29	7.11	9.16	15.615	16.37

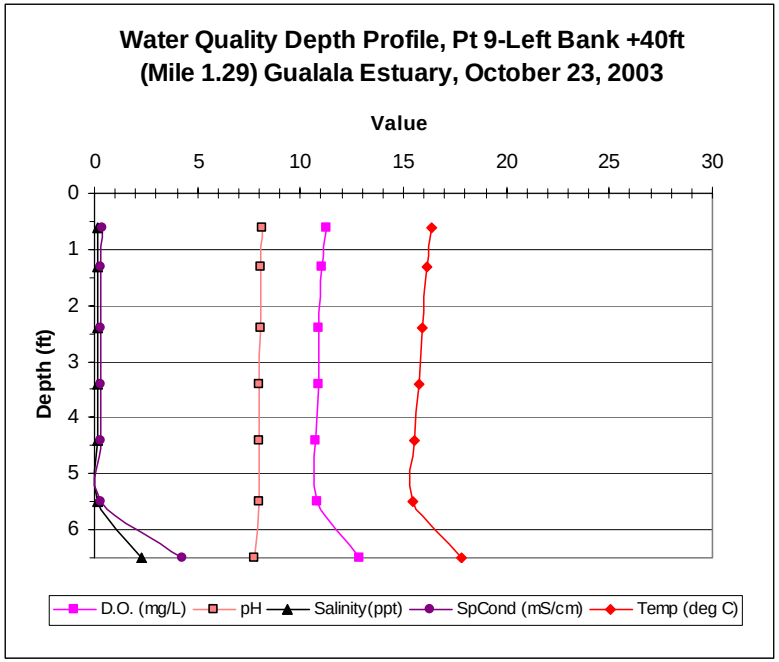

Figure 89 Depth profile of physical parameters at Pt-9 approximately 40 feet from the left bank of the Gualala Lagoon, October 23, 2003.

Table 78 Physical parameters at Pt-9 approximately 40 feet from the left bank of the Gualala Lagoon, October 23, 2003

Water Depth (ft)	D.O. (mg/L)	pH	Salinity (ppt)	SpCond (mS/cm)	Temp (deg C)
0.6	11.25	8.16	0.18	0.381	16.4
1.3	11.01	8.1	0.16	0.336	16.15
2.4	10.9	8.06	0.15	0.305	15.94
3.4	10.88	8.03	0.13	0.28	15.76
4.4	10.77	8.03	0.14	0.3	15.54
5.5	10.79	7.99	0.15	0.299	15.42
6.5	12.9	7.76	2.31	4.273	17.81

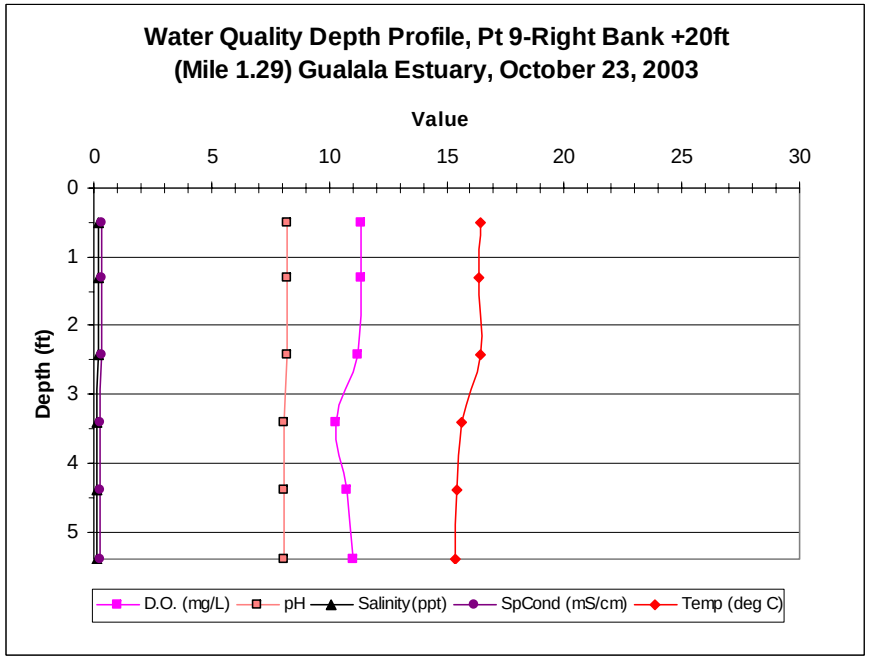

Figure 90 Depth profile of physical parameters at Pt-9 approximately 20 feet from the right bank of the Gualala Lagoon, October 23, 2003.

Table 79 Physical parameters at Pt-9 approximately 20 feet from the right bank of the Gualala Lagoon, October 23, 2003.

Water Depth (ft)	D.O. (mg/L)	pH	Salinity (ppt)	SpCond (mS/cm)	Temp (deg C)
0.5	11.38	8.23	0.17	0.352	16.43
1.3	11.34	8.22	0.17	0.346	16.39
2.43	11.2	8.21	0.17	0.35	16.42
3.4	10.3	8.08	0.14	0.3	15.62
4.4	10.78	8.08	0.12	0.258	15.41
5.4	11.01	8.1	0.14	0.299	15.4

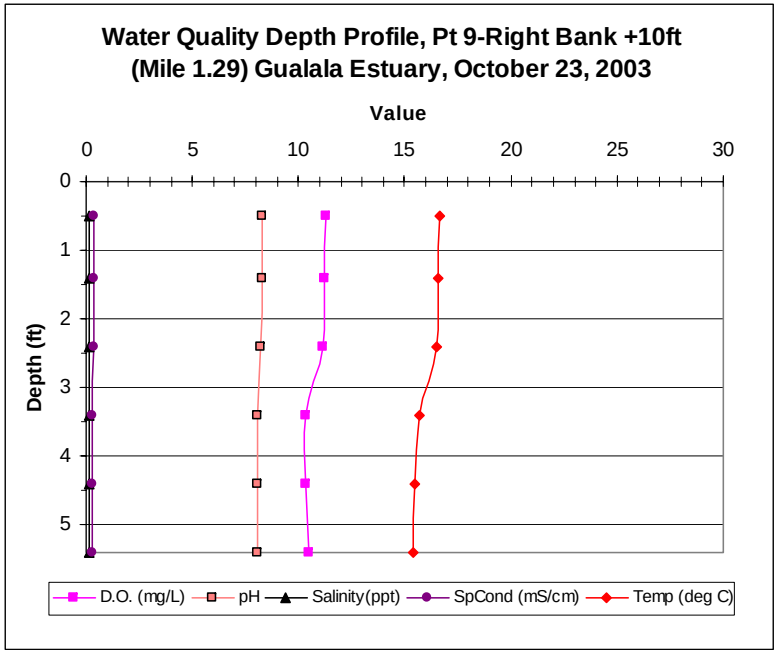

Figure 91 Depth profile of physical parameters at Pt-9 approximately 10 feet from the right bank of the Gualala Lagoon, October 23, 2003.

Table 80 Physical parameters at Pt-9 approximately 10 feet from the right bank of the Gualala Lagoon, October 23, 2003.

Water Depth (ft)	D.O. (mg/L)	pH	Salinity (ppt)	SpCond (mS/cm)	Temp (deg C)
0.5	11.27	8.27	0.17	0.364	16.66
1.4	11.24	8.26	0.18	0.365	16.6
2.4	11.13	8.23	0.17	0.35	16.54
3.4	10.32	8.08	0.15	0.316	15.72
4.4	10.33	8.07	0.14	0.301	15.46
5.4	10.47	8.08	0.15	0.308	15.44

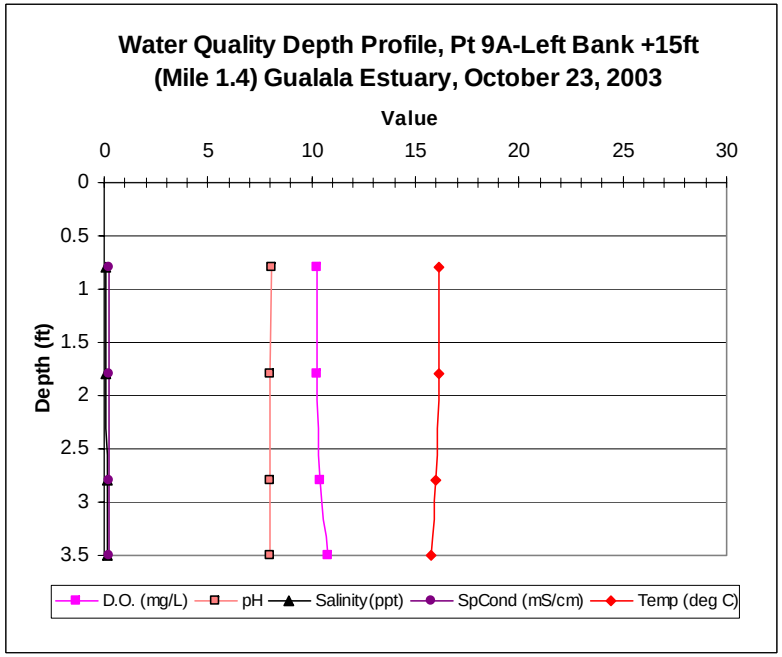

Figure 92 Depth profile of physical parameters at Pt-9A approximately 15 feet from the left bank of the Gualala Lagoon, October 23, 2003.

Table 81 Physical parameters at Pt-9A approximately 15 feet from the left bank of the Gualala Lagoon, October 23, 2003.

Water Depth (ft)	D.O. (mg/L)	pH	Salinity (ppt)	SpCond (mS/cm)	Temp (deg C)
0.8	10.26	8.03	0.11	0.239	16.15
1.8	10.25	8.01	0.11	0.24	16.14
2.8	10.4	7.99	0.12	0.244	16
3.5	10.81	8.02	0.12	0.245	15.72

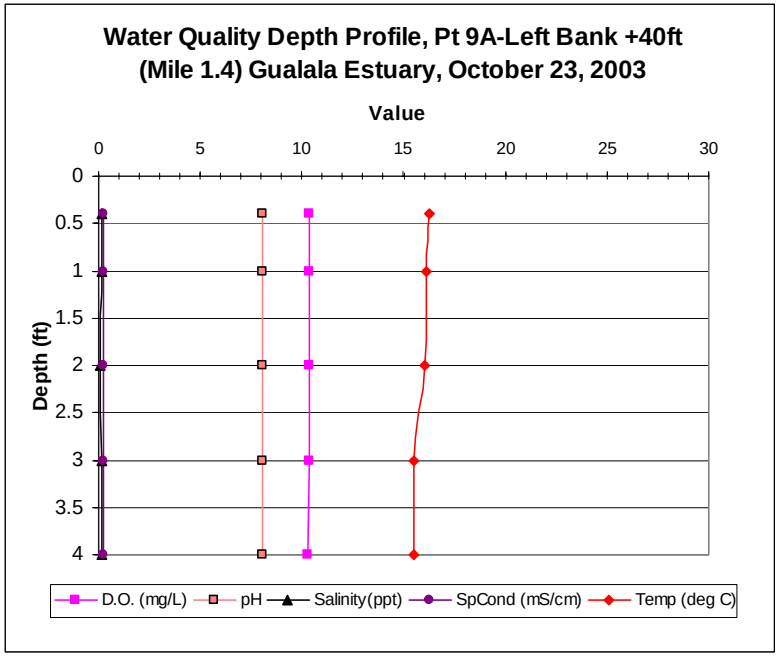

Figure 93 Depth profile of physical parameters at Pt-9A approximately 40 feet from the left bank of the Gualala Lagoon, October 23, 2003.

Table 82 Physical parameters at Pt-9A approximately 40 feet from the left bank of the Gualala Lagoon, October 23, 2003.

Water Depth (ft)	D.O. (mg/L)	pH	Salinity (ppt)	SpCond (mS/cm)	Temp (deg C)
0.4	10.37	8.08	0.12	0.249	16.27
1	10.32	8.07	0.12	0.244	16.14
2	10.39	8.07	0.11	0.241	16
3	10.37	8.05	0.12	0.247	15.49
4	10.29	8.04	0.12	0.251	15.49

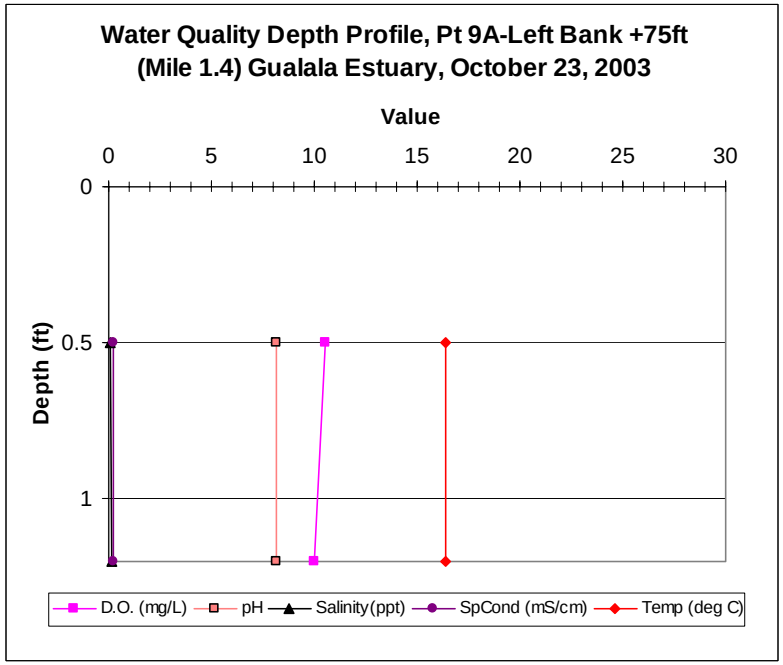

Figure 94 Depth profile of physical parameters at Pt-9A approximately 75 feet from the left bank of the Gualala Lagoon, October 23, 2003.

Table 83 Physical parameters at Pt-9A approximately 75 feet from the left bank of the Gualala Lagoon, October 23, 2003.

Water Depth (ft)	D.O. (mg/L)	pH	Salinity (ppt)	SpCond (mS/cm)	Temp (deg C)
0.5	10.51	8.14	0.11	0.248	16.35
1.2	10	8.14	0.12	0.248	16.36

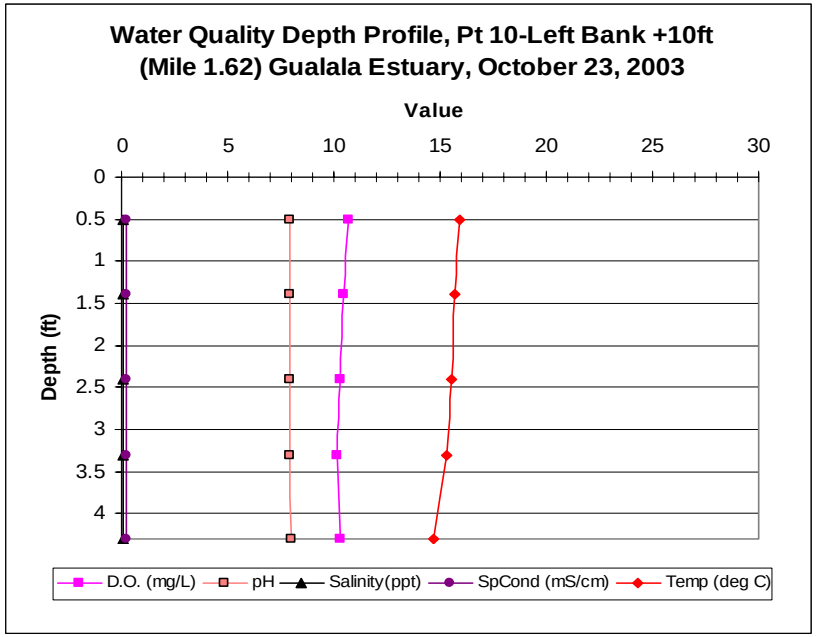

Figure 95 Depth profile of physical parameters at Pt-10 approximately 10 feet from the left bank of the Gualala Lagoon, October 23, 2003.

Table 84 Physical parameters at Pt-10 approximately 10 feet from the left bank of the Gualala Lagoon, October 23, 2003.

Water Depth (ft)	D.O. (mg/L)	pH	Salinity (ppt)	SpCond (mS/cm)	Temp (deg C)
0.5	10.66	7.94	0.11	0.221	15.95
1.4	10.45	7.92	0.11	0.221	15.67
2.4	10.31	7.91	0.11	0.221	15.52
3.3	10.16	7.91	0.11	0.221	15.31
4.3	10.34	7.97	0.11	0.224	14.72

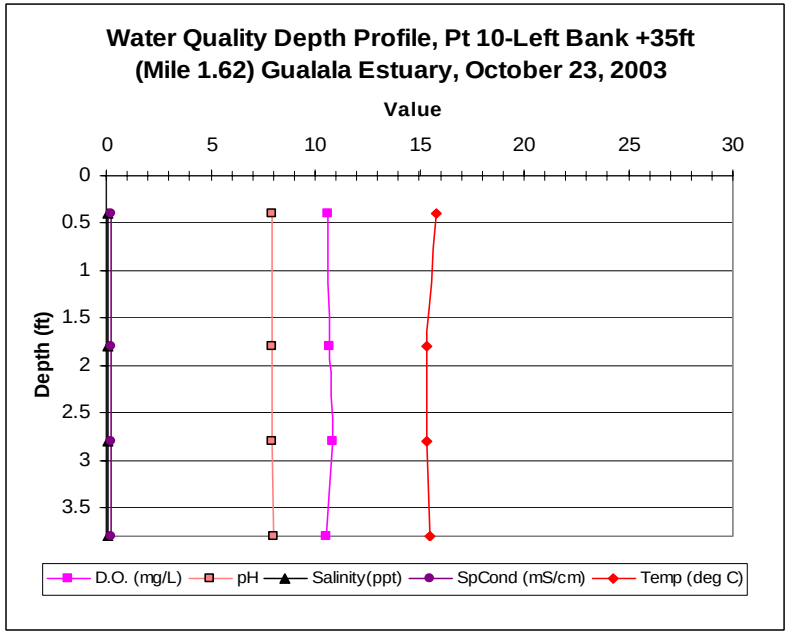

Figure 96 Depth profile of physical parameters at Pt-10 approximately 35 feet from the left bank of the Gualala Lagoon, October 23, 2003.

Table 85 Physical parameters at Pt-10 approximately 35 feet from the left bank of the Gualala Lagoon, October 23, 2003.

Water Depth (ft)	D.O. (mg/L)	pH	Salinity (ppt)	SpCond (mS/cm)	Temp (deg C)
0.4	10.63	7.96	0.11	0.222	15.79
1.8	10.68	7.97	0.11	0.223	15.35
2.8	10.81	7.97	0.11	0.222	15.33
3.8	10.54	7.98	0.11	0.223	15.49

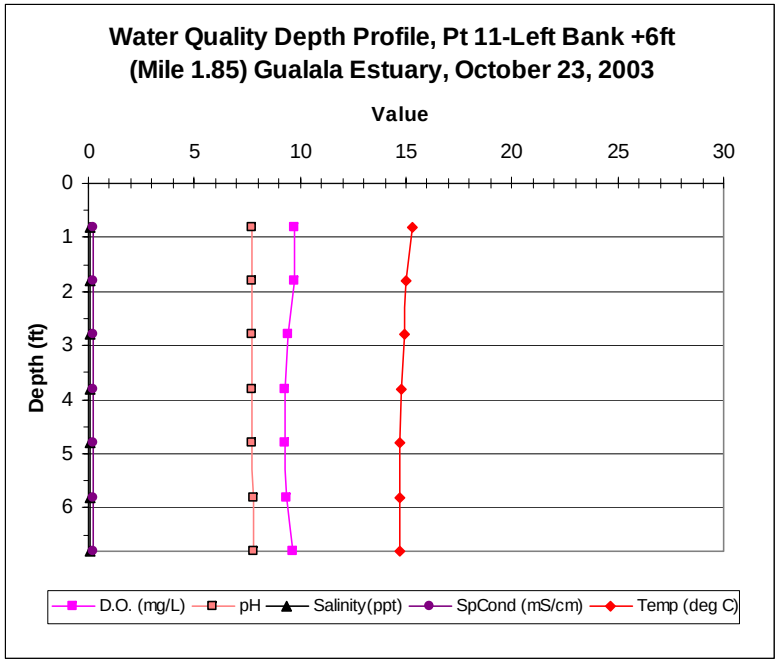

Figure 97 Depth profile of physical parameters at Pt-11 approximately 6 feet from the left bank of the Gualala Lagoon, October 23, 2003.

Table 86 Physical parameters at Pt-11 approximately 6 feet from the left bank of the Gualala Lagoon, October 23, 2003.

Water Depth (ft)	D.O. (mg/L)	pH	Salinity (ppt)	SpCond (mS/cm)	Temp (deg C)
0.8	9.74	7.7	0.11	0.222	15.29
1.8	9.75	7.7	0.11	0.221	15.03
2.8	9.46	7.7	0.11	0.221	14.91
3.8	9.31	7.71	0.11	0.221	14.81
4.8	9.31	7.74	0.11	0.221	14.72
5.8	9.39	7.77	0.11	0.221	14.72
6.8	9.62	7.8	0.11	0.222	14.71

Literature Cited:

EPA, 2003, Office of Ground Water & Drinking Water web site at:
http://www.epa.gov/safewater/dwa/electronic/presentations/uic/pt2/uic31.html

Mann, KH; Lazier, JRN. (1991) Dynamics of Marine Exosystems. Blackwell Scientific Publications, Oxford

NOAA Real Time Database. 2003. Point Arena Sea Buoy. Available form the World Wide Web at:
http://www.ndbc.noaa.gov/data/5day/46014_5day.txt