

**McNulty Slough, Thence Eel River Estuary
Fish and Water Quality Sampling
January 2008 through June 2009**



Introduction

As a follow-up to water quality and fish sampling conducted in September 2006 and 2007 by the California Department of Fish and Wildlife (CDFW), CDFW conducted additional fisheries and water quality sampling in McNulty Slough in the Eel River estuary. The purpose was to document water quality conditions and to determine if juvenile salmonids are present in the area. In 1994, the exterior McNulty Slough levee surrounding the eastern boundary of the CDFW Ocean Ranch Unit of the Eel River Wildlife Area (ERWA) was breached by high river flows and ocean swells. This resulted in returning approximately 260 acres of diked former tideland, currently managed as short grass pasture, back to muted tidal inundation. Over the course of a few years, this daily tidal action subsequently scoured and breached an interior levee in 1998 and drained about 120 acres of freshwater wetland. Consistent with the goals of the ERWA, this interior wetland basin/levee had been constructed by CDFW to create and manage for a diversity of wetland habitat types on the area.

In 2006/07, CDFW obtained the needed permits and funding to repair the interior levee to re-establish the 120 acre perennial freshwater pond. The interior levee repair was completed in September 2007. No repairs to the exterior levee along McNulty Slough at the breach site are proposed and CDFW is planning to allow the approximately 260 acres of diked former tideland (grazed short grass pasture) to remain tidal.

During discussions to repair the interior levee, concerns were expressed regarding negative impacts to aquatic species (especially juvenile anadromous salmonids) and aquatic habitat by cutting off the newly forming tidal marsh and reducing the tidal prism.

To address these concerns and assist in the future planning efforts of the Ocean Ranch Unit for tidal habitat restoration, CDFW began a monitoring effort in the Ocean Ranch Unit of ERWA. The monitoring goals were; 1) to determine if juvenile anadromous salmonids are present in McNulty Slough or inside the breached exterior levee, and determine the relative value of this habitat for anadromous salmonids; 2) to determine presence of other estuarine aquatic species in the Ocean Ranch Unit of ERWA; and, 3) provide baseline data to evaluate the feasibility and success of future habitat restoration projects in the Ocean Ranch Unit of ERWA.

Sampling in McNulty Slough

CDFW used a YSI Inc. water quality meter to collect dissolved oxygen, salinity, conductivity, and water temperature data. CDFW used a 100 X 5 foot seine net to capture fish in McNulty Slough, and a 30 X 5 foot seine net and minnow traps baited with frozen salmon roe to capture fish inside the McNulty Slough levee breach.

CDFW conducted fish sampling at nine sites in McNulty Slough, including two sites in Hawk Slough (Figure 1), ten times in 2008 from January to October, and four times in 2009 from February to June. During the fourteen sampling trips, seven yearling (1+) Chinook salmon, one young of year (YOY) Chinook salmon, three 1+ coho salmon, and four 1+ steelhead were captured at sites 1, 2, 3, 5, 8 and 9 (Figure 1). Captures occurred from 8/21/2008 to 6/17/2009 (Table 1). Numerous other fish species were also captured, including longfin smelt (State listed as threatened) and important sport and commercial fish species such as redbtail surfperch, Pacific herring, and large numbers of juvenile Dungeness crabs (Table 1).

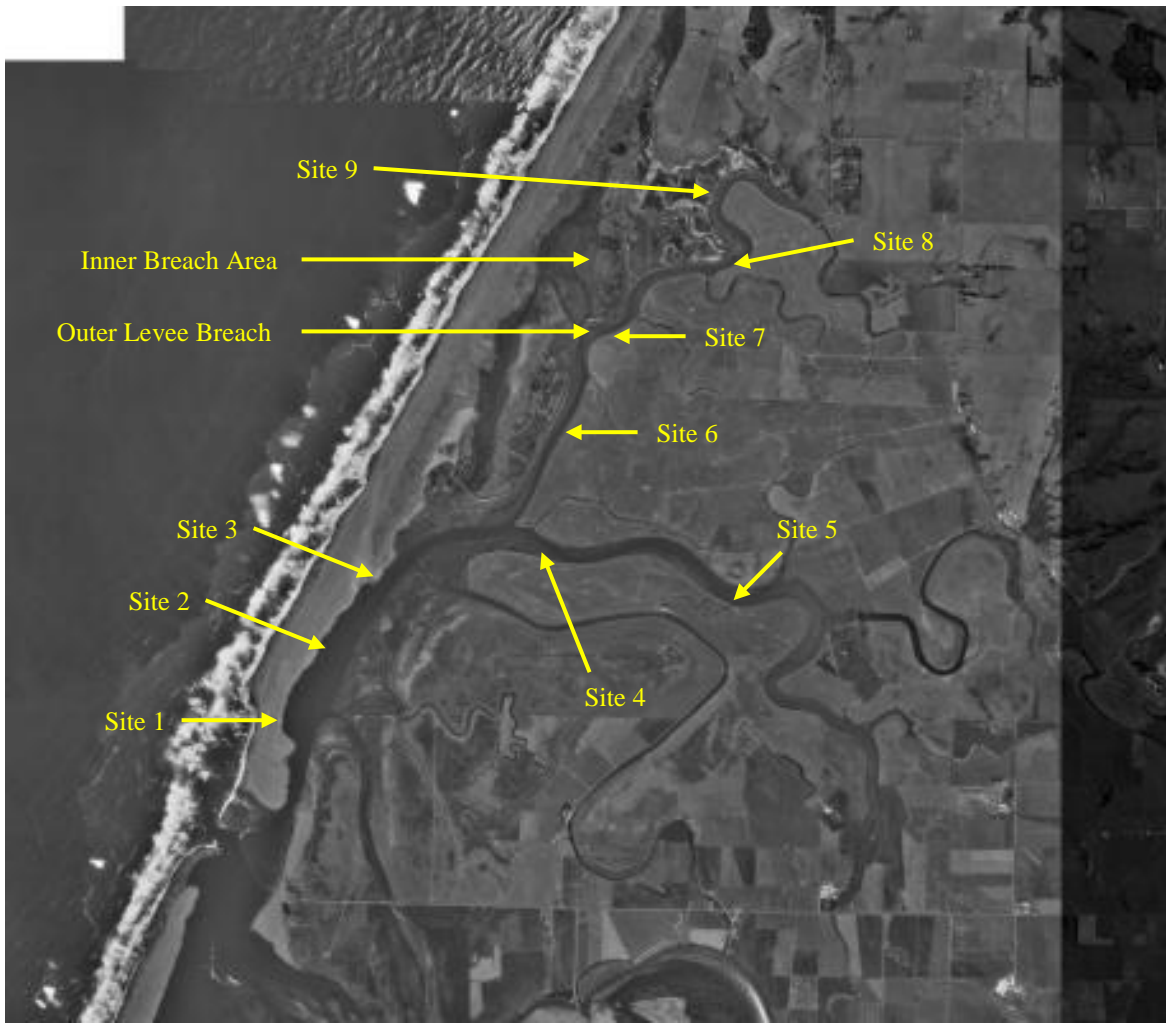


Figure 1. Approximate locations of McNulty Slough fish sampling sites.

Table 1. List of species collected from McNulty Slough, Eel River estuary January 2008 to June 2009.

Species	2008										2009			
	Jan 11	Feb 27	Mar 27	Apr 28	May 29	Jun 26	Jul 24	Aug 21	Sep 25	Oct 24	Feb 27	Apr 20	May 19	Jun 17
Chinook salmon (*ps, smolt)								X	X					X
Coho salmon (*ps, smolt)											X		X	
Steelhead (smolt)												X		
Steelhead (adult)									X	X	X			
American shad					X		X		X	X				
Arrow goby													X	
Bay pipefish			X	X	X		X	X	X	X		X		X
Buffalo sculpin				X					X					
Dace	X													
Dungeness crab (juvenile)					X	X	X	X	X	X				X
English sole						X	X			X				
Longfin smelt											X			
Northern anchovy						X	X	X	X	X				
Pacific herring					X	X	X	X						X
Pacific herring (adult)		X	X	X	X							X	X	
Pacific staghorn sculpin	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Prickly sculpin	X													
Redtail surfperch (adult)		X	X	X		X								
Sacramento pikeminnow											X			
Saddleback gunnel	X	X		X	X	X	X	X	X	X	X		X	X
Shiner surfperch						X	X		X	X			X	X
Starry flounder		X			X	X	X	X	X	X			X	X
Starry flounder (adult)							X							
Surfsmelt	X	X	X	X	X	X		X	X	X	X	X	X	
Surfsmelt (adult)			X	X	X		X	X	X	X			X	X
Threespine stickleback	X						X		X	X	X	X	X	
Tidepool sculpin										X				
Topsmelt			X		X	X	X	X	X	X				X
Topsmelt (adult)						X	X	X		X			X	X
Unidentified larval smelt		X								X				
Unidentified juv. gunnels														
Unidentified juv. flatfish				X								X	X	
Unidentified juv. minnow sp.	X	X												

*ps = pre-smolt

The Natural Stocks Assessment project (NSA) collected water temperature data in McNulty Slough during fish sampling from January 2008 to June 2009 (Table 2). Water temperatures were marginal for juvenile salmonids in the summer and early fall in Hawk Slough and upper McNulty Slough (Table 2). Previous Wiyot Tribe water quality sampling found McNulty Slough to be primarily brackish water with adequate dissolved oxygen for anadromous salmonids on most occasions (CDFG 2008).

Based on observed water quality within McNulty Slough, it is unlikely that young-of-the-year (yoy) coho salmon would use this area for rearing in the late spring and summer. NSA's observations in the tidal portions of Humboldt Bay tributaries indicate that yoy coho salmon avoid brackish water and require water temperatures ≤ 17 °C to successfully rear (CDFG 2008). However, conditions within McNulty Slough appear to be acceptable for juvenile Chinook salmon, yearling coho salmon, steelhead, and cutthroat trout that inhabit brackish water prior to emigrating to the ocean. In past Eel River estuary studies, juvenile Chinook salmon were found to rear throughout the summer in the Eel River estuary, including the lower portion of McNulty Slough, and juvenile salmonids were captured throughout the year in the Eel River estuary (Steve Cannata, CDFW, personal communication). Acoustic tagged yearling coho salmon were found to rear up to one month in Humboldt Bay during their seaward migration from May through June (William Pinnix et al., 2012). One short coming of NSA's sampling effort in McNulty Slough was that all samples were gathered at or near low tide. More juvenile salmonids may follow an incoming tide into McNulty Slough and be present there around the high tide.

Table 2. Surface water temperature (in degrees centigrade) collected from McNulty Slough, Eel River estuary January 2008-June 2009.

McNulty Slough Water Temps

Date	Site	1	2	3	4	5	6	7	8
11-Jan Time		1000	950	940	-	-	-	900	840
2008 Temp °C		7.5	7.5	8.0	-	-	-	8.5	8.5
28-Apr Time		1241	1225	1210	1139	1118	1103	1046	1027
2008 Temp °C		15.0	14.0	14.0	15.5	15.0	14.0	15.0	16.0
29-May Time		-	-	-	1440	-	-	1415	1350
2008 Temp °C		-	-	-	17.5	-	-	18.0	19.0
26-Jun Time		1230	1220	1200	1130	1150	1120	1100	1045
2008 Temp °C		16.0	16.0	16.0	17.0	17.0	17.0	17.0	17.0
24-Jul Time		1200	1145	1130	1100	1110	1045	1030	1015
2008 Temp °C		15.0	15.0	16.0	16.5	17.0	16.5	16.5	17.0
21-Aug Time		945	1010	1020	1035	1045	1100	1120	1130
2008 Temp °C		16.0	16.0	16.5	17.5	18.0	18.0	18.0	18.5
25-Sep Time		1435	1450	1500	1515	1525	1550	1600	1615
2008 Temp °C		14.0	14.0	15.0	17.0	17.5	17.5	19.5	19.0
24-Oct Time		1345	1400	1415	1430	1440	1455	1505	1520
2008 Temp °C		10.5	11.0	11.5	13.0	13.0	13.0	14.0	14.5
27-Feb Time		-	-	-	-	-	-	-	745
2009 Temp °C		-	-	-	-	-	-	-	10.0
20-Apr Time		1335	1315	1300	1245	1230	1220	1210	1155
2009 Temp °C		15.0	15.0	14.0	16.0	15.5	15.0	15.5	16.0
19-May Time		1310	1250	1230	1155	1210	1040	1030	1015
2009 Temp °C		16.5	15.5	15.0	15.5	16.0	15.0	15.5	16.0
17-Jun Time		1150	1140	1115	1045	1055	1030	1015	1000
2009 Temp °C		17.5	16.5	16.5	17.5	18.0	18.0	18.0	18.0

Sampling Inside McNulty Slough Levee Breach

CDFW conducted fish seining and minnow trapping at five sites inside the McNulty Slough levee breach (Figure 2). Sampling took place seven times in 2008 from January to August, and four times in 2009 from February to June. Salmonids were not captured during the sampling trips. However, numerous other fish species were captured (Table 3).

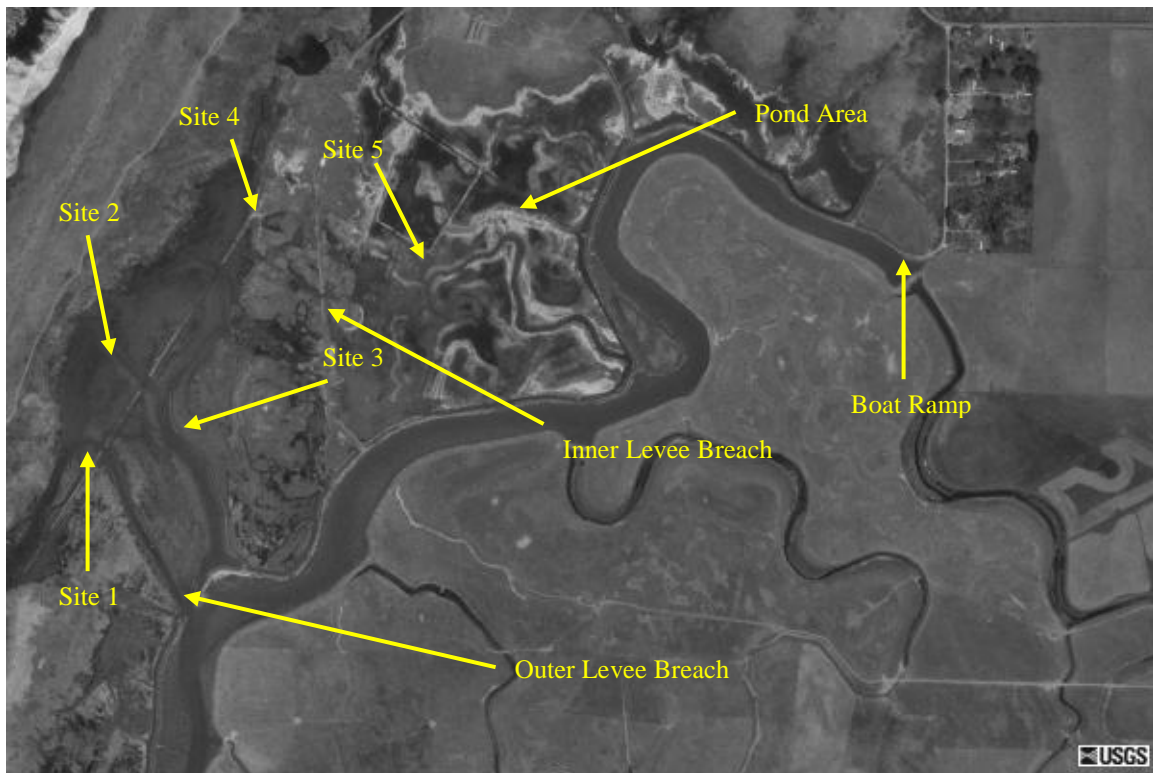


Figure 2. Approximate locations of McNulty Slough inner breach fish sampling sites.

Water quality measurements showed that the inner breach area is primarily brackish water (Table 4) and that spring and summer water temperatures were marginal for juvenile salmonids, particularly coho salmon (Table 5). Water temperatures could approach 25 ° C, as was recorded in mid-August, 2006 (CDFW, Unpublished thermograph data, 2006). The rest of this water quality data set collected by CDFW is available upon request (contact Michelle Gilroy, CDFW, Michelle.Gilroy@wildlife.ca.gov). Based on observed water quality inside the breach area, it is unlikely that young of year coho salmon would use this area for rearing in the late spring and summer. NSA's observations in the tidal portions of Humboldt Bay indicate that yoy coho salmon avoid brackish water and require water temperatures $\leq 17^{\circ}$ C to successfully rear (CDFG 2008). However, conditions within the breach area appear to be acceptable for juvenile Chinook salmon, yearling coho salmon, steelhead, and cutthroat trout smolts that inhabit brackish water prior to emigrating to the ocean. One shortcoming of NSA's sampling effort was that all samples were gathered at or near low tide. Juvenile salmonids may follow an incoming tide into the McNulty Slough breach

area and be present at high tide. Another factor that might limit juvenile salmonid presence inside the breach area is its distance from the mouth of the Eel River. Presently, juvenile salmonids need to travel two to three miles up McNulty Slough to find the one opening into the inner breach site. If one or more access sites were made at the southern end of the marsh it would reduce this distance by about a mile and juvenile salmonids would be more likely to gain access to the inner breach area, especially during years when the Eel River mouth shifts to a more northern location.

Table 3. List of species collected from inside the Mc Nulty slough levee breach on the Eel River Wildlife Area, Eel River estuary, January 2008 to June 2009.

Species	2008							2009			
	Jan 29	Feb 21	Apr 23	May 21	Jun 25	Jul 25	Aug 20	Feb 26	Apr 21	May 20	Jun 16
Dungeness crab (juvenile)				X	X	X	X				X
English sole					X	X					X
Pacific herring					X						
Pacific staghorn sculpin	X	X	X	X	X	X	X	X	X	X	X
Sacramento pikeminnow								X			
Saddleback gunnel			X	X	X	X	X			X	X
Starry flounder		X		X	X	X	X				X
Starry flounder (adult)					X						
Surfsmelt	X	X	X	X	X			X	X	X	
Surfsmelt (adult)	X										
Threespine stickleback		X	X	X	X	X	X	X	X	X	X
Topsmelt					X	X	X				
Unidentified larval smelt								X			X
Unidentified juv. flatfish			X	X					X		

Table 4. Water quality measurements within the McNulty Slough levee breach at fish sampling sites 1 through 5 (Figure 2), Ocean Ranch Unit, Eel River Wildlife Area, McNulty Slough, Eel River estuary, June and July 2008.

Inner McNulty Slough Water Quality						
Date	Location	Depth (ft)	Water Temperature (°C)	Salinity (ppt)	Dissolved Oxygen (mg/l)	Conductivity (ms/cm)
25-Jun 2008	Site 5 @ 1138					
	Surface	0.5	17.1	27.4	1.32	36.08
	Middle	-	-	-	-	-
	Bottom	2.0	17.1	29.9	0.17	39.03
	Site 4 @ 1150					
	Surface	-	-	-	-	-
	Middle	-	-	-	-	-
	Bottom	1.0	17.7	29.2	9.66	38.71
	Site 2 @ 1206					
	Surface	-	-	-	-	-
	Middle	-	-	-	-	-
	Bottom	1.0	17.0	31.2	6.01	40.58
	Site 3 @ 1242					
	Surface	0.5	17.6	31.2	6.47	40.99
	Middle	-	-	-	-	-
Bottom	2.0	17.1	31.4	6.85	40.76	
Site 1 @ 1315						
Surface	0.5	16.8	31.3	6.3	40.4	
Middle	-	-	-	-	-	
Bottom	2.0	16.1	31.6	5.67	40.14	
25-Jul 2008	Site 5					
	Surface	-	-	-	-	-
	Middle	-	-	-	-	-
	Bottom	0.5	15.0	26.0	4.37	33.08
	Site 4					
	Surface	0.5	15.5	29.2	5.61	36.84
	Middle	-	-	-	-	-
	Bottom	1.0	15.1	29.4	4.57	37.17
	Site 1					
Surface	0.5	14.8	30.6	3.39	37.89	
Middle	1.5	14.7	30.7	3.37	37.89	

Table 5. Surface water temperature (in degrees centigrade) collected from inside McNulty Slough levee breach, Eel River estuary, January 2008-June 2009.

Inner McNulty Slough Water Temps

Date	Site	1	2	3	4	5
29-Jan Time		1050	-	1030	-	930
2008 Temp °C		5.0	-	4.5	-	5.0
23-Apr Time		930	845	900	825	800
2008 Temp °C		10.0	8.5	8.0	9.5	10.5
21-May Time		1030	1000	930	900	-
2008 Temp °C		12.5	13.0	14.0	12.0	-
25-Jun Time		1315	1230	1300	1045	-
2008 Temp °C		16.5	17.0	17.5	17.0	-
20-Aug Time		1030	950	1005	930	920
2008 Temp °C		17.0	16.5	17.0	17.0	17.0
21-Apr Time		1455	1415	1440	-	-
2009 Temp °C		19.0	19.0	19.5	-	-
20-May Time		1100	1025	1045	1005	955
2009 Temp °C		16.0	15.0	15.0	15.5	15.5
16-Jun Time		1200	1115	1130	-	1050
2009 Temp °C		17.0	17.0	17.5	-	17.5

Management Recommendations

Continue to collect baseline information on fish use, water quality (preferably continuous data), hydrology, channel profiles, and tidal prism of main McNulty Slough and McNulty Slough on Ocean Ranch Unit (inner breach area) to help determine the best alternatives for future habitat restoration projects.

The muted tidal areas behind or influenced by the levee and levee breach (McNulty Slough and the inner breach area) support large numbers of important aquatic species such as Dungeness crab, redbtail perch, flatfish, and baitfish such as surfsmelt and topsmelt (Table 6). Several federal and/or state listed threatened species were also captured within main McNulty Slough, including Chinook salmon, coho salmon, steelhead, and longfin smelt. Since the conclusion of this survey, tidewater goby (a federally listed endangered species) have also been captured within the inner breach area (CDFW 2012).

Future management activities that could potentially benefit these species are being pursued. Alternatives will be developed to enhance aquatic habitat. Following further investigations, possible alternatives may include creating new levee breach/es and/or

channels, particularly at the southern end of the McNulty Slough levee. This would increase tidal exchange, tidal channel formation, and fish access (particularly for juvenile salmonids and tidewater goby) within the approximately 260 acre muted tidal area. A long term fisheries and water quality monitoring plan should be included in any management activity to identify changes in fish populations and water quality over time. The sporadic captures of many species, including and not limited to Chinook and coho salmon, steelhead, longfin smelt, and Sacramento pikeminnow during the three years of sampling demonstrates the need for regular long term sampling. A list of all species captured, inclusive of the 2007 fisheries sampling (CDFG 2008) is provided in Table 6 below.

Table 6. Complete list of species captured from main McNulty Slough (outer) and inside the levee breach (inner) on the Eel River Wildlife Area from February 2007 to June 2009.

Species	2007		2008		2009	
	Inner	Outer	Inner	Outer	Inner	Outer
Chinook salmon				X		X
Coho salmon						X
Steelhead		X		X		X
American shad				X		
Arrow goby						X
Bay pipefish	X	X		X		X
Buffalo sculpin				X		
Dace				X		
Dungeness crab	X	X	X	X	X	X
English sole			X	X	X	
Longfin smelt		X				X
Northern anchovy		X		X		
Pacific herring		X	X	X		X
Pacific staghorn sculpin	X	X	X	X	X	X
Prickly sculpin				X		
Redtail surfperch		X		X		
Sacramento pikeminnow					X	X
Saddleback gunnel	X	X	X	X	X	X
Shiner surfperch	X	X		X		X
Starry flounder	X	X	X	X	X	X
Surfmelt	X	X	X	X	X	X
Threespine stickleback	X	X	X	X	X	X
Tidepool sculpin		X		X		
Topsmelt	X	X	X	X		X
Unidentified larval smelt		X		X	X	

Species	2007		2008		2009	
	Inner	Outer	Inner	Outer	Inner	Outer
Unidentified juv. gunnels		X				
Unidentified juv. flatfish	X	X	X	X	X	X
Unidentified juv. minnow sp.				X		

Continue collaborative efforts within CDFW (began coordination meetings in March 2007), as well as with other agencies and entities to develop a comprehensive and coordinated Eel River estuary management plan that will lead to aquatic, as well as terrestrial, species and habitat benefits.

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Literature Cited

California Department of Fish and Game. 2008. McNulty Slough, Thence Eel River Estuary February through October, 2007. Field Note, January 2008.

California Department of Fish and Wildlife. 2012. Tidewater goby and water quality sampling. Ocean Ranch Unit, Eel River Wildlife Area Summer 2012.

Cannata, Steve. Personal Communication. 2007.

Pinnix, William D., and Peter A. Nelson, Gregory Stutzer, Katrina A. Wright. May 2012. Residence time and habitat use of coho salmon in Humboldt Bay, California: an acoustic telemetry study. *Environmental Biology of Fishes* (24 May 2012), pp. 1-9.