State of California
The Resources Agency
DEPARTMENT OF FISH AND GAME

SEASONAL WATER QUALITY MONITORING IN THE KLAMATH RIVER ESTUARY, 1991-1994

by

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Region 1, Inland Fisheries

Inland Fisheries

Administrative Report No. 98-9

1998

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ABSTRACT

The California Department of Fish and Game's Natural Stocks Assessment Project (NSAP) collected water quality data at high tides on a monthly basis from February 1991 to October 1994, and during low tides from March 1992 to June 1994 in the Klamath River estuary to describe water quality conditions. NSAP collected data on water temperature, dissolved oxygen, salinity, depth of saltwedge, and Klamath River flow. Klamath River flows ranged from 44.5 m^3/s (1570 cfs) in August 1994 to 3832.2 m^3/s (135,315 cfs) in March 1993. Saltwater was present in the estuary primarily in the summer and early fall and generally extended 2 to 3 miles upstream. Surface water temperatures ranged from 6-8° C in the winter to 20-24° C in the summer. Summer water temperatures within the saltwedge were generally 5 to 8° C cooler than the surface water temperature. Dissolved oxygen in the estuary was generally greater than 6 to 7 ppm year-round. A sand berm formed at the mouth of the river each year in the late summer or early fall which raised the water level in the estuary and reduced tidal fluctuation so that the Klamath estuary became essentially a lagoon. I hypothesize the formation of the sand berm may increase the production of the estuary and help provide favorable conditions for rearing juvenile chinook salmon.

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[1] Inland Fisheries Administrative Report No. 98-9. Submitted August 1998. Edited by M. Ralph Carpenter, California Department of Fish and Game, 1416 Ninth Street, Sacramento, California 95814.

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INTRODUCTION

Declines in the number of salmonids returning to the Klamath-Trinity River system have caused concern among user groups, conservation groups, and the biological community. Causes for the declines have been attributed in part to improper land use and water diversion. Some of these activities have degraded water quality conditions to below acceptable levels for juvenile salmonids in the mainstem Klamath River and some of its tributaries (Klamath River Task Force 1991). There is concern that the water quality in the Klamath estuary has also been degraded (Klamath River Task Force 1991), but we could find little water quality information about the estuary to evaluate these concerns. The U.S. Geological Survey (USGS) maintained a water quality monitoring station approximately 2.4 km (1.5 miles) upstream of the estuary (USGS 1977-1996). They collected data on water temperature, river flow, specific conductance, dissolved oxygen, sediment load, water chemistry and biological data such as micro-organism and algae surveys for various periods of time from the 1950's to the 1990's. However, these data were collected upstream of almost all estuarine processes and provided little insight on conditions in the estuary or how the estuary functioned.

Many estuaries along the West Coast of North America have been shown to be important rearing areas for some salmonid species (Reimers 1971; Healey 1980; Kjelson et al. 1982; Levy and Northcote 1982; Myers and Horton 1982). Simenstad et al. (1982) hypothesized that juvenile salmonids use estuaries for productive foraging, physiological transition and refugia from predators. The importance of an estuary as a rearing area is, in part, dependent on its water quality.

The California Department of Fish and Game's (CDFG) Natural Stocks Assessment Project monitored the Klamath River estuary from 1991-1994 to describe general seasonal changes and ranges of water quality conditions occurring there. This study allowed us to evaluate whether water quality conditions in the Klamath estuary were adequate for juvenile salmonids and to alert fishery managers to any potential water quality problems in the estuary.

METHODS AND MATERIALS

We collected water quality data near high slack tide on a monthly basis from February 1991 to October 1994 and near low ebb tide from May 1991 to June 1994. When practical we attempted to sample the highest and lowest tides of the month to identify the extreme range of saltwedge location in the estuary. Some months were not sampled due to equipment problems or high river flows which created unsafe sampling conditions. Also, during some months in the late summer or early fall we only collected water quality information at one tide level because tidal fluctuation was negligible due to the formation of a sand berm at the mouth of the river. We collected water temperature, dissolved oxygen, salinity, and depth of the saltwedge information using a YSI Model 33 Conductivity/Salinity meter, and YSI Model 57 Oxygen/Temperature meter. We sampled a minimum of four stations starting at the most downstream station, or (especially in the summer and early fall), until we no longer detected saltwater. We sampled transects perpendicular to the river flow every 0.4 to 0.8 km (¼ to ½ mile) corresponding to a permanent landmark to insure that we sampled the same general location each month (Figure 1). We collected data at three stations (middle, right, left) along the transect at surface, mid-water, and bottom elevations. We also routinely sampled surface water temperature with a hand-held thermometer during fish sampling trips. Daily river flow information was provided by the U.S. Geological Survey gaging station at Terwer, approximately 3.2 km (2 miles) upstream of the estuary.

RESULTS AND DISCUSSION

Water quality conditions within the Klamath estuary are dominated by freshwater inflow from the Klamath River. Most years when river flows were high from November through April, conditions within the estuary were similar to the lower mainstem river. Klamath River flow through the estuary varied greatly between seasons and years (Figure 2). They ranged from a low of 44.5 m^3/s (1570 CFS) in August 1994 to a high of 3832.2 m^3/s (135,315 cfs) in March 1993. Our water quality samples were collected during flows ranging from 46.2 to 778.8 m^3/s (1631 to 27,499 cfs). Three of the years, 1991, 1992, and 1994, were considered drought years, while 1993 was considered a wet year.

The normal upriver extent of tidal influence in the Klamath estuary during high tides greater than about 6 feet was Waukell Riffle at river mile (RM) 4, just upstream of the U.S. Highway 101 bridge. However, during October 1991 we observed "standing water" backed up as far as the Roy Rook boatramp (RM 6) caused by sill formation at the river mouth. Water was impounded behind the sill and the water level in the estuary rose .9 - 1.2 m (3 - 4 feet) above normal high tide elevations.

We detected saltwater in the estuary primarily in the summer and early fall. Saltwater concentrations ranged from 0 to 32 parts-per-thousands (ppt), with the highest concentrations usually occurring June through August (Appendix 1). The normal maximum upstream penetration of the saltwedge extended about 4.0 km (2.5 miles) upstream from the mouth, but we did detect it nearly 6.4 km (4 miles) upstream during September 1991 (Figure 3). During low tides the saltwater wedge typically receded to about 1.6 - 3.2 km (1 - 2 miles) above the river mouth (Appendix 2). We

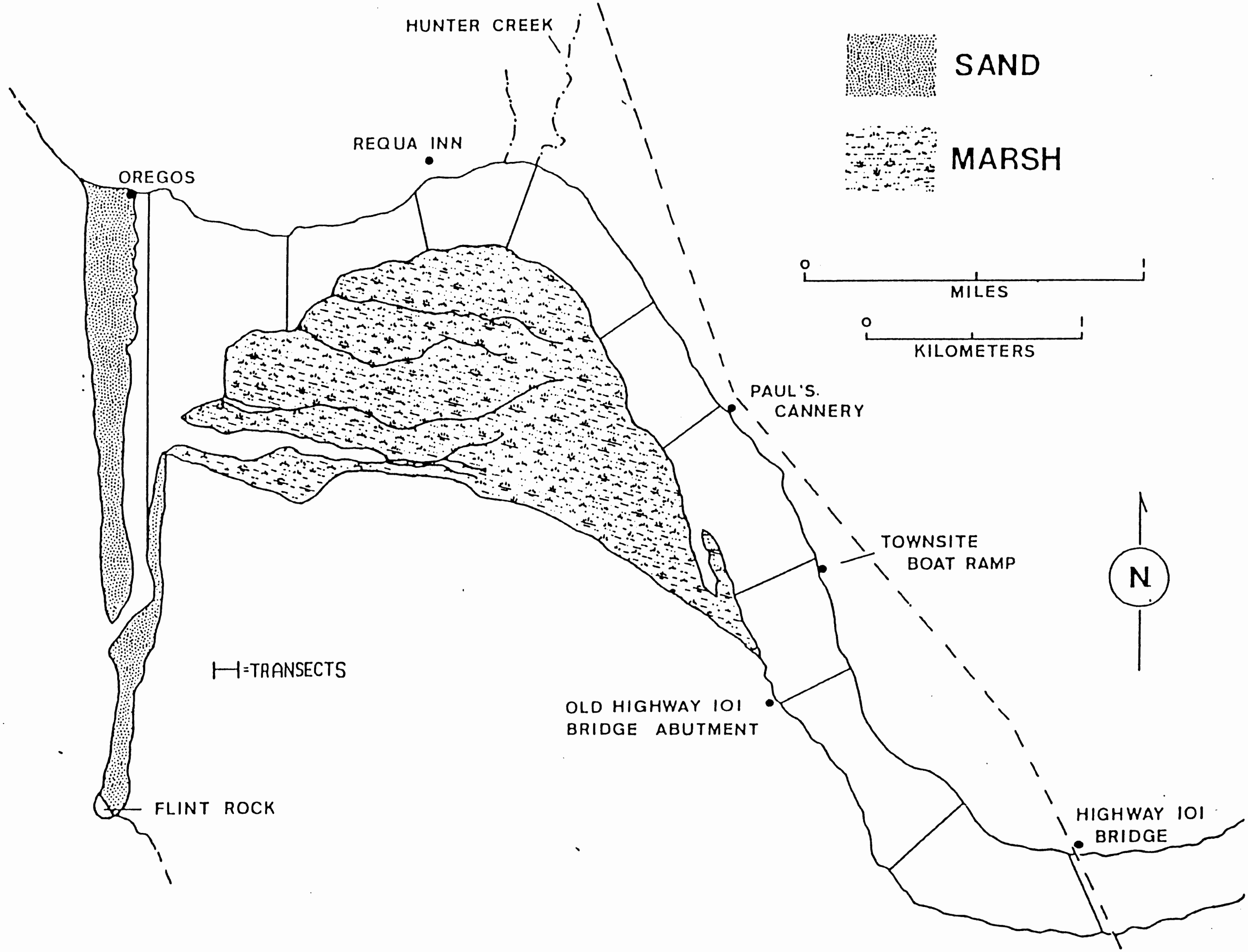

Figure 1. Locations of water quality stations in the Klamath River estuary.

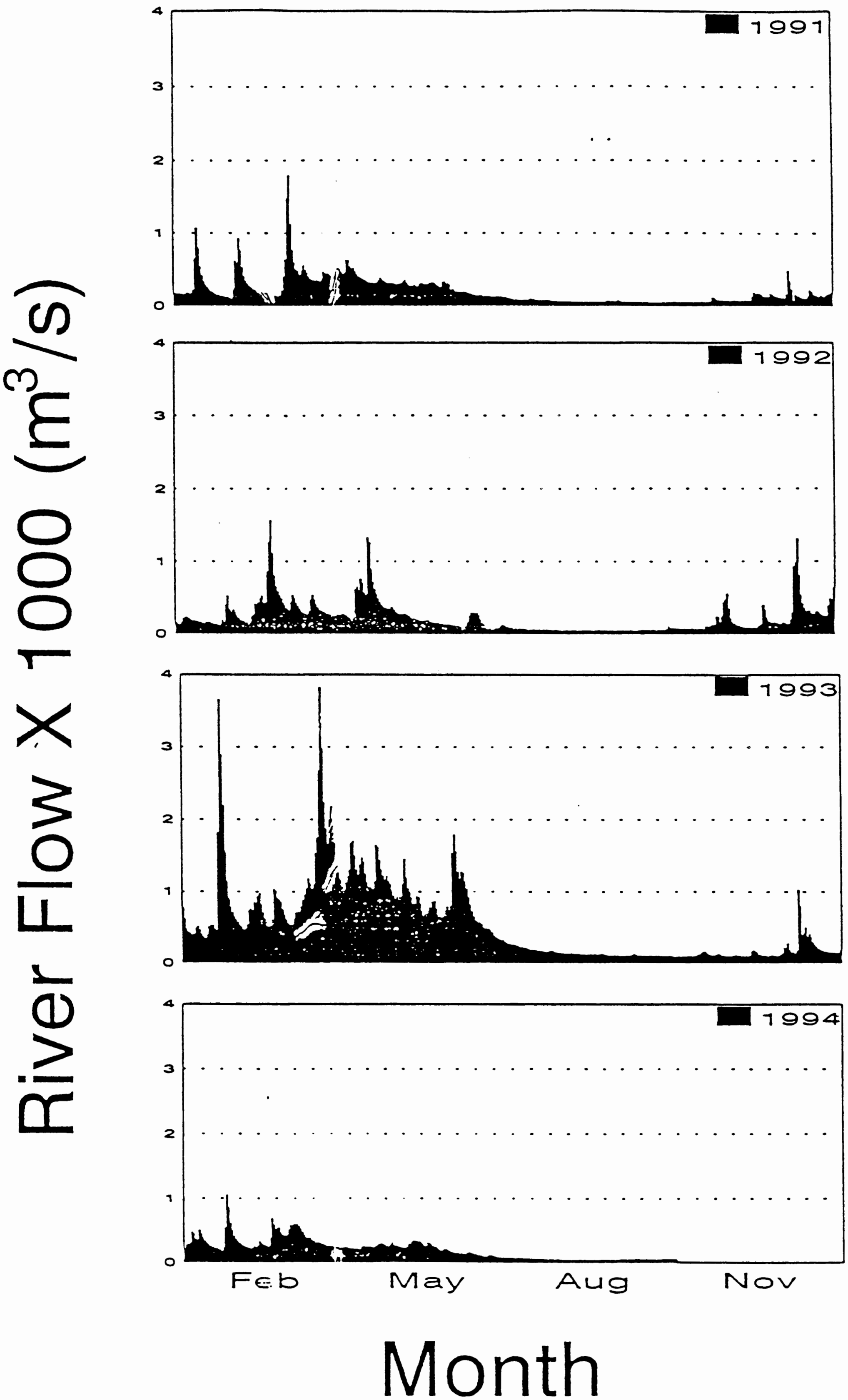

Figure 2. Daily Klamath River flows at the Terwer gage station, 1991-1994.

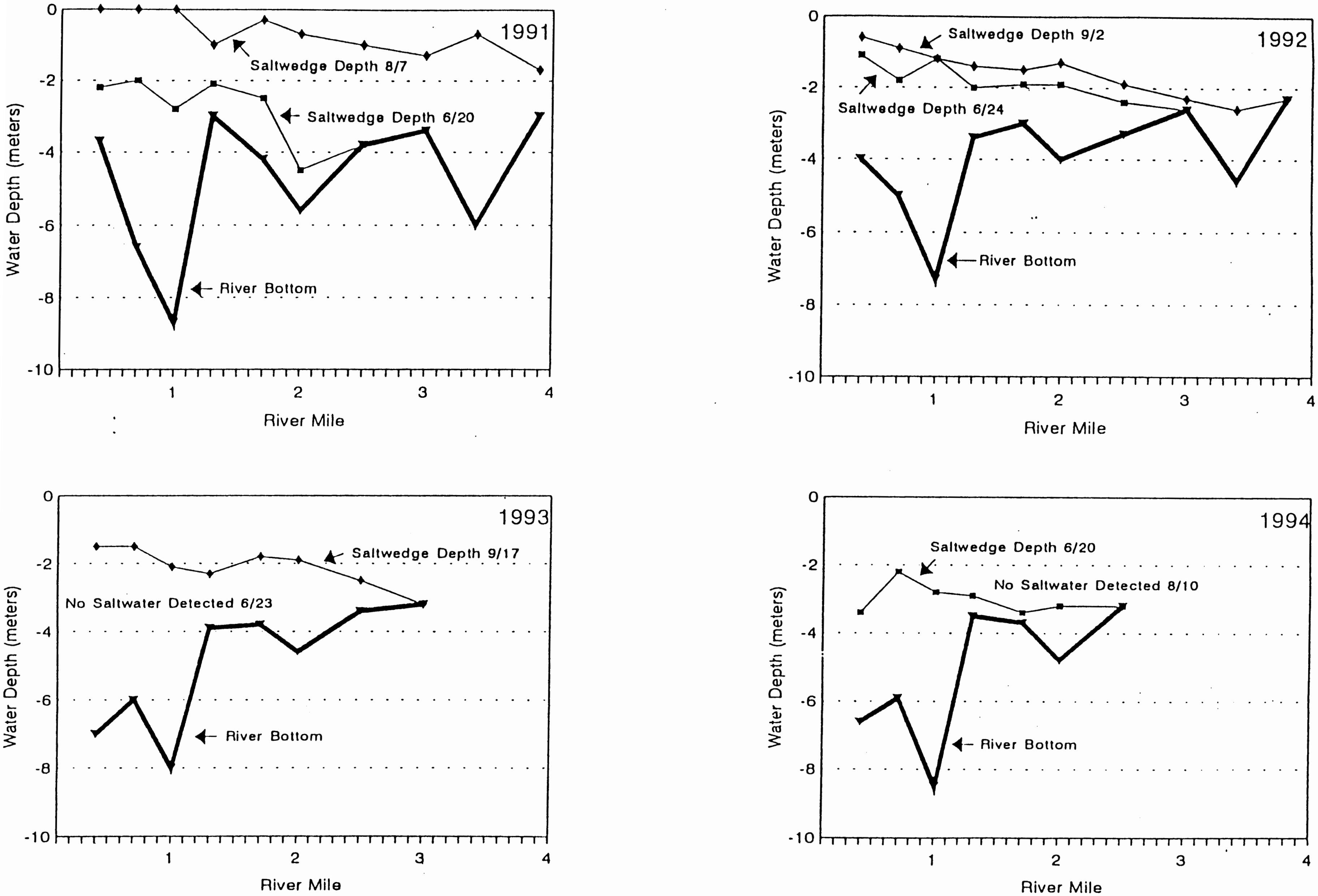

Figure 3. Extent of saltwedge penetration into the Klamath River estuary thalweg during the summers of 1991-1994.

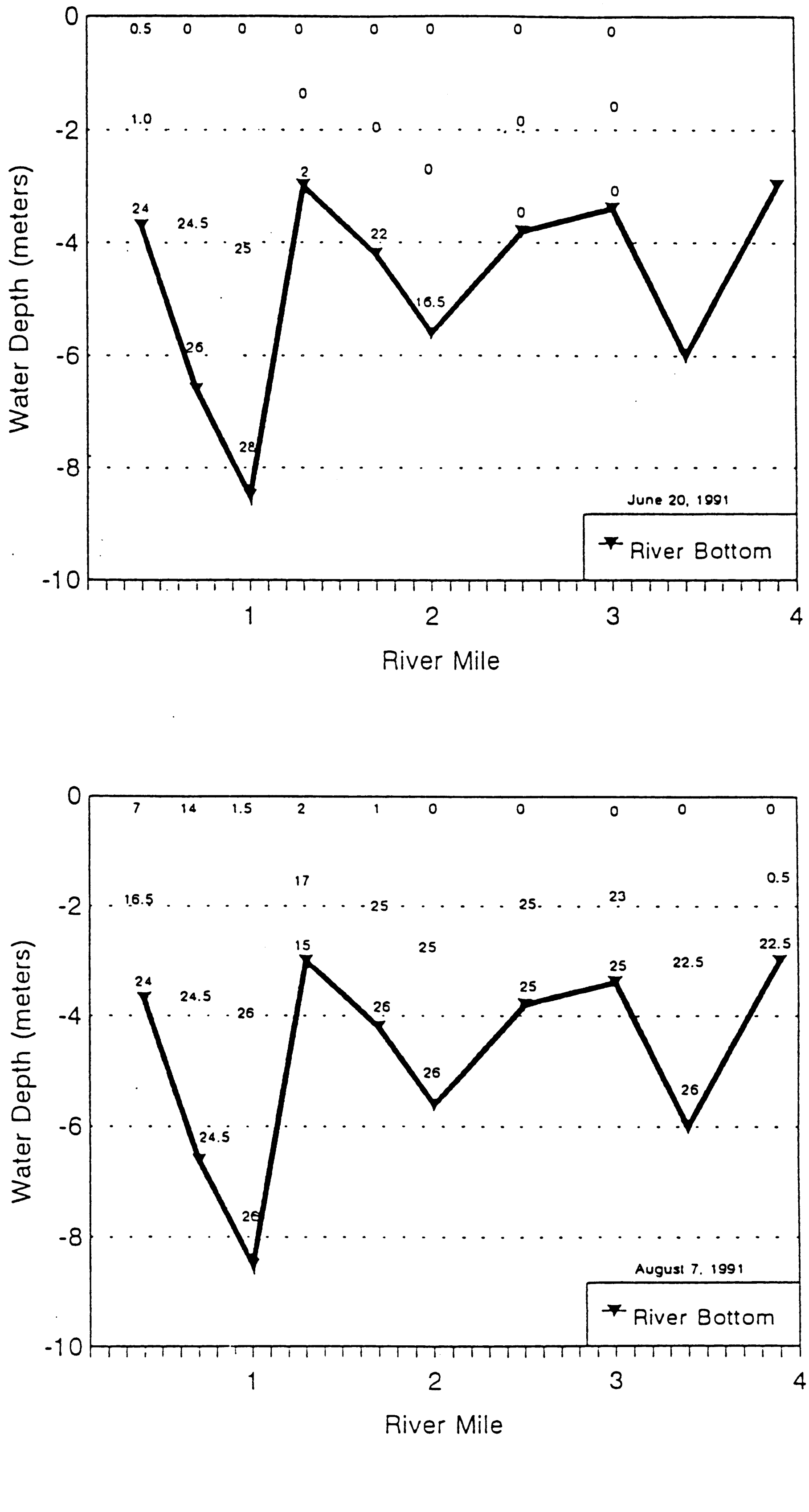

Figure 4. Comparison of saltwater strength, in parts per thousand, in the Klamath River estuary thalweg between June and August, 1991.

found the Klamath estuary heavily stratified with a distinct wedge of saltwater along the bottom (Figure 4).

Surface water temperatures ranged from a low of 6 to 8° C in December through February to a high of 20 to 24° C June through August (Figure 5). However, temperatures within the saltwedge near the bottom were normally 5 to 8° C cooler than the surface freshwater layer (Figure 6; Appendix 1).

Dissolved oxygen concentrations in the estuary were generally greater than 6 to 7 ppm throughout the year. This oxygen concentration is generally adequate to support salmonids (Bjornn and Reiser 1991). We had occasional readings as low 2.5 to 5.5 ppm at the bottom of deep pools or within heavily vegetated side channels (Appendix 1), but these are relatively isolated areas of the estuary . We also collected a few oxygen samples within the heavily vegetated slough areas in the lower 2.4 river km (1.5 river miles) on the south side of the estuary near dawn and found oxygen levels < 2 ppm.

A sand berm formed at the mouth of the Klamath River each year during the late summer or early fall as the result of sediment deposition, most likely from marine sources (Barnes 1980), and decreased river flows. Tidal fluctuation steadily decreased within the estuary during the summer until it became negligible by late summer or early fall, essentially transforming the estuary into a lagoon. High flows during the winter and spring usually washed away the berm. The berm formed each year even though the location of the river mouth migrated south from Oregos to Flint Rock during the course of our study (Figure 1).

Of the water quality parameters we measured, water temperature was probably the most serious problem for juvenile salmonids in the Klamath estuary. High water temperatures in the estuary from June through August ranged from 18 to 24°C (Appendix 1), which approaches lethal levels for salmonids (Bjornn and Reiser 1991). These temperatures are slightly lower than the high temperatures reported from upstream areas of the mainstem Klamath and Trinity Rivers. Bartholow (1995 as cited by Bureau of Reclamation 1998) stated the mainstem Klamath River reached 26.6°C for up to 10 days per year, while the mainstem Trinity River near Willow Creek reached as high as 25°C (U.S.Fish and Wildlife Service[3]). However, our temperature data may not document the extreme high temperature found in the estuary because we sampled only once a month and not necessarily during the warmest time of day. For example, maximum water temperatures at the USGS gaging station

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[3]United States Fish and Wildlife Service. Juvenile salmonid monitoring on the mainstem Trinity River at Willow Creek and mainstem Klamath River at Big Bar, 1992-1995. Coastal California Fish and Wildlife Office. Arcata, California. 146 pp.

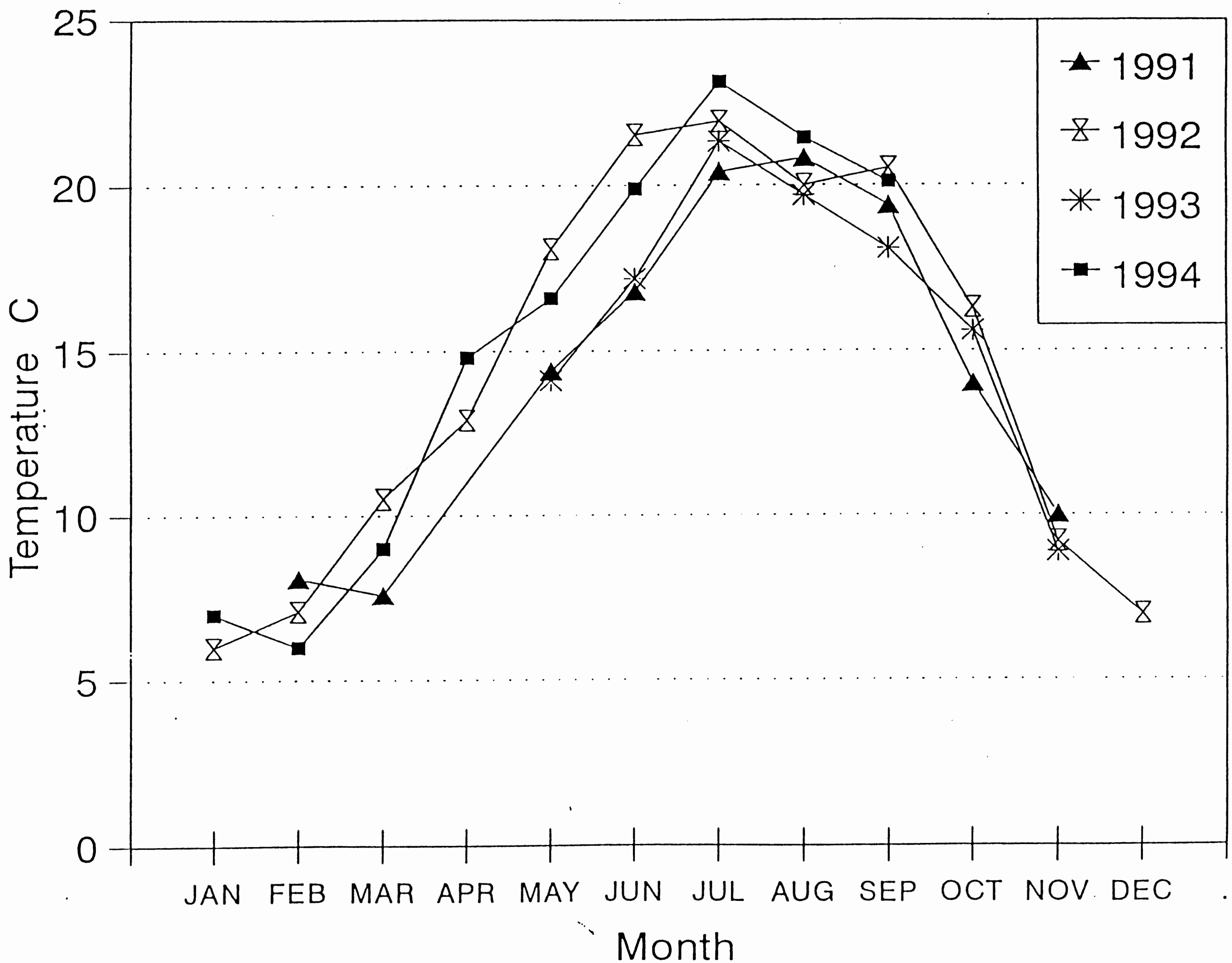

Figure 5. Average surface water temperatures by month in the Klamath River estuary, 1991-1994.

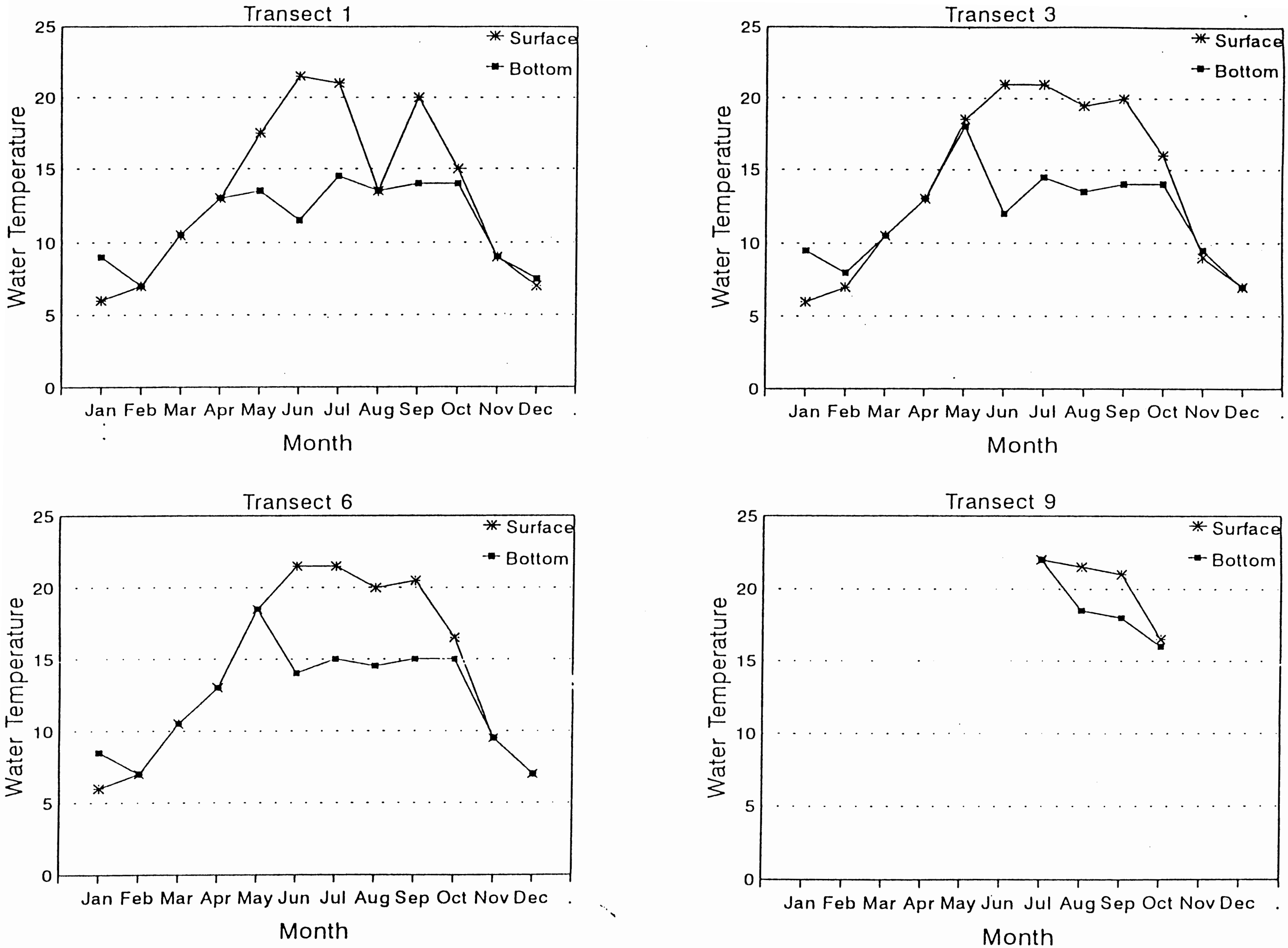

Figure 6. Surface and bottom water temperatures in the thalweg at selected transects in the Klamath River estuary, 1992.

just upstream of the estuary ranged from 24.5 to 26.5° C during daily samples in the summers of 1976 to 1981, but only 20.0 to 23.5° C during bi-monthly samples in the summers of 1991-1994 (USGS 1977-1996).

Fish stress due to high water temperatures is due not only to the magnitude of maximum temperatures but to its duration as well (Bjornn and Reiser 1991). Based on surface water temperature data collected by our project during fish sampling, temperatures became elevated in the afternoon and remained high until late in the evening. This protracted period of warm water is likely detrimental to salmonid health in the estuary. It appears that the relatively cool climate near the coast has little moderating effect on lower mainstem and estuary water temperature.

For the above reasons the brackish water layer along the bottom of the estuary may be extremely important to rearing juvenile salmonids. Water temperatures within the saltwedge near the bottom were normally 5 to 8° C cooler than the surface freshwater layer (Appendix 1). In the Klamath estuary juvenile salmonids, especially chinook salmon, appeared to be more abundant near the freshwater/saltwater interface suggesting that they may use the cooler brackish water layer as a thermal refuge (CDFG 1995a). Mills[4] and Belchik (1997), both observed higher abundances of juvenile salmonids in cool water areas of the mainstem Klamath and Trinity Rivers and hypothesized that these areas were being used by juvenile salmonids as refuge areas from high mainstem water temperatures. The brackish water also probably eases the salmonid's acclimatization process to full strength salt water.

Generally, our study found that a wedge of saltwater moves along the river bottom with the tide, following the channel up and down the estuary. As river flow dropped, the saltwedge was able to move farther upstream. Also, the wedge moves farther upstream with increased tidal height. However, in the summer of 1994 the formation of a sand sill at the river mouth coupled with its migration far to the south, greatly constricted the mouth and apparently inhibited tidal flow into the estuary (CDFG 1994). The farthest upstream occurrence of saltwater that year was only about 3.2 km (2.0 miles) above the mouth in July, and by August we detected no saltwater anywhere in the estuary. Consequently, the water temperature was 21° C throughout the estuary (Appendix 1), and we detected no areas of cool brackish water near the bottom. We do not know what effect this had on juvenile salmonids present in the estuary, though it seems likely it would be detrimental to their health.

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[4] T. J. Mills. Distribution, abundance, fork length, and coded-wire tag recovery data for juvenile anadromous salmonids within the Klamath-Trinity basin, 1985. Unpublished manuscript.

Measured oxygen levels within the Klamath estuary suggest that there is adequate water circulation throughout the estuary to minimize the chances of meromixus or anaerobic conditions developing. Studies of some other smaller coastal lagoons have shown that after sand bar closure a lens of saltwater located at the bottom of deep pools tend to become anaerobic and reduce production in the lagoon (Smith 1987). Also, seasonal meromixus has been reported in coastal lagoons in Oregon (Lichatowich and Nicholas 1985), and California (Busby 1991). However, we found no evidence of meromixus, and only small isolated pockets of low oxygen conditions within the Klamath estuary. This is probably due to the relatively substantial river flow into the estuary and to the constant partial breaching of the sand spit that naturally occurs once the water level of the estuary rises above a certain height. Also, unlike smaller coastal lagoons which may form sand bars that isolate the lagoon from the ocean for 3 to 6 months, we observed that the sand bar at the mouth of the Klamath rarely closes completely, and when it does it only remains closed from a few hours to a few days.

The formation of a sand berm at the mouth of the Klamath River and the subsequent impoundment of water in the estuary is a natural process and may increase the production of the estuary in part by increasing its surface area. Reimers (1971) felt that sill formation increased the wetted productive areas of the Sixes River estuary. In other studied Pacific Coast estuaries, nutrients and detritus become trapped behind their sills (Reimers 1978; Barnes 1980; Simenstad 1983) and form the base of a food web which supports populations of anadromous salmonids (Sibert et al. 1977; Healey 1979). Prolonged estuarine rearing by juvenile chinook salmon has been shown to increase their survival to adults (Reimers 1971; Nicholas and Hankin 1989). In addition, the reduced tidal fluctuation in the estuary may create a more stable environment by decreasing the area normally dewatered during the tidal cycle. As a result the estuary may be able to support more sedentary or burrowing animals such as the Corophium amphipod, which is an important food item for juvenile chinook salmon in the Klamath River estuary (CDFG 1995b). Ratti (1979) hypothesized that extensive modifications (jetties) at the mouth of the Rogue River, Oregon, has prevented the historic shoaling at the mouth, which led to reduced food production in the estuary. This in turn caused juvenile chinook salmon to rear for a shorter time in the estuary.

CONCLUSIONS

Water quality in the Klamath estuary appears to be sufficient to support salmonids, though the high water temperatures from the mainstem Klamath River is a concern. Generally, dissolved oxygen levels are adequate to support salmonids. The occurrence of brackish water in the estuary during the summer of most years when young-of-the-year chinook salmon emigration is highest provides cool water refugia and ensures an area for gradual physiological transformation of smolts from fresh to saltwater. This study was designed only to give a general description of some basic water quality conditions in the estuary. We found that the estuary is an extremely dynamic system with water quality conditions greatly affected by factors with different temporal cycles including annual and seasonal river flows, seasonal bar formation, monthly and daily tidal cycles and daily temperature changes. Therefore, our monthly sampling at best only approximates the range of conditions found in the estuary and we recommend future more detailed studies incorporate a sampling scheme to measure shorter temporal cycles.

A monitoring program to assess the response of water quality parameters to changing physical processes such as river flow and river mouth location along the spit should continue. This information would be useful such as when the California Department of Fish and Game used this data to raise concerns about the Army Corps of Engineers proposed project to artificially breach the sand bar at the river mouth. Also by documenting the lack of saltwater in the estuary during August and September 1994 (and hence absence of cool water refuge) biologists had some explanation for the perceived higher hooking mortality of adult salmonids at the mouth of the Klamath in 1994. Physical studies of the estuary, including descriptions of flushing rates, circulation patterns and nutrient sources and cycles would be valuable to provide managers a description of how the Klamath estuary functions.

ACKNOWLEDGMENTS

This work was supported by Federal Aid in Sport Fish Restoration Act (F-51-R-6, Project No. 33, Job 2) and the California Department of Fish and Game.

The author thanks the following for their assistance with this project: S. Borok, M. Callaghan, B. Collins, J.P. Dellasega, A. Eller, M.C. Kier, K. Nichols, B. Schaefer, and J. Sullivan.

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Appendix 1. Water temperature, salinity, and dissolved oxygen measurements taken along fixed transects at surface, mid-water and bottom elevations in the Klamath River estuary near **high** tide, 1991-1994. River right (R), mid channel (M), and river left (L) designations were made facing upstream. Transect 1 is closest to the river mouth and subsequent transects progress upstream.

1991

	River Flow/Depth(m)			Temperature			Salinity			Dissolved Oxygen		
	L	M	R	L	M	R	L	M	R	L	M	R
February 12	256.3 cms											
Transect 1	3.2	42	4.8									
Surface				8.0	8.5	8.5	0	0	0	-	-	-
Mid Water				8.0	8.5	8.5	0	0	0	-	-	-
Bottom	5.9	5.9	3.2	8.5	9.0	8.5	0	1	1	-	-	-
Transect 2												
Surface				7.0	8.0	8.5	0	0	0	-	-	-
Mid Water				6.5	8.0	8.0	0	0	0	-	-	-
Bottom	7.0	3.4	1.8	7.0	8.0	8.0	0	0	0	-	-	-
Transect 3												
Surface				8.0	8.0	8.0	0	0	0	-	-	-
Mid Water				8.0	8.0	8.0	0	0	0	-	-	-
Bottom	2.0	3.5	3.2	8.0	8.0	8.0	0	0	0	-	-	-
Transect 4												
Surface				8.0	8.0	8.5	0	0	0	-	-	-
Mid Water				8.0	8.0	8.0	0	0	0	-	-	-
Bottom				8.0	8.0	8.0	0	0	0	-	-	-
March 13	549.4 cms											
Transect 1	2.7	3.7	4.9									
Surface				7.5	7.0	7.5	0	0	0	10.2	9.4	9.7
Mid Water				7.0	7.0	7.0	0	0	0	9.9	9.1	9.6
Bottom				7.0	7.0	7.0	0	0	0	9.4	9.4	9.4
Transect 2	5.5	4.5	2.9									
Surface				7.5	7.5	8.0	0	0	0	9.6	10.4	10.0
Mid Water				7.5	7.5	8.0	0	0	0	7.9	6.0	9.5
Bottom				8.0	7.5	8.0	0	0	0	8.4	5.8	10.5
Transect 3	>10	3.2	2.2									
Surface				7.0	7.5	8.0	0	0	0	10.0	10.6	10.3
Mid Water				7.0	7.5	8.0	0	0	0	6.4	10.5	10.6
Bottom				7.0	7.5	8.0	0	0	0	8.2	10.9	11.1
Transect 4	1.4	2.5	2.4									
Surface				8.0	7.5	8.0	0	0	0	10.4	10.5	10.5
Mid Water				7.5	7.5	8.0	0	0	0	10.7	10.8	10.5
Bottom				7.5	7.5	7.5	0	0	0	10.9	11.3	10.8
June 20	149.8 cms											
Transect 1	3.4	3.0	-									
Surface				16.5	16.5	-	1	1	-	8.3	8.3	-
Mid Water				16.5	16.5	-	1	1	-	8.1	8.3	-
Bottom				12.5	16.5	-	24	1	-	8.6	8.3	-

Appendix 1 continued. Water temperature, salinity, and dissolved oxygen measurements taken along fixed transects at surface, mid-water and bottom elevations in the Klamath River estuary near **high** tide, 1991-1994. River right (R), mid channel (M), and river left (L) designations were made facing upstream. Transect 1 is closest to the river mouth and subsequent transects progress upstream.

	River Flow/Depth(m)			Temperature			Salinity			Dissolved Oxygen		
	L	M	R	L	M	R	L	M	R	L	M	R
June 20 (con't)	149.8 cms											
Transect 2	7.5	2.8	1.5									
Surface				16.0	17.0	17.0	0	0	1	8.8	8.9	8.3
Mid Water				12.0	17.0	16.5	25	0	1	9.5	8.8	8.6
Bottom				12.0	17.0	16.5	26	1	1	9.8	8.6	8.8
Transect 3	>10	2.5	1.5									
Surface				15.0	17.0	17.0	0	0	0	9.0	8.6	8.4
Mid Water				12.0	17.0	17.0	25	0	0	10.4	8.8	8.6
Bottom				12.0	16.0	17.0	23	2	1	8.8	8.4	8.6
Transect 4	2.7	2.7	2.5									
Surface				17.0	17.0	17.0	0	0	0	8.8	8.6	8.8
Mid Water				17.0	17.0	17.0	0	0	0	8.8	8.5	8.7
Bottom				16.0	16.0	16.5	1	0	2	8.5	8.4	8.6
Transect 5	3.0	3.3	3.9									
Surface				17.0	17.0	17.0	0	0	0	8.6	8.7	8.7
Mid Water				17.0	17.0	17.0	0	1	0	8.7	8.4	8.6
Bottom				16.5	14.0	13.5	2	17	22	8.5	9.0	9.2
Transect 6	5.5	2.7	1.6									
Surface				17.0	17.0	17.0	0	0	0	8.7	8.5	9.1
Mid Water				17.0	17.0	17.0	0	0	0	8.6	8.5	9.1
Bottom				14.0	17.0	17.0	17	0	0	8.9	8.4	9.0
Transect 7	3.5	2.5	1.1									
Surface				17.0	17.0	17.0	0	0	0	8.6	8.6	8.6
Mid Water				17.0	17.0	-	0	0	-	8.6	8.6	-
Bottom				17.0	17.0	17.0	0	0	0	8.5	8.6	8.5
Transect 8	1.5	2.8	2.7									
Surface				17.5	17.0	17.0	0	0	0	8.8	8.4	8.5
Mid Water				17.5	17.0	17.0	0	0	0	8.8	8.4	8.4
Bottom				17.0	17.0	17.0	0	0	0	8.7	8.4	8.3
July 17	104.8 cms											
Transect 1	2.8	3.0	4.2									
Surface				20.0	20.0	20.0	2	1	2	7.4	7.9	7.8
Mid Water				19.5	19.5	18.0	4	4	9	7.3	7.6	7.6
Bottom				17.5	15.0	14.0	17	25	26	7.8	8.0	7.5
Transect 2	5.5	5.2	2.2									
Surface				20.0	20.0	20.5	1	1	1	8.4	8.4	8.1
Mid Water				15.0	14.0	20.0	24	24	2	7.9	7.4	8.1
Bottom				13.0	13.0	16.0	27	27	19	7.6	7.7	7.4
Transect 3	8.5	2.7	1.3									
Surface				19.0	21.0	21.0	1	0	1	8.4	8.5	8.1
Mid Water				14.0	20.0	21.0	26	1	1	7.5	8.5	8.1
Bottom				13.0	14.0	20.0	27	23	2	7.4	7.4	8.0
Transect 4	1.5	3.8	2.5									
Surface				21.0	21.0	20.0	1	0	1	8.3	8.4	8.0
Mid Water				21.0	20.0	19.0	1	2	4	8.2	8.1	7.4
Bottom				20.0	13.0	15.0	1	27	24	8.2	7.0	8.3

Appendix 1 continued. Water temperature, salinity, and dissolved oxygen measurements taken along fixed transects at surface, mid-water and bottom elevations in the Klamath River estuary near **high** tide, 1991-1994. River right (R), mid channel (M), and river left (L) designations were made facing upstream. Transect 1 is closest to the river mouth and subsequent transects progress upstream.

	River Flow/Depth(m)			Temperature			Salinity			Dissolved Oxygen		
	L	M	R	L	M	R	L	M	R	L	M	R
July 17 (con't)	104.8 cms											
Transect 5	3.0	3.3	3.6									
Surface				19.0	20.5	20.0	0	0	1	8.4	8.6	8.5
Mid Water				16.5	19.0	18.0	14	4	10	6.8	7.8	7.5
Bottom				14.0	13.0	13.0	25	26	27	7.5	7.2	7.8
Transect 6	5.0	2.7	1.5									
Surface				20.0	20.5	21.0	0	0	0	8.6	8.6	8.6
Mid Water				14.0	20.0	20.0	24	2	0	7.0	8.3	8.6
Bottom				14.0	13.0	20.0	24	25	8	7.7	7.3	7.4
Transect 7	3.3	2.3	1.4									
Surface				20.0	21.0	22.0	0	0	0	8.6	8.6	8.1
Mid Water				20.0	21.0	22.0	0	0	0	8.6	8.4	8.2
Bottom				16.5	20.0	21.0	14	2	0	7.6	8.2	8.2
Transect 8	1.6	2.7	2.7									
Surface				20.5	20.5	20.0	0	0	0	8.2	8.6	8.3
Mid Water				20.5	20.0	20.0	0	0	0	8.1	8.7	8.3
Bottom				20.5	20.0	20.0	0	0	0	8.4	8.3	8.2
August 7	62.9 cms											
Transect 1	3.6	3.0	2.4									
Surface				21.0	20.0	19.0	7	3	4	7.2	7.0	7.6
Mid water				17.0	17.0	15.5	17	16	19	8.1	7.6	7.6
Bottom				15.0	16.0	15.0	18	21	24	8.2	8.0	8.0
Transect 2	5.2	4.6	2.1									
Surface				18.0	20.0	20.0	14	2	2	7.4	8.2	8.2
Mid Water				15.0	15.0	16.0	25	25	22	7.6	7.9	7.7
Bottom				15.0	15.0	15.0	25	26	25	7.8	8.0	7.5
Transect 3	7.0	2.4	1.5									
Surface				20.0	20.0	21.0	2	2	2	8.2	8.0	8.2
Mid Water				15.0	17.5	21.0	26	19	2	7.8	7.6	8.0
Bottom				15.0	15.0	19.0	26	26	15	7.4	7.9	7.4
Transect 4	3.0	2.7	2.6									
Surface				20.0	20.5	20.5	2	2	1	7.8	7.9	8.4
Mid Water				17.0	16.0	17.0	17	25	23	7.4	7.5	7.3
Bottom				15.0	15.0	15.0	26	26	26	7.8	7.4	7.6
Transect 5	3.0	3.3	3.6									
Surface				21.0	21.0	21.0	1	1	1	8.8	8.6	8.7
Mid Water				16.5	15.0	16.0	24	25	25	7.8	7.2	7.4
Bottom				15.0	15.0	15.0	26	26	26	7.9	7.7	7.5
Transect 6	5.2	-	-									
Surface				20.5	-	-	0	-	-	9.0	-	-
Mid Water				16.0	-	-	25	-	-	7.9	-	-
Bottom				15.0	-	-	26	-	-	7.6	-	-
Transect 7	3.6	2.4	-									
Surface				22.0	21.5	-	0	0	-	9.0	9.3	-
Mid Water				-	-	-	-	-	-	-	-	-
Bottom				15.0	15.5	-	25	25	-	8.3	7.6	-

Appendix 1 continued. Water temperature, salinity, and dissolved oxygen measurements taken along fixed transects at surface, mid-water and bottom elevations in the Klamath River estuary near **high** tide, 1991-1994. River right (R), mid channel (M), and river left (L) designations were made facing upstream. Transect 1 is closest to the river mouth and subsequent transects progress upstream.

	River Flow/Depth(m)			Temperature			Salinity			Dissolved Oxygen		
	L	M	R	L	M	R	L	M	R	L	M	R
August 7 (con't)	62.9 cms											
Transect 8	2.4	3.6	2.4									
Surface				22.0	21.0	22.0	0	0	1	9.4	9.3	9.2
Mid Water				19.5	16.0	18.5	12	23	17	8.2	7.6	7.0
Bottom				15.5	15.0	16.0	25	25	25	7.7	7.9	7.2
Transect 9	1.7	2.1	5.5									
Surface				22.0	22.0	21.5	0	0	0	9.0	8.7	8.8
Mid Water				22.0	21.5	21.0	2	1	23	8.6	8.6	7.1
Bottom				21.0	21.5	15.0	6	21	26	8.2	7.2	7.3
Transect 10	1.8	2.7	-									
Surface				22.0	22.0	-	0	0	-	7.9	7.6	-
Mid Water				-	21.5	-	-	1	-	-	7.5	-
Bottom				22.0	17.0	-	1	23	-	8.0	7.8	-
September 25	50.4 cms											
Transect 1	-	-	-									
Surface				-	-	-	-	-	-	-	-	-
Mid Water				-	-	-	-	-	-	-	-	-
Bottom				-	-	-	-	-	-	-	-	-
Transect 2	8.0	6.5	2.8									
Surface				18.0	19.0	19.0	0	0	0	6.8	7.2	6.9
Mid Water				16.0	17.0	18.5	14	9	0	7.0	7.1	7.1
Bottom				15.0	15.0	18.0	22	19	7	2.4	6.4	7.2
Transect 3	>10	4.0	3.0									
Surface				19.0	19.0	19.0	0	0	0	7.2	7.3	7.7
Mid Water				18.0	19.0	19.0	7	0	0	7.2	7.1	7.4
Bottom				15.0	16.0	18.0	23	12	7	2.0	7.3	7.2
Transect 4	3.0	4.5	4.4									
Surface				19.0	19.0	19.0	0	0	0	6.9	7.3	7.4
Mid Water				19.0	18.5	19.0	0	5	4	7.0	6.8	7.0
Bottom				17.0	16.0	16.0	8	14	14	7.1	7.1	6.7
Transect 5	4.5	4.7	5.3									
Surface				20.0	19.0	19.0	0	0	0	7.8	8.0	7.3
Mid Water				19.0	18.0	18.0	5	5	8	7.1	7.4	6.5
Bottom				17.0	16.0	16.0	14	16	18	6.6	6.6	6.4
Transect 6	6.2	5.2	2.8									
Surface				19.0	20.0	20.0	0	0	0	7.9	7.9	7.9
Mid Water				17.5	18.0	20.0	10	7	0	7.0	7.2	7.9
Bottom				15.0	16.5	18.0	19	17	8	6.5	6.6	7.2
Transect 7	4.7	3.6	2.4									
Surface				19.5	20.0	20.0	0	0	0	8.0	7.9	7.8
Mid Water				19.0	19.5	20.0	1	0	0	7.6	7.5	7.4
Bottom				16.5	18.0	19.0	14	9	0	6.5	6.4	7.6
Transect 8	2.4	4.7	4.4									
Surface				20.0	20.0	20.0	0	0	0	7.6	7.7	7.6
Mid Water				19.5	19.0	19.5	0	0	0	7.3	7.4	7.4
Bottom				18.0	17.0	17.0	0	13	13	7.5	6.0	6.2

Appendix 1 continued. Water temperature, salinity, and dissolved oxygen measurements taken along fixed transects at surface, mid-water and bottom elevations in the Klamath River estuary near **high** tide, 1991-1994. River right (R), mid channel (M), and river left (L) designations were made facing upstream. Transect 1 is closest to the river mouth and subsequent transects progress upstream.

	River Flow/Depth(m)			Temperature			Salinity			Dissolved Oxygen		
	L	M	R	L	M	R	L	M	R	L	M	R
Sept. 25 (con't)		50.4 cms										
Transect 9	3.0	3.8	7.6									
Surface				19.0	20.0	19.5	0	0	0	7.5	7.2	7.4
Mid Water				20.0	20.0	18.0	0	0	11	7.2	6.9	6.5
Bottom				19.0	18.0	17.0	3	11	14	6.4	6.0	5.8
Transect 10	4.1	4.3	3.2									
Surface				20.0	20.0	20.0	0	0	0	7.2	7.1	7.2
Mid Water				20.0	20.0	20.0	0	0	0	7.2	6.9	6.8
Bottom				18.0	18.0	19.0	12	12	0	6.2	5.7	7.0
October 24		58.6 cms										
Transect 1	3.9	3.3	5.0									
Surface				14.0	14.0	14.0	1	1	1	8.7	8.5	8.6
Mid Water				14.0	14.0	15.0	1	1	3	8.3	8.2	8.5
Bottom				16.0	14.0	15.0	23	22	23	8.4	8.0	7.3
Transect 2	5.8	6.0	2.3									
Surface				14.0	14.0	14.0	1	1	1	8.5	8.2	8.1
Mid Water				14.5	14.5	14.0	22	20	1	7.6	7.6	7.7
Bottom				15.0	14.0	14.0	24	24	2	5.7	6.2	7.8
Transect 3	8.6	2.6	1.7									
Surface				14.0	14.0	14.0	1	1	1	8.2	8.0	7.8
Mid Water				14.0	14.0	14.0	8	1	1	6.7	8.3	8.1
Bottom				15.0	14.0	14.0	26	6	1	5.2	7.8	8.6
Transect 4	1.5	3.4	2.5									
Surface				14.0	14.0	14.0	1	1	1	8.3	8.2	8.2
Mid Water				14.0	14.0	14.0	1	1	1	8.4	8.2	8.0
Bottom				14.0	14.0	14.0	1	22	11	7.8	8.0	7.3
Transect 5	3.0	3.4	3.8									
Surface				14.0	14.0	14.0	1	1	1	8.4	8.2	8.1
Mid Water				14.0	14.0	14.0	1	1	1	8.5	8.0	8.0
Bottom				14.0	14.0	14.0	19	23	25	7.9	6.3	7.0
Transect 6	5.1	2.4	1.6									
Surface				14.0	14.0	14.0	0	0	0	8.0	8.0	7.9
Mid Water				14.0	14.0	14.0	13	0	0	7.3	7.9	7.6
Bottom				14.0	14.0	14.0	25	12	0	7.0	7.2	8.0
Transect 7	3.7	1.5	1.5									
Surface				14.0	14.0	14.0	0	0	0	7.9	7.9	8.0
Mid Water				14.0	14.0	14.0	0	0	0	7.9	7.8	8.0
Bottom				14.0	14.0	14.0	24	0	0	7.1	7.8	8.0
Transect 8	1.5	3.2	2.5									
Surface				14.0	14.0	14.0	0	0	0	7.9	8.0	7.4
Mid Water				14.0	14.0	14.0	0	0	0	7.9	7.9	7.6
Bottom				14.0	15.0	14.0	0	15	5	7.9	6.1	7.3
Transect 9	1.3	2.0	5.8									
Surface				14.0	14.0	14.0	0	0	0	8.2	8.0	7.5
Mid Water				--	14.0	15.0	--	0	15	--	8.2	6.5
Bottom				14.0	14.0	15.0	0	0	19	8.3	8.3	6.9

Appendix 1 continued. Water temperature, salinity, and dissolved oxygen measurements taken along fixed transects at surface, mid-water and bottom elevations in the Klamath River estuary near **high** tide, 1991-1994. River right (R), mid channel (M), and river left (L) designations were made facing upstream. Transect 1 is closest to the river mouth and subsequent transects progress upstream.

	River Flow/Depth(m)			Temperature			Salinity			Dissolved Oxygen		
	L	M	R	L	M	R	L	M	R	L	M	R
Oct. 24 (con't)	58.6 cms											
Transect 10	2.8	2.7	2.1									
Surface				14.0	14.0	14.0	0	0	0	8.5	8.4	8.5
Mid Water				-	-	-	-	-	-	-	-	-
Bottom				14.0	14.0	14.0	0	0	0	8.6	8.6	8.7
November 21	168.5 cms											
Transect 1	4.4	4.2	5.2									
Surface				10.0	10.0	10.0	1	1	0	12.0	12.1	12.5
Mid Water				10.0	10.0	10.0	1	1	1	11.3	12.0	12.2
Bottom				10.5	10.0	10.0	24	1	9	10.0	12.2	11.6
Transect 2	6.0	5.8	1.9									
Surface				10.0	10.0	10.0	0	0	0	12.3	12.7	12.3
Mid Water				10.0	10.0	10.0	1	1	0	11.6	11.5	11.8
Bottom				10.5	10.5	10.0	26	26	0	9.1	10.2	12.0
Transect 3	8.5	3.1	1.8									
Surface				10.0	10.0	10.0	0	0	0	12.1	12.4	11.9
Mid Water				11.0	10.0	10.0	28	0	0	6.6	12.4	11.9
Bottom				11.0	10.0	10.0	29	1	0	4.9	12.3	11.9
Transect 4	3.0	4.2	3.4									
Surface				10.0	10.0	10.0	0	0	0	12.1	12.5	12.2
Mid Water				10.0	10.0	10.0	0	0	0	12.0	12.5	12.1
Bottom				10.0	10.0	10.0	0	0	0	12.2	12.5	12.2
Transect 5	3.5	3.9	4.5									
Surface				10.0	10.0	10.0	0	0	0	12.4	12.5	12.2
Mid Water				10.0	10.0	10.0	0	0	0	12.2	12.5	12.0
Bottom				10.0	10.0	10.0	0	0	0	12.2	12.5	12.1
Transect 6	5.5	3.5	2.1									
Surface				10.0	10.0	10.0	0	0	0	12.5	12.6	11.6
Mid Water				10.0	10.0	10.0	0	0	0	12.4	12.6	11.6
Bottom				10.0	10.0	10.0	0	0	0	12.4	12.6	11.7
Transect 7	-	-	-									
Surface				-	-	-	-	-	-	-	-	-
Mid Water				-	-	-	-	-	-	-	-	-
Bottom				-	-	-	-	-	-	-	-	-
Transect 8	-	-	4.2									
Surface				-	-	10.0	-	-	0	-	-	12.7
Mid Water				-	-	10.0	-	-	0	-	-	12.7
Bottom				-	-	10.0	-	-	0	-	-	12.7

Appendix 1 continued. Water temperature, salinity, and dissolved oxygen measurements taken along fixed transects at surface, mid-water and bottom elevations in the Klamath River estuary near **high** tide, 1991-1994. River right (R), mid channel (M), and river left (L) designations were made facing upstream. Transect 1 is closest to the river mouth and subsequent transects progress upstream.

1992

	River Flow/Depth(m)			Temperature			Salinity			Dissolved Oxygen		
	L	M	R	L	M	R	L	M	R	L	M	R
January 20	148.9 cms											
Transect 1	3.9	2.9	3.4									
Surface				6.0	6.5	6.0	1	1	1	13.0	13.0	13.2
Mid Water				6.0	6.5	6.0	1	1	1	12.6	12.6	13.2
Bottom				9.0	6.5	8.0	21	1	16	11.8	13.1	12.9
Transect 2	6.1	5.7	3.1									
Surface				6.0	6.0	6.5	0	0	0	13.1	13.1	13.0
Mid Water				7.0	7.0	6.0	5	5	1	12.8	13.0	12.8
Bottom				9.0	9.0	6.5	24	24	6	12.1	12.3	12.5
Transect 3	9.7	3.3	1.8									
Surface				6.0	6.0	6.0	0	0	1	13.0	13.2	13.0
Mid Water				9.0	6.0	6.0	21	0	1	10.6	13.3	13.0
Bottom				9.5	6.0	6.0	27	2	1	10.4	13.0	12.9
Transect 4	2.7	4.4	2.2									
Surface				6.0	6.0	6.0	0	0	0	12.8	13.2	13.0
Mid Water				6.0	6.0	6.0	0	0	1	12.7	13.0	13.0
Bottom				6.0	8.5	6.0	0	21	1	12.9	10.7	12.8
Transect 5	3.2	3.8	4.2									
Surface				6.0	6.0	6.0	0	0	0	12.9	13.4	12.7
Mid Water				6.0	6.0	6.0	1	0	0	12.7	13.4	12.9
Bottom				6.0	7.0	8.0	1	11	19	12.6	11.8	10.5
Transect 6	5.7	2.6	1.2									
Surface				6.0	6.0	6.5	0	0	0	13.4	13.3	12.7
Mid Water				6.0	6.0	6.5	0	0	0	13.0	13.4	12.8
Bottom				8.5	6.0	6.5	20	2	0	10.8	13.0	12.6
Transect 7	3.6	2.0	1.7									
Surface				6.0	6.0	6.0	0	0	0	13.6	13.6	13.2
Mid Water				6.0	6.0	6.0	0	0	0	13.6	13.6	13.2
Bottom				6.0	6.0	6.0	4	0	0	12.5	13.6	13.2
Transect 8	2.1	3.4	3.2									
Surface				6.0	6.0	5.5	0	0	0	13.8	13.8	13.8
Mid Water				6.0	6.0	5.5	0	0	0	13.8	13.8	13.7
Bottom				6.0	6.0	6.0	0	0	0	13.5	13.6	13.8
February 17	521.1 cms											
Transect 1	4.3	4.2	5.2									
Surface				7.0	7.0	7.0	0	0	0	13.6	13.4	13.6
Mid Water				7.0	7.0	7.0	0	0	0	13.2	13.2	13.6
Bottom				7.0	7.0	7.0	0	0	0	13.4	13.2	13.6
Transect 2	6.0	5.5	3.1									
Surface				8.0	8.0	7.0	0	0	0	13.4	13.6	13.6
Mid Water				8.0	8.0	7.0	0	0	0	13.4	13.6	13.6
Bottom				8.0	8.0	7.0	0	0	0	13.4	13.6	13.6
Transect 3	>10	4.5	2.7									
Surface				7.0	7.0	7.0	0	0	0	13.8	13.8	13.6
Mid Water				7.0	7.0	7.0	0	0	0	13.6	13.8	13.6
Bottom				7.0	7.0	7.0	0	0	0	13.6	13.6	13.6

Appendix 1 continued. Water temperature, salinity, and dissolved oxygen measurements taken along fixed transects at surface, mid-water and bottom elevations in the Klamath River estuary near **high** tide, 1991-1994. River right (R), mid channel (M), and river left (L) designations were made facing upstream. Transect 1 is closest to the river mouth and subsequent transects progress upstream.

	River Flow/Depth(m)			Temperature			Salinity			Dissolved Oxygen		
	L	M	R	L	M	R	L	M	R	L	M	R
Feb 17 (con't)	521.1 cms											
Transect 4	2.0	3.0	4.5									
Surface				7.0	7.0	7.0	0	0	0	13.6	13.6	13.8
Mid Water				7.0	7.0	7.0	0	0	0	13.6	13.8	13.8
Bottom				7.0	7.0	7.0	0	0	0	13.6	13.8	13.8
Transect 5	5.5	4.5	2.0									
Surface				7.0	7.0	7.0	0	0	0	13.8	13.8	13.6
Mid Water				7.0	7.0	7.0	0	0	0	13.8	13.8	13.8
Bottom				7.0	7.0	7.0	0	0	0	13.8	13.8	13.8
March 16	470.1 cms											
Transect 1	3.8	4.4	2.5									
Surface				10.5	10.5	10.5	0	0	0	11.0	11.0	11.8
Mid Water				10.5	10.5	10.5	0	0	0	11.0	11.3	11.8
Bottom				11.0	10.5	10.5	0	0	0	11.1	11.3	11.8
Transect 2	6.6	4.5	1.2									
Surface				10.5	10.5	11.0	0	0	0	11.7	11.6	11.1
Mid Water				10.5	10.5	-	0	0	-	11.6	11.5	-
Bottom				10.5	10.5	11.0	0	0	0	11.6	11.6	11.2
Transect 3	9.0	3.7	2.0									
Surface				10.5	10.5	10.5	0	0	0	11.6	11.5	11.5
Mid Water				10.5	10.5	10.5	0	0	0	11.5	11.5	11.5
Bottom				10.5	10.5	10.5	0	0	0	11.7	11.6	11.5
Transect 4	3.2	3.5	3.0									
Surface				10.5	10.5	10.5	0	0	0	11.6	11.6	11.6
Mid Water				10.5	10.5	10.5	0	0	0	11.6	11.6	11.6
Bottom				10.5	10.5	10.5	0	0	0	11.6	11.6	11.6
Transect 5	3.1	3.5	4.3									
Surface				10.5	10.5	10.5	0	0	0	11.7	11.7	11.5
Mid Water				10.5	10.5	10.5	0	0	0	11.6	11.7	11.5
Bottom				10.5	10.5	10.5	0	0	0	11.6	11.7	11.6
Transect 6	4.8	3.3	1.6									
Surface				10.5	10.5	10.5	0	0	0	11.6	11.6	11.6
Mid Water				10.5	10.5	10.5	0	0	0	11.6	11.6	11.6
Bottom				10.5	10.5	10.5	0	0	0	11.6	11.6	11.6
April 22	552.2 cms											
Transect 1	3.3	2.7	2.9									
Surface				13.0	13.0	13.0	0	0	0	11.4	11.2	11.4
Mid Water				12.5	13.0	13.0	0	0	0	11.8	11.2	11.4
Bottom				13.0	13.0	13.0	0	0	0	12.0	11.2	11.4
Transect 2	5.5	4.3	0.9									
Surface				12.5	13.0	14.0	0	0	0	11.2	11.3	10.8
Mid Water				12.5	13.0	-	0	0	-	11.3	11.2	-
Bottom				12.5	13.0	14.0	0	0	0	11.3	11.2	10.8
Transect 3	9.0	2.4	1.1									
Surface				13.0	13.0	13.0	0	0	0	11.3	11.3	11.2
Mid Water				13.0	13.0	-	0	0	-	11.3	11.3	-
Bottom				13.0	13.0	13.0	0	0	0	11.3	11.4	11.2

Appendix 1 continued. Water temperature, salinity, and dissolved oxygen measurements taken along fixed transects at surface, mid-water and bottom elevations in the Klamath River estuary near **high** tide, 1991-1994. River right (R), mid channel (M), and river left (L) designations were made facing upstream. Transect 1 is closest to the river mouth and subsequent transects progress upstream.

	River Flow/Depth(m)			Temperature			Salinity			Dissolved Oxygen		
	L	M	R	L	M	R	L	M	R	L	M	R
April 22 (con't)		552.2 cms										
Transect 4	1.0	1.9	2.2									
Surface				13.0	12.5	13.0	0	0	0	11.4	11.3	11.2
Mid Water				-	12.5	13.0	-	0	0	-	11.3	11.2
Bottom				13.0	12.5	13.0	0	0	0	11.4	11.3	11.3
Transect 5	2.4	3.1	3.0									
Surface				13.0	12.5	13.0	-	-	-	11.3	11.3	11.2
Mid Water				13.0	12.5	13.0	-	-	-	11.4	11.3	11.3
Bottom				13.0	12.5	12.5	-	-	-	11.4	11.3	11.2
Transect 6	4.1	2.1	1.4									
Surface				13.0	12.5	13.0	-	-	2	11.3	11.3	11.0
Mid Water				13.0	12.5	-	-	-	-	11.4	11.3	-
Bottom				13.0	12.5	13.5	-	-	2	11.4	11.3	11.0
May 21		183.5 cms										
Transect 1	3.1	2.6	4.7									
Surface				17.5	17.5	17.5	1	1	1	10.6	12.0	12.0
Mid Water				17.5	17.5	17.0	1	1	1	12.0	11.8	11.8
Bottom				16.0	16.5	13.5	15	7	23	-	-	-
Transect 2	5.2	3.3	1.4									
Surface				18.0	18.0	18.0	1	1	1	15.0	11.0	10.8
Mid Water				18.0	18.0	18.0	1	1	1	11.8	12.0	11.2
Bottom				17.0	18.0	18.0	5	1	1	-	-	12.6
Transect 3	8.8	3.0	1.3									
Surface				18.5	18.0	18.5	0	-	0	12.2	11.8	10.6
Mid Water				18.0	18.0	-	0	-	-	11.7	11.2	-
Bottom				18.0	18.0	19.0	1	-	1	12.6	13.0	12.0
Transect 4	1.5	3.0	2.3									
Surface				17.0	18.0	18.5	-	-	-	11.0	11.2	11.0
Mid Water				17.0	18.0	18.0	-	-	1	11.4	12.0	11.2
Bottom				18.0	18.0	18.0	0	-	1	12.2	12.8	12.8
Transect 5	2.0	2.5	3.0									
Surface				18.0	18.5	19.0	-	-	-	10.6	10.8	10.6
Mid Water				18.0	18.0	18.5	-	-	-	12.0	11.5	11.8
Bottom				18.0	18.0	18.0	-	-	-	12.0	12.4	12.1
Transect 6	3.5	1.9	0.6									
Surface				18.5	18.5	19.0	-	-	-	11.6	10.8	10.4
Mid Water				18.5	18.5	-	-	-	-	12.0	11.4	-
Bottom				18.5	18.5	19.0	-	-	-	13.0	12.0	11.0
June 24		85.0 cms										
Transect 1	1.8	3.5	4.0									
Surface				21.5	21.5	21.5	1	1	1	9.2	9.4	9.0
Mid Water				21.0	13.5	13.5	3	26	27	7.7	9.2	9.0
Bottom				15.0	11.5	11.5	26	32	32	11.0	13.4	13.4
Transect 2	5.0	4.5	2.0									
Surface				21.0	21.0	21.0	1	1	1	9.7	9.8	9.4
Mid Water				13.5	13.5	18.0	27	27	13	9.7	9.4	8.0
Bottom				12.0	12.0	15.0	31	31	23	13.4	14.0	11.3

Appendix 1 continued. Water temperature, salinity, and dissolved oxygen measurements taken along fixed transects at surface, mid-water and bottom elevations in the Klamath River estuary near **high** tide, 1991-1994. River right (R), mid channel (M), and river left (L) designations were made facing upstream. Transect 1 is closest to the river mouth and subsequent transects progress upstream.

	River Flow/Depth(m)			Temperature			Salinity			Dissolved Oxygen		
	L	M	R	L	M	R	L	M	R	L	M	R
June 24 (con't)	85.0 cms											
Transect 3	7.3	6.0	1.9									
Surface				21.0	21.0	21.5	0	0	0	10.2	10.0	9.4
Mid Water				12.5	12.5	21.0	30	30	1	10.0	10.2	8.5
Bottom				12.0	12.0	13.5	31	31	26	14.4	14.0	11.2
Transect 4	2.4	3.2	3.4									
Surface				21.5	21.5	21.5	0	0	0	8.4	9.5	9.2
Mid Water				21.5	21.5	19.5	0	0	6	8.0	8.0	7.5
Bottom				14.0	13.0	13.0	29	31	31	10.0	10.2	10.3
Transect 5	2.5	2.6	3.0									
Surface				21.5	21.5	21.5	0	0	0	8.7	9.4	9.2
Mid Water				21.5	21.5	21.5	0	0	1	8.4	8.7	8.8
Bottom				15.0	14.0	13.5	27	29	29	9.0	9.6	11.8
Transect 6	4.0	3.5	1.6									
Surface				21.5	21.5	22.0	0	0	0	8.8	9.0	8.3
Mid Water				16.5	20.0	21.5	22	8	0	7.0	7.5	8.6
Bottom				14.0	14.0	20.0	28	28	5	11.4	11.4	9.4
Transect 7	3.3	1.5	1.5									
Surface				22.0	22.0	22.0	0	0	0	8.6	8.4	8.2
Mid Water				21.5	22.0	22.0	0	0	0	9.0	8.4	8.1
Bottom				17.0	22.0	22.0	22	0	0	8.4	4.6	4.4
Transect 8	1.0	2.2	2.4									
Surface				21.5	22.0	22.0	0	0	0	8.8	9.0	8.8
Mid Water				21.5	22.0	22.0	0	0	0	9.4	9.2	9.0
Bottom				21.5	22.0	22.0	0	0	0	9.9	10.0	10.2
July 7	87.2 cms											
Transect 1	3.4	3.9	5.0									
Surface				22.0	21.0	21.0	2	2	5	9.4	9.1	8.3
Mid Water				15.0	15.0	15.0	27	28	31	9.7	10.0	11.0
Bottom				15.0	15.0	14.5	29	30	31	14.0	12.3	12.0
Transect 2	5.5	5.1	2.2									
Surface				22.0	22.0	22.0	0	1	1	8.9	9.4	8.7
Mid Water				15.0	15.0	16.5	29	30	22	10.9	10.9	9.8
Bottom				15.0	14.5	15.5	30	30	27	13.8	13.0	10.6
Transect 3	8.8	2.7	1.3									
Surface				21.0	22.0	21.5	0	0	1	9.7	9.4	8.7
Mid Water				14.5	17.0	-	30	23	-	11.4	9.7	-
Bottom				14.5	15.0	18.0	31	30	24	13.1	11.6	10.3
Transect 4	2.2	3.1	3.0									
Surface				22.0	22.0	21.5	0	0	0	8.9	9.0	9.0
Mid Water				22.0	15.5	17.5	1	26	18	9.8	10.5	10.4
Bottom				14.5	15.0	15.0	28	28	29	11.4	12.3	12.4
Transect 5	2.7	3.2	3.5									
Surface				22.0	22.0	22.0	0	0	0	9.2	9.2	9.1
Mid Water				19.5	17.5	16.5	15	22	24	9.0	9.8	10.3
Bottom				15.5	14.5	14.5	28	29	29	11.8	12.5	12.3

Appendix 1 continued. Water temperature, salinity, and dissolved oxygen measurements taken along fixed transects at surface, mid-water and bottom elevations in the Klamath River estuary near **high** tide, 1991-1994. River right (R), mid channel (M), and river left (L) designations were made facing upstream. Transect 1 is closest to the river mouth and subsequent transects progress upstream.

	River Flow/Depth(m)			Temperature			Salinity			Dissolved Oxygen		
	L	M	R	L	M	R	L	M	R	L	M	R
July 7 (con't)		87.2 cms										
Transect 6	4.8	2.8	1.3									
Surface				21.5	22.0	22.0	0	0	0	9.6	9.3	10.0
Mid Water				16.0	18.0	-	27	16	-	10.3	9.0	-
Bottom				15.0	15.0	22.0	28	28	6	12.4	11.4	10.3
Transect 7	3.1	3.6	1.2									
Surface				22.0	22.0	23.0	0	0	0	9.0	9.4	9.2
Mid Water				17.0	17.0	-	22	23	-	9.8	9.8	-
Bottom				16.0	16.0	18.0	26	26	0	11.2	11.4	10.0
Transect 8	1.4	2.5	2.9									
Surface				22.0	22.0	22.0	0	0	0	9.5	10.0	10.4
Mid Water				-	22.0	22.0	-	0	2	-	10.0	10.0
Bottom				22.0	18.0	20.0	0	22	16	9.8	10.2	9.5
Transect 9	1.1	1.6	5.6									
Surface				22.0	22.0	22.0	0	0	0	10.4	10.2	10.9
Mid Water				-	22.0	22.0	-	0	0	-	10.0	9.3
Bottom				22.0	22.0	20.0	0	0	0	11.1	10.4	9.4
August 3		53.8 cms										
Transect 1	2.6	1.5	3.0									
Surface				20.0	19.5	13.5	7	5	32	8.0	9.8	7.0
Mid Water				14.5	15.0	13.5	30	27	32	10.6	7.8	7.0
Bottom				14.5	14.0	13.5	31	30	32	14.0	7.4	7.0
Transect 2	4.7	5.0	1.6									
Surface				19.5	18.5	18.0	5	9	10	9.6	8.0	7.5
Mid Water				14.0	14.0	15.0	30	30	26	7.1	7.2	8.2
Bottom				13.5	14.0	15.0	31	31	27	7.0	7.1	9.8
Transect 3	9.0	2.4	0.9									
Surface				19.5	19.0	20.0	4	5	4	8.4	8.7	8.2
Mid Water				14.0	15.0	-	31	27	-	11.1	8.6	-
Bottom				13.5	14.0	19.0	32	30	20	11.1	9.0	8.9
Transect 4	2.0	3.2	1.8									
Surface				19.5	19.5	20.0	4	4	4	7.8	8.0	7.5
Mid Water				17.0	14.5	18.0	25	28	14	9.0	9.4	8.1
Bottom				14.5	14.0	14.5	29	30	30	10.5	10.8	10.1
Transect 5	2.1	2.6	3.1									
Surface				20.0	20.0	20.0	3	3	3	7.5	7.4	10.0
Mid Water				19.0	16.0	15.5	17	25	28	8.0	8.4	9.0
Bottom				15.5	15.0	14.5	29	30	31	10.4	10.8	10.6
Transect 6	3.8	2.0	1.2									
Surface				20.0	20.0	20.5	2	2	2	7.6	7.4	7.5
Mid Water				14.5	19.0	-	29	10	-	9.9	7.8	-
Bottom				14.5	15.0	18.0	30	29	18	11.4	10.4	8.6
Transect 7	2.9	1.6	1.2									
Surface				20.0	20.5	21.0	2	2	2	7.5	7.5	7.7
Mid Water				16.0	20.0	-	26	3	-	9.5	8.0	-
Bottom				15.0	16.0	18.0	29	27	18	7.6	10.0	8.7

Appendix 1 continued. Water temperature, salinity, and dissolved oxygen measurements taken along fixed transects at surface, mid-water and bottom elevations in the Klamath River estuary near **high** tide, 1991-1994. River right (R), mid channel (M), and river left (L) designations were made facing upstream. Transect 1 is closest to the river mouth and subsequent transects progress upstream.

	River Flow/Depth(m)			Temperature			Salinity			Dissolved Oxygen		
	L	M	R	L	M	R	L	M	R	L	M	R
August 3 (con't)		53.8 cms										
Transect 8	1.2	2.3	2.6									
Surface				21.0	21.0	21.0	0	0	0	8.2	8.3	8.2
Mid Water				21.0	21.0	21.0	0	0	1	8.2	8.6	8.4
Bottom				21.0	17.0	18.5	0	24	20	9.1	10.4	9.0
Transect 9	1.0	1.5	5.0									
Surface				21.0	21.0	21.5	0	0	0	8.6	8.8	8.3
Mid Water				-	21.0	21.0	-	0	1	-	8.9	8.6
Bottom				21.0	21.0	18.5	0	0	18	9.3	9.6	9.0
Transect 10	1.7	2.0	2.0									
Surface				21.5	21.5	21.5	0	0	0	9.0	9.2	9.0
Mid Water				21.5	21.5	21.5	0	0	0	9.6	9.6	9.4
Bottom				21.0	21.5	21.5	0	0	0	10.4	10.1	9.0
September 2		49.8 cms										
Transect 1	2.5	2.5	3.6									
Surface				20.0	20.0	20.0	1	1	1	9.4	8.2	8.4
Mid Water				17.0	18.0	14.0	22	21	31	9.0	8.6	9.6
Bottom				15.0	15.0	14.0	29	29	31	8.5	9.2	9.6
Transect 2	4.0	4.7	1.5									
Surface				20.0	19.5	20.0	1	1	1	8.6	8.5	7.9
Mid Water				16.0	15.0	20.0	28	28	1	9.0	8.8	8.0
Bottom				15.0	14.5	16.5	31	31	23	9.5	10.2	8.6
Transect 3	6.0	2.4	1.5									
Surface				20.0	20.0	20.0	1	1	1	6.6	8.1	8.0
Mid Water				15.0	20.0	20.0	30	2	1	9.1	8.2	8.0
Bottom				14.0	15.0	17.5	31	29	26	9.2	9.2	8.6
Transect 4	1.0	2.7	3.2									
Surface				20.0	20.0	20.0	1	1	1	7.7	7.5	7.7
Mid Water				-	20.0	17.5	-	2	24	-	7.5	8.4
Bottom				20.0	15.5	14.5	1	28	31	7.8	9.0	9.3
Transect 5	2.5	2.8	3.0									
Surface				20.0	20.0	20.0	1	1	1	7.6	7.6	7.8
Mid Water				20.0	20.0	18.5	1	1	19	7.5	7.8	8.3
Bottom				16.0	14.5	14.5	30	31	31	8.5	9.3	9.4
Transect 6	3.0	2.3	1.5									
Surface				20.5	20.0	20.5	1	1	1	7.8	7.8	8.0
Mid Water				20.5	21.0	-	1	0	-	7.9	7.8	-
Bottom				15.0	16.0	20.0	30	29	3	9.3	9.2	7.5
Transect 7	2.9	2.1	0.5									
Surface				20.5	21.0	21.0	0	1	1	8.3	8.2	8.5
Mid Water				20.0	20.5	-	4	1	-	7.7	7.9	-
Bottom				15.5	17.0	21.0	30	30	1	9.6	8.5	9.0
Transect 8	2.5	2.6	2.6									
Surface				21.0	21.0	21.0	0	0	0	9.6	9.4	9.2
Mid Water				21.0	21.0	21.0	1	0	1	8.4	8.6	8.3
Bottom				18.0	17.0	19.0	26	28	21	8.0	8.3	7.0

Appendix 1 continued. Water temperature, salinity, and dissolved oxygen measurements taken along fixed transects at surface, mid-water and bottom elevations in the Klamath River estuary near **high** tide, 1991-1994. River right (R), mid channel (M), and river left (L) designations were made facing upstream. Transect 1 is closest to the river mouth and subsequent transects progress upstream.

	River Flow/Depth(m)			Temperature			Salinity			Dissolved Oxygen		
	L	M	R	L	M	R	L	M	R	L	M	R
Sept. 2 (con't)	49.8 cms											
Transect 9	4.6	1.5	1.0									
Surface				21.0	21.0	21.0	0	0	0	9.8	9.4	8.9
Mid Water				-	21.0	20.5	-	0	2	-	9.5	8.3
Bottom				21.0	21.0	16.5	0	0	29	9.7	9.6	7.2
Transect 10	2.0	2.3	1.8									
Surface				21.5	21.5	21.5	0	0	0	11.0	10.4	10.4
Mid Water				21.5	21.5	21.5	0	0	0	11.0	10.3	10.4
Bottom				21.0	21.5	21.5	0	0	0	10.8	10.3	10.6
October 26	125.5 cms											
Transect 1	4.0	2.5	4.5									
Surface				16.0	16.0	15.0	0	0	0	8.4	8.8	8.6
Mid Water				15.0	16.0	15.0	2	0	3	8.1	8.9	8.5
Bottom				14.0	16.0	14.0	25	14	23	6.8	8.3	7.5
Transect 2	5.8	4.5	2.5									
Surface				16.0	16.0	16.0	0	0	0	8.7	8.5	8.0
Mid Water				15.0	16.0	16.0	14	0	0	7.9	8.3	8.0
Bottom				14.0	14.0	16.0	28	25	0	6.5	6.8	8.3
Transect 3	8.0	3.2	2.0									
Surface				16.0	16.0	16.0	0	0	0	8.4	8.5	9.3
Mid Water				14.0	16.0	16.0	25	0	0	6.9	8.5	9.9
Bottom				14.0	15.0	16.0	28	18	0	4.0	7.5	9.8
Transect 4	2.2	4.0	3.4									
Surface				16.0	16.0	16.0	0	0	0	8.5	8.5	8.6
Mid Water				16.0	16.0	16.0	0	0	0	8.4	8.5	8.7
Bottom				16.0	15.0	15.0	0	24	24	8.6	7.1	7.4
Transect 5	3.2	3.5	4.2									
Surface				16.5	16.0	16.0	0	0	0	8.2	8.4	8.3
Mid Water				16.0	16.0	16.0	0	0	0	8.1	8.3	7.9
Bottom				15.0	14.5	14.0	18	24	26	6.9	7.2	6.5
Transect 6	4.4	3.3	2.4									
Surface				16.5	16.5	16.0	0	0	0	7.9	8.0	8.3
Mid Water				16.0	16.0	16.0	0	0	0	8.0	8.1	8.3
Bottom				15.0	15.0	16.0	25	19	0	6.0	7.2	8.4
Transect 7	3.5	2.5	2.0									
Surface				16.5	17.0	17.0	0	0	0	8.0	8.4	8.6
Mid Water				16.5	17.0	16.5	0	0	0	8.0	8.3	9.0
Bottom				15.0	16.5	16.5	23	0	0	6.2	8.3	9.1
Transect 8	2.2	3.3	3.4									
Surface				16.5	16.5	16.5	0	0	0	8.2	8.3	8.1
Mid Water				16.5	16.5	16.5	0	0	0	8.2	8.2	8.0
Bottom				17.0	16.5	16.5	0	0	0	6.0	8.0	7.5
Transect 9	2.0	2.5	6.1									
Surface				17.0	17.0	16.5	0	0	0	8.2	8.2	7.9
Mid Water				16.5	16.5	16.5	0	0	0	8.4	8.3	7.6
Bottom				16.5	16.5	16.0	0	0	18	8.5	8.3	5.1

Appendix 1 continued. Water temperature, salinity, and dissolved oxygen measurements taken along fixed transects at surface, mid-water and bottom elevations in the Klamath River estuary near **high** tide, 1991-1994. River right (R), mid channel (M), and river left (L) designations were made facing upstream. Transect 1 is closest to the river mouth and subsequent transects progress upstream.

	River Flow/Depth(m)			Temperature			Salinity			Dissolved Oxygen		
	L	M	R	L	M	R	L	M	R	L	M	R
October 26 (con't)	125.5 cms											
Transect 10	1.7	3.1	2.6									
Surface				17.0	17.0	17.0	0	0	0	8.5	8.8	8.7
Mid Water				17.0	17.0	17.0	0	0	0	8.9	8.8	8.7
Bottom				17.0	17.0	17.0	0	0	0	8.9	8.8	8.7
November 23	328.5 cms											
Transect 1	4.8	3.1	4.6									
Surface				9.0	9.0	9.0	0	0	0	10.8	11.0	10.8
Mid Water				9.0	9.0	9.0	0	0	0	10.6	11.0	10.8
Bottom				11.0	9.0	9.0	27	0	0	5.2	11.0	11.0
Transect 2	6.1	5.5	2.6									
Surface				9.0	9.0	9.0	0	0	0	10.9	11.0	10.6
Mid Water				9.0	9.0	9.0	0	0	0	10.9	11.0	10.6
Bottom				9.0	9.0	9.0	0	0	0	10.9	10.9	11.0
Transect 3	8.0	3.4	2.2									
Surface				9.0	9.5	9.0	0	0	0	11.0	11.0	10.6
Mid Water				9.5	9.5	9.0	0	0	0	11.0	11.0	10.0
Bottom				9.5	9.5	9.0	0	0	0	11.0	11.2	10.3
Transect 4	2.5	4.2	3.4									
Surface				9.0	9.0	9.0	0	0	0	10.8	11.0	11.0
Mid Water				9.0	9.0	9.0	0	0	0	10.8	11.2	11.0
Bottom				9.0	9.0	9.0	0	0	0	11.0	11.2	11.2
Transect 5	3.2	3.7	4.2									
Surface				9.5	9.5	9.5	0	0	0	11.0	11.2	11.0
Mid Water				9.5	9.5	9.5	0	0	0	11.0	11.2	11.0
Bottom				9.5	9.5	9.5	0	0	0	11.2	11.2	11.0
Transect 6	5.1	3.3	1.8									
Surface				9.5	9.5	10.0	0	0	0	11.2	11.2	11.2
Mid Water				9.5	9.5	10.0	0	0	0	11.2	11.2	11.2
Bottom				9.5	9.5	10.0	0	0	0	11.2	11.3	11.2
December 22	317.2 cms											
Transect 1	4.2	3.0	5.4									
Surface				7.0	7.0	7.0	0	0	0	12.8	12.0	9.2
Mid Water				7.0	7.0	7.0	0	0	0	13.0	12.2	10.3
Bottom				9.5	7.0	7.5	17	0	5	6.4	13.0	13.4
Transect 2	6.0	5.2	1.5									
Surface				7.0	7.0	7.0	0	0	0	7.0	6.6	6.4
Mid Water				7.0	7.0	7.0	0	0	0	7.3	6.7	6.5
Bottom				7.0	7.0	7.0	0	0	0	7.3	6.8	6.7
Transect 3	8.0	2.9	1.4									
Surface				7.0	7.0	7.0	0	0	0	8.8	9.4	10.0
Mid Water				7.0	7.0	7.0	0	0	0	8.8	9.4	10.0
Bottom				7.0	7.0	7.0	0	0	0	11.0	9.4	10.0
Transect 4	1.8	3.2	2.6									
Surface				7.0	7.0	7.0	0	0	0	10.3	10.0	10.2
Mid Water				7.0	7.0	7.0	0	0	0	10.3	10.2	10.3
Bottom				7.0	7.0	7.0	0	0	0	10.8	10.7	10.4

Appendix 1 continued. Water temperature, salinity, and dissolved oxygen measurements taken along fixed transects at surface, mid-water and bottom elevations in the Klamath River estuary near **high** tide, 1991-1994. River right (R), mid channel (M), and river left (L) designations were made facing upstream. Transect 1 is closest to the river mouth and subsequent transects progress upstream.

	River Flow/Depth(m)			Temperature			Salinity			Dissolved Oxygen		
	L	M	R	L	M	R	L	M	R	L	M	R
Dec. 22 (con't)	317.2 cms											
Transect 5	3.0	3.4	3.8									
Surface				7.0	7.0	7.0	0	0	0	11.0	11.3	11.5
Mid Water				7.0	7.0	7.0	0	0	0	11.1	11.3	11.5
Bottom				7.0	7.0	7.0	0	0	0	11.2	11.4	11.6
Transect 6	4.5	2.9	1.4									
Surface				7.0	7.0	7.0	0	-	0	11.9	12.0	11.3
Mid Water				7.0	7.0	-	0	0	0	12.0	12.0	-
Bottom				7.0	7.0	7.0	0	0	0	12.0	12.0	11.5

1993

	River Flow			Temperature			Salinity			Dissolved Oxygen		
				L	M	R	L	M	R	L	M	R
May 18	778.8 cms											
Transect 1	2.7	2.2	7.5									
Surface				14.0	14.0	14.0	0	0	0	10.0	10.2	10.5
Mid Water				14.0	14.0	14.0	0	0	0	10.2	10.3	10.6
Bottom				14.0	14.0	14.0	0	0	0	10.4	10.6	9.3
Transect 2	6.0	4.8	2.3									
Surface				14.0	14.0	14.5	0	0	0	10.5	10.4	10.2
Mid Water				14.0	14.0	14.0	0	0	0	10.5	10.5	10.4
Bottom				14.0	14.0	14.0	0	0	0	10.5	10.5	10.4
Transect 3	8.0	2.4	1.2									
Surface				14.0	14.0	14.5	0	0	0	10.5	10.5	10.5
Mid Water				14.0	14.0	14.5	0	0	0	10.5	10.6	10.6
Bottom				14.0	14.0	14.5	0	0	0	10.7	10.6	10.6
Transect 4	1.7	2.9	2.0									
Surface				14.0	14.0	14.0	0	0	0	10.6	10.5	10.6
Mid Water				14.0	14.0	14.0	0	0	0	10.7	10.6	10.7
Bottom				14.0	14.0	14.0	0	0	0	10.8	10.8	10.8
Transect 5	2.5	3.0	3.5									
Surface				14.0	14.0	14.0	0	0	0	10.5	10.5	10.5
Mid Water				14.0	14.0	14.0	0	0	0	10.6	10.5	10.6
Bottom				14.0	14.0	14.0	0	0	0	10.8	10.8	10.8
Transect 6	4.2	4.2	1.5									
Surface				14.0	14.0	14.0	0	0	0	10.6	10.4	10.8
Mid Water				14.0	14.0	-	0	0	-	10.8	10.5	-
Bottom				14.0	14.0	14.0	0	0	0	10.8	10.6	10.8

Appendix 1 continued. Water temperature, salinity, and dissolved oxygen measurements taken along fixed transects at surface, mid-water and bottom elevations in the Klamath River estuary near **high** tide, 1991-1994. River right (R), mid channel (M), and river left (L) designations were made facing upstream. Transect 1 is closest to the river mouth and subsequent transects progress upstream.

	River Flow/Depth(m)			Temperature			Salinity			Dissolved Oxygen		
	L	M	R	L	M	R	L	M	R	L	M	R
June 23	382.3 cms											
Transect 1	2.5	2.5	5.0									
Surface				17.0	18.0	17.0	0	0	0	11.9	12.1	12.3
Mid Water				17.0	18.0	17.0	0	0	0	11.8	12.1	12.2
Bottom				17.0	17.5	17.0	0	0	0	11.4	12.1	12.2
Transect 2	5.5	5.6	1.5									
Surface				17.0	17.0	18.0	0	0	0	12.3	12.2	12.2
Mid Water				17.0	17.0	18.0	0	0	0	12.3	12.3	12.2
Bottom				17.0	17.0	18.0	0	0	0	12.6	12.3	12.3
Transect 3	7.5	2.6	1.3									
Surface				17.0	17.0	18.0	0	0	0	12.4	12.2	12.3
Mid Water				17.0	17.0	-	0	0	-	12.4	12.3	-
Bottom				17.0	17.0	18.0	0	0	0	12.4	12.2	12.4
Transect 4	0.7	2.9	2.1									
Surface				17.0	17.0	17.5	0	0	0	12.4	12.2	12.2
Mid Water				-	17.0	17.5	-	0	0	-	12.2	12.2
Bottom				17.0	17.0	17.5	0	0	0	12.4	12.2	12.3
Transect 5	2.5	2.5	3.2									
Surface				17.0	17.0	17.5	0	0	0	12.4	12.3	12.2
Mid Water				17.0	17.0	17.5	0	0	0	12.4	12.3	12.2
Bottom				17.0	17.0	17.0	0	0	0	12.2	12.4	12.2
Transect 6	4.6	2.9	1.6									
Surface				17.0	17.0	17.0	0	0	0	12.3	12.1	12.0
Mid Water				17.0	17.0	17.0	0	0	0	12.3	12.1	12.0
Bottom				17.0	17.0	17.0	0	0	0	12.4	12.3	12.1
July 26	156.9 cms											
Transect 1	3.5	3.5	6.8									
Surface				21.0	21.0	20.5	-	-	-	11.0	11.0	11.1
Mid Water				21.0	21.0	16.0	-	-	20	11.1	11.1	-
Bottom				13.5	12.0	11.0	25	27	29	-	-	10.3
Transect 2	5.5	5.2	1.3									
Surface				21.0	21.0	21.0	-	-	-	11.3	11.2	11.2
Mid Water				19.0	19.0	-	9	6	-	11.4	11.0	-
Bottom				13.5	12.0	21.0	25	27	-	-	-	-
Transect 3	8.9	2.4	1.7									
Surface				21.0	21.0	21.5	-	-	-	11.3	11.0	11.7
Mid Water				14.0	21.0	21.0	23	-	-	-	11.0	11.7
Bottom				12.0	21.0	21.0	27	-	-	-	-	-
Transect 4	2.0	3.9	2.8									
Surface				21.0	21.0	21.0	-	-	-	11.1	10.9	10.8
Mid Water				21.0	21.0	21.0	-	-	-	11.1	11.0	10.9
Bottom				21.0	14.0	21.0	-	23	2	11.2	10.9	10.8
Transect 5	2.7	3.2	2.8									
Surface				21.5	22.0	22.0	-	-	-	11.0	10.8	11.2
Mid Water				21.5	21.5	21.5	-	-	-	11.0	10.8	11.0
Bottom				21.5	21.5	21.5	-	-	-	11.2	11.0	11.0

Appendix 1 continued. Water temperature, salinity, and dissolved oxygen measurements taken along fixed transects at surface, mid-water and bottom elevations in the Klamath River estuary near **high** tide, 1991-1994. River right (R), mid channel (M), and river left (L) designations were made facing upstream. Transect 1 is closest to the river mouth and subsequent transects progress upstream.

	River Flow/Depth(m)			Temperature			Salinity			Dissolved Oxygen		
	L	M	R	L	M	R	L	M	R	L	M	R
July 26 (con't)	156.9 cms											
Transect 6	5.0	3.5	1.7									
Surface				21.5	22.0	22.0	-	-	-	11.0	11.1	11.1
Mid Water				21.5	21.5	21.5	-	-	-	10.9	10.9	11.1
Bottom				21.5	21.5	21.5	-	-	-	11.1	11.0	11.2
August 20	127.4 cms											
Transect 1	3.0	3.4	6.8									
Surface				20.0	19.5	19.5	3	1	2	8.8	8.5	8.7
Mid Water				18.0	19.5	14.0	8	2	30	8.3	8.4	9.4
Bottom				14.5	14.0	14.0	30	30	30	9.3	9.5	9.3
Transect 2	5.7	5.7	2.9									
Surface				19.5	19.5	19.5	0	0	1	8.8	8.8	8.6
Mid Water				14.5	14.0	19.0	29	30	2	9.4	9.4	8.6
Bottom				14.0	14.0	14.0	30	30	30	9.5	9.4	9.4
Transect 3	7.9	2.5	1.5									
Surface				19.5	20.0	20.0	0	0	0	8.8	9.0	8.9
Mid Water				14.0	19.5	20.0	30	1	0	9.2	8.6	8.9
Bottom				14.0	15.0	19.0	30	29	2	8.8	9.2	8.7
Transect 4	1.8	2.6	2.8									
Surface				20.0	20.0	20.0	0	0	0	8.8	9.1	9.3
Mid Water				20.0	20.0	19.0	0	0	1	8.7	9.0	8.8
Bottom				20.0	16.0	15.0	0	28	27	8.8	8.9	9.4
Transect 5	2.5	3.0	3.0									
Surface				19.5	19.5	19.5	0	0	0	9.0	9.1	9.3
Mid Water				19.5	19.5	19.5	1	0	0	8.9	9.0	9.1
Bottom				16.0	15.0	14.5	24	27	29	8.7	9.4	9.1
Transect 6	4.7	3.0	1.4									
Surface				19.5	19.5	19.5	0	0	0	9.2	9.4	9.2
Mid Water				16.0	19.5	19.5	21	0	0	8.5	9.3	9.0
Bottom				14.5	15.0	19.5	29	24	1	9.2	9.2	9.2
Transect 7	3.4	0.9	1.2									
Surface				19.5	19.5	19.5	0	0	0	9.2	9.3	9.2
Mid Water				19.5	-	-	0	-	-	9.1	-	-
Bottom				16.0	19.5	19.5	25	0	0	8.8	9.6	9.2
Transect 8	1.5	2.5	2.4									
Surface				20.0	20.0	19.5	0	0	0	9.8	9.3	9.0
Mid Water				20.0	19.5	19.5	0	0	0	9.7	9.1	9.3
Bottom				20.0	19.5	19.5	0	0	0	9.7	9.4	9.2
September 17	108.2 cms											
Transect 1	3.0	3.2	7.0									
Surface				18.0	18.0	18.0	2	1	1	9.0	8.5	8.0
Mid Water				17.5	17.0	13.5	7	7	30	8.0	8.2	9.7
Bottom				14.0	13.5	13.0	29	31	31	9.0	9.5	9.4
Transect 2	6.0	5.8	4.2									
Surface				18.0	18.0	18.0	0	0	0	8.2	8.0	7.9
Mid Water				14.0	14.0	14.0	28	28	26	9.3	9.6	9.4
Bottom				13.5	13.5	14.0	30	30	29	9.6	9.6	9.6

Appendix 1 continued. Water temperature, salinity, and dissolved oxygen measurements taken along fixed transects at surface, mid-water and bottom elevations in the Klamath River estuary near **high** tide, 1991-1994. River right (R), mid channel (M), and river left (L) designations were made facing upstream. Transect 1 is closest to the river mouth and subsequent transects progress upstream.

	River Flow/Depth(m)			Temperature			Salinity			Dissolved Oxygen		
	L	M	R	L	M	R	L	M	R	L	M	R
Sept. 17 (con't)	108.2 cms											
Transect 3	8.0	3.0	2.1									
Surface				18.0	18.0	18.0	0	0	0	8.0	8.0	7.7
Mid Water				13.5	18.0	18.0	29	0	0	9.0	8.0	7.6
Bottom				13.5	14.0	17.0	30	29	20	8.8	9.2	7.5
Transect 4	2.2	2.6	3.9									
Surface				18.0	18.0	18.0	0	0	0	7.9	8.0	8.3
Mid Water				18.0	18.0	18.0	0	0	2	7.9	8.0	7.5
Bottom				16.0	14.0	14.0	12	27	29	7.3	9.0	9.4
Transect 5	2.8	3.0	3.8									
Surface				18.0	18.0	18.0	0	0	0	8.4	8.7	8.5
Mid Water				18.0	18.0	18.0	0	0	1	8.4	8.7	8.6
Bottom				14.0	14.0	14.0	27	29	29	9.1	9.2	9.0
Transect 6	4.6	3.6	1.8									
Surface				18.0	18.0	18.5	0	0	0	8.6	8.7	9.2
Mid Water				16.0	18.0	18.5	16	0	0	8.3	8.6	9.2
Bottom				14.0	14.0	17.5	28	28	6	9.0	9.0	8.2
Transect 7	3.4	2.8	0.9									
Surface				18.0	18.0	18.5	0	0	0	9.1	9.0	9.4
Mid Water				18.0	18.0	-	0	0	-	9.0	9.0	-
Bottom				14.5	15.0	18.0	26	26	0	8.3	8.4	9.4
Transect 8	2.0	3.2	3.0									
Surface				18.5	18.5	18.5	0	0	0	9.8	9.5	9.5
Mid Water				18.5	18.5	18.5	0	0	0	9.8	9.5	9.4
Bottom				18.5	18.5	18.5	0	0	0	9.6	9.4	9.4
October 19	125.7 cms											
Transect 1	3.2	3.8	7.4									
Surface				15.5	15.5	16.0	0	0	0	9.8	9.4	8.9
Mid Water				15.5	15.5	16.0	0	0	0	9.7	9.5	8.7
Bottom				15.0	15.5	15.5	0	0	0	9.8	9.6	7.5
Transect 2	6.2	6.4	2.5									
Surface				16.0	16.0	16.0	0	0	0	9.4	9.5	10.2
Mid Water				16.0	15.5	16.0	0	0	0	9.1	9.4	10.2
Bottom				15.5	15.0	16.0	12	13	0	5.3	7.0	10.3
Transect 3	7.7	3.5	2.2									
Surface				16.0	15.5	15.0	0	0	0	9.5	9.7	9.6
Mid Water				16.0	15.5	15.0	0	0	0	9.4	9.7	9.6
Bottom				15.0	15.5	15.0	14	0	0	7.3	9.6	9.8
Transect 4	2.4	2.9	3.4									
Surface				16.0	15.5	16.0	0	0	0	9.4	9.8	10.2
Mid Water				16.0	15.5	15.0	0	0	0	9.5	9.7	9.8
Bottom				15.0	15.5	15.0	0	0	0	9.3	9.9	9.8
Transect 5	3.1	3.3	4.2									
Surface				15.5	15.5	15.5	0	0	0	9.6	9.9	10.5
Mid Water				15.5	15.5	15.5	0	0	0	9.6	9.8	10.3
Bottom				15.5	15.5	15.5	0	0	0	10.0	10.0	10.2

Appendix 1 continued. Water temperature, salinity, and dissolved oxygen measurements taken along fixed transects at surface, mid-water and bottom elevations in the Klamath River estuary near **high** tide, 1991-1994. River right (R), mid channel (M), and river left (L) designations were made facing upstream. Transect 1 is closest to the river mouth and subsequent transects progress upstream.

	River Flow/Depth(m)			Temperature			Salinity			Dissolved Oxygen		
	L	M	R	L	M	R	L	M	R	L	M	R
October 19 (con't)		125.7 cms										
Transect 6	4.3	3.6	2.0									
Surface				15.5	15.5	15.0	0	0	0	9.8	10.2	10.0
Mid Water				15.5	15.5	15.5	0	0	0	10.0	10.1	10.0
Bottom				15.5	15.5	15.0	0	0	0	10.0	10.2	10.0
November 15		144.4 cms										
Transect 1	4.4	4.1	7.7									
Surface				9.0	9.0	9.0	0	0	0	11.8	12.3	12.3
Mid Water				9.0	9.0	9.0	0	0	0	11.8	12.3	12.3
Bottom				9.0	9.0	9.0	0	0	0	11.7	12.2	11.4
Transect 2	5.0	6.8	3.0									
Surface				9.0	9.0	9.0	0	0	0	12.1	11.5	12.5
Mid Water				9.0	9.0	9.0	0	0	0	12.0	11.4	12.4
Bottom				9.0	11.0	9.0	0	25	0	12.0	8.4	12.3
Transect 3	8.8	3.7	2.4									
Surface				9.0	9.0	9.0	0	0	0	12.0	11.4	11.8
Mid Water				9.0	9.0	9.0	0	0	0	11.5	11.4	11.8
Bottom				11.0	9.0	9.0	25	0	0	8.6	11.4	11.6
Transect 4	2.7	3.0	4.3									
Surface				9.0	9.0	9.0	0	0	0	12.0	11.6	11.4
Mid Water				9.0	9.0	9.0	0	0	0	12.0	11.7	11.4
Bottom				9.0	9.0	9.0	0	0	0	12.0	11.8	11.2
Transect 5	3.6	3.9	4.4									
Surface				9.0	9.0	9.0	0	0	0	11.2	11.2	12.2
Mid Water				9.0	9.0	9.0	0	0	0	11.2	11.2	12.2
Bottom				9.0	9.0	9.0	0	0	0	11.5	11.2	12.0
Transect 6	4.2	4.2	2.6									
Surface				9.0	9.0	9.0	0	0	0	11.0	11.2	11.4
Mid Water				9.0	9.0	9.0	0	0	0	10.7	11.4	11.4
Bottom				9.0	8.5	9.0	11	0	0	8.0	11.3	11.4
Transect 7	4.4	2.2	1.6									
Surface				8.5	8.5	8.5	0	0	0	11.7	12.1	12.0
Mid Water				8.5	8.5	-	0	0	-	11.7	12.1	-
Bottom				8.5	8.5	8.5	0	0	0	11.8	12.0	12.0