Tidewater Goby and Water Quality Sampling
Ocean Ranch Unit, Eel River Wildlife Area
Summer 2012
Federal Fish and Wildlife Permit # TE-60149A-0

Tidewater goby captured at the Ocean Ranch Unit

INTRODUCTION

In an ongoing fisheries, hydrology, and water quality monitoring effort to document current conditions and evaluate the potential for tidal marsh restoration on the California Department of Fish and Wildlife (CDFW) Ocean Ranch Unit (ORU) of the Eel River Wildlife Area (ERWA), CDFW surveyed for the federally endangered and California Species of Special Concern tidewater goby (*Eucyclogobius newberryi*) from June 13 through August 17, 2012. This was the first survey conducted specifically to determine tidewater goby presence or absence throughout the ORU (Figure 1).

The ORU is divided by levees into three sections. The 23.4 acre upper section and the 99.9 acre middle section were established to be maintained as freshwater habitats. The 258.1 acre lower section is the area currently influenced by the McNulty Slough levee breach and the area of proposed restoration.

Previous fisheries surveys conducted in the ORU have primarily focused on salmonids (CDFG 2008). In 2006, one survey targeting tidewater gobies was conducted in the ORU by CDFG and the U.S. Fish and Wildlife Service (USFWS), however this survey was limited to one day of sampling and focused only on the area of the interior levee breach that occurred in 1998 (Figure 2). No tidewater gobies were found at that time (CDFG 2006).

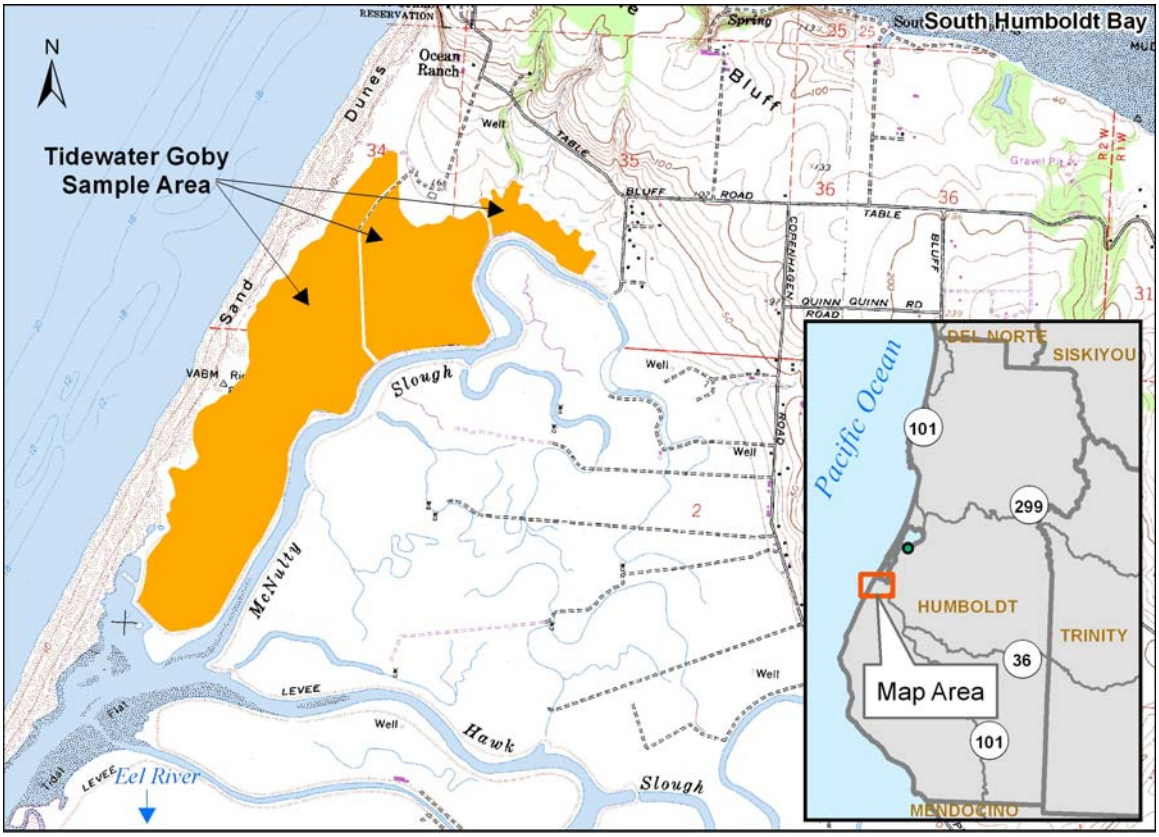

Figure1. Tidewater goby sample area, CDFW Ocean Ranch Unit of the Eel River Wildlife Area, located in Humboldt County.

MATERIALS AND METHODS

The recent sampling effort attempted to identify tidewater goby presence and habitat, as well as water quality within the ORU. CDFW survey protocol followed the guidelines established by the U. S. Fish and Wildlife Service Recovery Plan for the Tidewater Goby (USFWS, 2005). Habitat was evaluated by field crew leader. Slow moving water, ponded areas, and upper estuary habitats were considered to have the highest probability of finding gobies. When potential tidewater goby habitat was discovered, a site number was assigned and sampling was conducted. Sites were numbered by order of discovery. A 2 millimeter (mm) mesh, 1.3 x 3 meter (m) long seine was used to capture fish. Sampling was conducted until presence was confirmed or all potential tidewater goby habitat was adequately sampled. If tidewater goby were not detected at sites, the habitat potential of these sites was reevaluated. If habitat was determined to still be viable for tidewater goby presence, the sites were sampled a second time on another day. If during a subsequent site visit the area was deemed unsuitable (i.e. dewatered at low tide (Site 10, Appendix A)); survey crews noted why and did not survey the second time.

Water quality data was collected using YSI Inc. Model 55 and Professional Plus handheld multiparameter instrument. Dissolved oxygen (DO), salinity, specific conductivity and

water temperature parameters were recorded at least once at all sites (Table 2). Universal Transverse Mercator (UTM) locations, sampling time, site name and number, photographs, estimated average site depth, substrate type, percent aquatic vegetation, water clarity, high and low tide levels and times, weather, sampling gear used and personnel were also recorded.

RESULTS

Fish and Habitat Sampling

Thirty-one sites were sampled within the Upper, Middle, and Lower ORU sections (Figure 2). A total of 85 tidewater gobies were captured from 13 sites (Appendix A).

Three sample sites (27, 28, and 29) were selected within the upper section. Sites 27 and 29 were located in a borrow ditch along the inside of the McNulty Slough levee. Sites 27 and 29 each produced one tidewater goby (Figures 3 and 4). Site 28 was along a shallow bank on the northern edge of the section and did not produce any tidewater gobies (Appendix A). The following non target aquatic species were captured in the upper section: threespine stickleback, staghorn sculpin, larval unidentified fish species, *Crangon* shrimp, and amphipods (Appendix B).

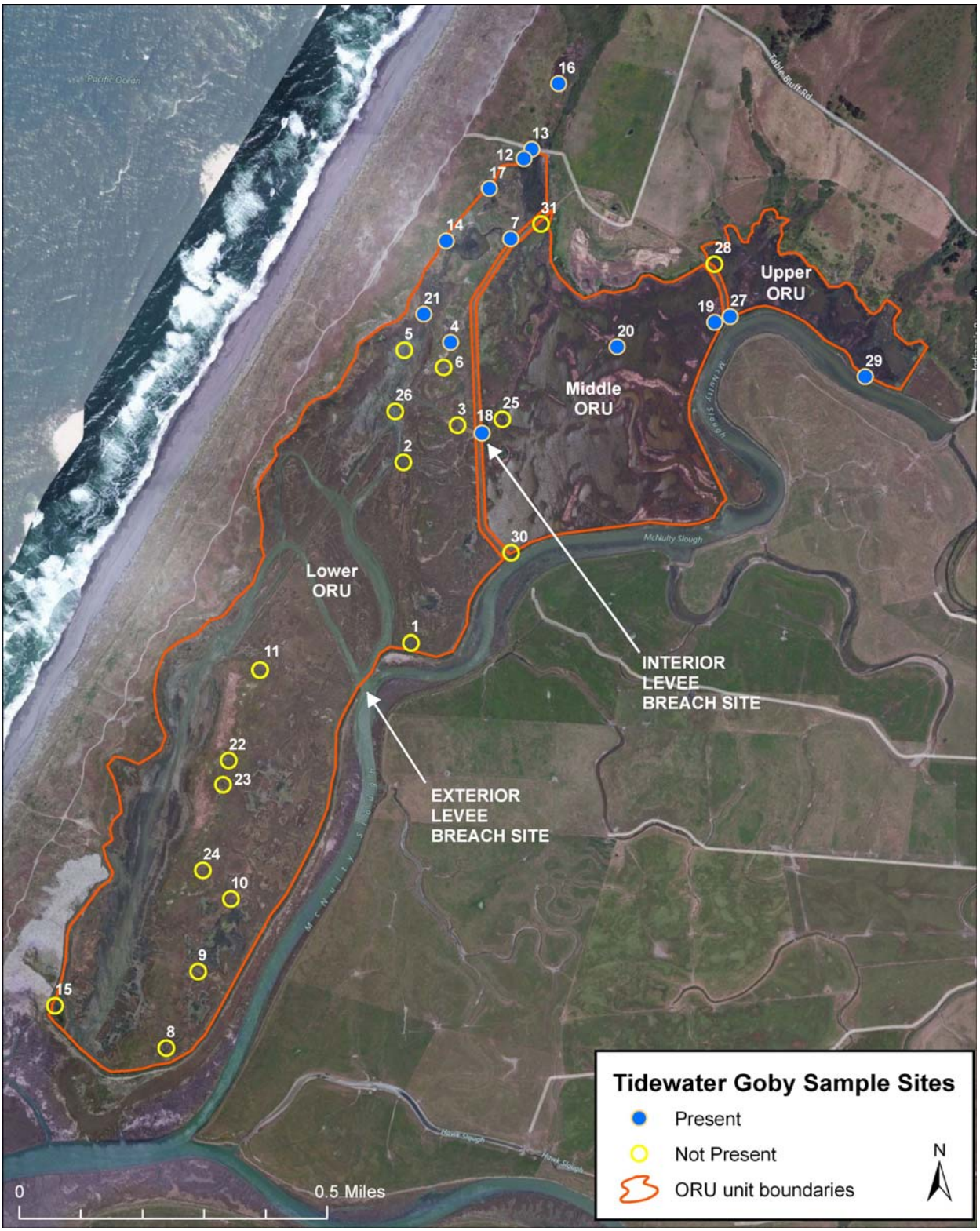

Figure 2. Ocean Ranch Unit, Eel River Wildlife Area. 2012 tidewater goby sample sites and detections in the upper, middle, and lower sections.

Figure 3. ORU Site 27 looking south.

Figure 4. ORU Site 29 looking east.

The 99.9 acre middle section is separated from the upper section by a levee with a flashboard riser and from McNulty slough by a levee and tide gate. The western edge of the section is completely isolated from the lower section by a solid levee. The middle section was sampled at six sites (18, 19, 20, 25, 30 and 31) (Appendix A). Site 18 was located along the western levee at the location of the 2007 repaired levee breach (Figure 5). One tidewater goby was captured during the first survey visit and two during the third visit. One tidewater goby was captured at site 19 which was located near the culvert connecting the middle and upper sections (Figure 6). Site 20 was located at roughly the center of the middle section (Figure 7). Three tidewater gobies were captured during the second visit to this site. Sampling crews did not capture any tidewater goby at Sites 25, 30, and 31 (Figure 2). The following non target aquatic species were captured in the middle section: threespine stickleback, Pacific staghorn sculpin, unidentified smelt, unidentified larval fish species, *Crangon* shrimp, and amphipods (Appendix B).

Figure 5. ORU Site 18 at interior breach site.

Figure 6. ORU Site 19 looking south.

Figure 7. ORU Site 20 looking north.

The 258.1 acre salt marsh/lower section was sampled at twenty-two sites and produced tidewater gobies at eight of the sampled locations. All eight of the sites where gobies were captured are located at the northern end of the lower section (Figure 2). These sites from north to south were 16, 13, 12, 17, 7, 14, 21 and 4 (Figures 8, 9, 10, 11, 12, 13, 14, and 15, respectively). These sites, with the exception of Site 4, are located within a series of interconnected ponds and channels. Site 4 is an isolated pond that is likely only inundated during high flow and/or tidal events. The following non target aquatic species were captured at these sites: threespine stickleback, Pacific staghorn sculpin, saddleback gunnel, unidentified smelt, unidentified larval fish species, *Crangon* shrimp, amphipods, and unidentified juvenile crab species (Appendix B).

Figure 8. ORU Site 16 looking north.

Figure 9. ORU Site 13 looking northeast.

Figure 10. ORU Site 12 looking north.

Figure 11. ORU Site 17 looking south.

Figure 12. ORU Site 7 looking south.

Figure 13. ORU Site 14 looking southeast.

Figure 14. ORU Site 21 looking north.


Figure 15. ORU Site 4 looking north.

South of Site 4, much of the habitat consists of major slough channels with velocities too great for tidewater goby and minor channels and flooded tidal mud flats that dewater at low tide. A small number of channels and ponds held water at low tide and were surveyed for tidewater gobies. Six sites were sampled (5, 6, 3, 26, 2 and 1), none of which produced tidewater gobies. Other species captured at these sites included: arrow goby, threespine stickleback, Pacific staghorn sculpin, saddleback gunnel, starry flounder, unidentified goby species, unidentified smelt, unidentified larval fish species, *Crangon* shrimp, amphipods, unidentified juvenile crab species, and nudibranchs (Appendix B). South of the McNulty slough breach is an island surrounded by a borrow ditch on one side and a large slough channel on the other. The tidal flow velocity of both channels is likely too high for tidewater gobies to settle. The interior of the island contained minor channels and flooded tidal mud flats, many of which dewater at low tide. The west side of the island contained a number of small ponds that are not likely subjected to frequent tidal inundation. Water depths of the ponds were measured at six inches or less and many did not contain any fish. Seven sites were sampled in this area (11, 22, 23, 24, 10, 9 and 8) and no tidewater goby were captured. Other species captured at these sites include: threespine stickleback, Pacific staghorn sculpin, *Crangon* shrimp, and amphipods (Appendix B). Site 15 was a small freshwater pond at the southern tip of the lower section. The pond is completely enclosed by levees from the lower section and from McNulty slough. Only threespine sticklebacks were captured at Site 15 (Appendix B).

Incidental observations of California Endangered Species Act (CESA) listed species and CA species of special concern (CSCC) at the ORU were recorded during the survey. One northern red-legged frog (*Rana aurora)* (CSCC) was observed at Site 15 on June 26, 2012. One bald eagle (*Haliaeetus leucocephalus*) (CESA Endangered) and one osprey (*Pandion haliaetus*) (CSSC) were observed at Site 3 on July 18, 2012.

Tidewater Goby Total Lengths

Total lengths (TL) were taken from 32 tidewater goby that were large enough to safely handle (Table 1). Measured tidewater goby total lengths ranged from 20 to 56mm with an average of 33.91 mm. No known mortalities occurred. Site specifics are depicted in Table 1 below.

Table 1. Tidewater goby total lengths.

			TL range (mm)		TL average (mm)
Date	Site	n	min	max	
6/15/2012	4	12	21	25	23.17
	7	1	49	49	49.00
6/22/2012	12	1	42	42	42.00
	13	3	46	50	48.00
	14	1	48	48	48.00
6/28/2012	16	1	46	46	46.00
	17	1	26	26	26.00
	18	1	32	32	32.00
7/3/2012	19	1	25	25	25.00
7/12/2012	12	3	50	52	51.00
7/23/2012	14	1	20	20	20.00
	21	1	56	56	56.00
7/24/2012	20	3	30	32	31.33
	27	1	46	46	46.00
	29	1	26	26	26.00
Grand Total		32	20	56	33.91

Water Quality

Water quality measurements were taken at mid water column at all sites prior to seining or in undisturbed water near the seine set. Dissolved oxygen measurements were not reported at some locations due to equipment malfunctions. Water quality characteristics were highly variable between sites. At all sites sampled during the monitoring period, temperature ranged from 13.8 to 28.1°C with an average of 20.0°C. Salinity ranged from 4.2 to 38.8ppt and dissolved oxygen ranged from 0.1 to 23.6 mg/l. At sites where tidewater gobies were captured, salinity ranged from 7.3 to 37.7 ppt. Other parameters were equally variable between tidewater goby occupied sites. Water temperatures ranged from 15.9 to 26.0°C and dissolved oxygen ranged from 2.10 to 12.1 mg/l (Table 2).

Discussion

Tidewater goby are known to occupy other portions of the CDFW Eel River Wildlife Area and eel estuary (CDFG 2010, USFWS 2010 and 2011). They had not yet been detected within the Ocean Ranch Unit of ERWA prior to this effort.

Although presence of tidewater goby was determined in ORU, abundance estimates were not made. The largest tidewater goby catches were recorded at Sites 4, 12, and 13 (Appendix A). Site 13 results were notable due to the capture of larval tidewater goby. In one seine haul, 19 larval goby were captured. The large number of larval gobies would suggest site 13 could be nursery habitat.

At this time, the northern portion of the lower ORU section is clearly the most suitable tidewater goby habitat. Additional time should be spent to further characterize the existing habitat. These sites were characterized by a wider diversity of estuarine species (e.g. gunnels, crabs). This more diverse estuarine species composition would be expected throughout the southern portion of the lower ORU section if habitat restoration occurred to increase tidal inundation in the lower ORU. At this time, suitable tidewater goby habitat is lacking in the southern area of the lower ORU.

Similar to previous tidewater goby survey results by USFWS, water quality data collected during this effort was highly variable where tidewater goby were found; therefore, conclusions about TWG presence/absence could not be made based on water quality (USFWS 2006).

Future habitat restoration activities will need to consider existing occupied tidewater goby habitat. There is potential to improve and increase tidewater goby habitat in the ORU. CDFW will continue to work closely with USFWS and many other partners as multi-species habitat restoration planning moves forward for Ocean Ranch Unit.

It will be important to conduct additional fisheries, habitat, and water quality monitoring within ORU prior to and following future habitat restoration.

Table 2. Water quality recorded at the ORU tidewater goby sample sites 2012.

			Temp	Salinity	DO		Sp Cond	Depth from	Low Tide		High Tide	
	Date	Time	°C	ppt	mg/l	% DO	µS/cm	Surface (m)	Time	Height (ft)	Time	Height (ft)
Site 1	06/13/12	12:21	18.8	25.1	7.1	87.3	34220	0.30	8:20	1.2	13:46	2.0
	07/18/12	10:25	15.9	27.2	4.5	56.0	42287	0.30	6:19	-0.6	12:59	5.3
Site 2	06/13/12	14:15	19.8	24.2	5.4	68.7	34080	0.30	8:20	1.2	13:46	2.0
	07/11/12	9:45	18.6	27.1	4.9	61.6	42130	0.20	12:00	2.1	6:27	4.3
Site 3	06/15/12	9:00	13.8	23.0	4.2	45.8	28610	0.61	15:27	2.7	10:39	4.4
	07/18/12	13:39	21.0	22.6	5.7	73.2	35933	0.30	6:19	-0.6	12:59	5.3
Site 4	06/15/12	10:35	15.9	27.7	7.0	85.2	35480	0.30	15:27	2.7	10:39	4.4
	07/23/12	9:31	18.7	34.4	5.3	65.7	52221	0.05	9:12	0.2	15:49	6.5
Site 5	06/15/12	11:45	18.8	23.9	8.2	98.4	33130	0.20	15:27	2.7	10:39	4.4
Site 6	06/15/12	12:43	28.1	35.1	7.4	105.4	55700	0.10	15:27	2.7	10:39	4.4
	07/23/12	9:58	20.1	38.8	3.8	118.1	58085	0.46	9:12	0.2	15:49	6.5
Site 7	06/15/12	13:21	23.2	22.2	*	*	34300	0.15	15:27	2.7	10:39	4.4
Site 8	06/18/12	10:55	21.8	30.8	*	*	44330	0.08	6:08	-0.7	12:52	5.0
Site 9	06/18/12	11:15	19.2	27.1	*	*	37460	0.15	6:08	-0.7	12:52	5.0
	07/17/12	12:50	16.2	13.6	4.0	43.7	22446	0.15	5:43	-0.4	12:26	5.1
Site 10	06/18/12	12:00	22.8	27.4	*	*	40840	0.15	6:08	-0.7	12:52	5.0
Site 11	06/18/12	13:26	23.5	29.9	*	*	44750	0.15	6:08	-0.7	12:52	5.0
	07/17/12	13:57	19.9	30.0	23.6	254.0	46206	0.10	5:43	-0.4	12:26	5.1
Site 12	06/22/12	11:17	16.3	7.9	*	*	11420	0.15	8:29	-0.8	15:17	5.4
	07/12/12	10:10	17.9	27.3	7.2	90.9	42771	0.15	7:47	4.1	12:52	2.7
	08/17/12	11:20	19.6	29.5	8.8	112.6	45506	0.30	6:21	-0.3	12:49	6.0
Site 13	06/22/12	11:40	20.0	21.3	*	*	30640	0.30	8:29	-0.8	15:17	5.4
Site 14	06/22/12	12:36	17.5	20.8	*	*	28390	0.08	8:29	-0.8	15:17	5.4
	07/23/12	12:45	26.0	28.2	11.6	167.5	43269	0.20	9:12	0.2	15:49	6.5
	08/17/12	12:30	19.4	32.8	11.4	146.7	49952	0.25	6:21	-0.3	12:49	6.0
Site 15	06/28/12	NA	23.3	4.2	4.8	58.7	7521	0.30	12:55	1.9	7:33	4.4
	07/31/12	13:30	18.6	4.6	0.1	1.7	8278	1.22	16:56	2.4	11:51	5.6
Site 16	06/28/12	10:15	21.1	7.3	5.3	67.5	12606	0.20	12:55	1.9	7:33	4.4
Site 17	06/28/12	11:26	23.8	20.2	12.1	163.3	32298	0.15	12:55	1.9	7:33	4.4
Site 18	06/28/12	12:17	22.3	30.4	6.5	91.3	46875	0.30	12:55	1.9	7:33	4.4
	07/12/12	12:00	18.7	33.4	7.9	104.1	51191	0.30	12:52	2.7	7:47	4.1
	08/17/12	14:00	20.6	37.7	10.2	140.2	56515	0.30	6:21	-0.3	12:49	6.0
Site 19	07/03/12	11:00	16.8	28.5	6.1	73.9	45472	0.30	6:14	-1.8	12:57	5.7
Site 20	07/03/12	12:10	20.0	31.0	9.6	125.2	47481	0.30	6:14	-1.8	12:57	5.7
	07/24/12	11:30	19.2	32.8	7.9	103.9	49976	0.30	9:51	0.8	16:29	6.7
Site 21	07/11/12	11:27	18.0	27.4	7.6	93.6	42508	0.30	12:00	2.1	6:27	4.3
	07/23/12	11:47	21.8	27.5	8.5	114.6	42714	0.30	9:12	0.2	15:49	6.5
Site 22	07/17/12	11:08	17.1	28.9	1.7	21.0	44749	0.10	5:43	-0.4	12:26	5.1
Site 23	07/17/12	11:19	17.6	30.9	4.1	51.3	47953	0.10	5:43	-0.4	12:26	5.1
Site 24	07/17/12	12:00	18.3	20.2	6.7	79.7	32258	0.08	5:43	-0.4	12:26	5.1
Site 25	07/18/12	12:38	22.6	30.3	9.5	134.4	46567	0.18	6:19	-0.6	12:59	5.3
Site 26	07/23/12	10:39	22.8	24.4	4.6	61.2	38374	0.20	9:12	0.2	15:49	6.5
Site 27	07/24/12	9:30	16.8	31.1	2.1	26.1	47776	0.30	9:51	0.8	16:29	6.7
Site 28	07/24/12	10:40	18.7	27.0	8.0	100.3	42016	0.20	9:51	0.8	16:29	6.7
Site 29	07/24/12	13:15	24.0	14.9	3.1	39.5	24468	0.30	9:51	0.8	16:29	6.7
Site 30	07/30/12	11:05	20.3	32.6	13.4	177.5	49708	0.15	15:58	2.7	11:03	5.2
Site 31	07/30/12	13:00	22.9	37.1	9.6	137.3	55863	0.25	15:58	2.7	11:03	5.2

* No data collected due to equipment malfunction.

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Appendix A. Seine effort and tidewater goby (TW Goby) captured per site at the ORU 2012.

Date	Effort	Sites																															
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Totals
06/13/12	Seines	2	5																														
	tw goby	0	0																														
06/15/12	Seines			3	4	4	1	8																									
	tw goby			0	12	0	0	2																									
06/18/12	Seines								2	3	2	1																					
	tw goby								0	0	0	0																					
06/22/12	Seines												1	1	2																		
	tw goby												1	22	1																		
06/26/12	Seines															16																	
	tw goby															0																	
06/28/12	Seines																3	1	1														
	tw goby																2	1	1														
07/03/12	Seines																			1	3												
	tw goby																			1	0												
07/11/12	Seines		10																			3											
	tw goby		0																			0											
07/12/12	Seines							5					1						3														
	tw goby							0					3						0														
07/17/12	Seines									5	0*	1											1	3	2								
	tw goby									0	0	0											0	0	0								
07/18/12	Seines	3		5																						8							
	tw goby	0		0																						0							
07/23/12	Seines				2		1								1							2					3						
	tw goby				0		0								2							1					0						
07/24/12	Seines																				2							2	3	2			
	tw goby																				3							1	0	1			
07/30/12	Seines																														6	5	
	tw goby																														0	0	
07/31/12	Seines															6																	
	tw goby															0																	
08/17/12	Seines												1		1				1														
	tw goby												28		1				2														
Number of Seines		5	15	8	6	4	2	13	2	8	2	2	3	1	4	22	3	1	5	1	5	5	1	3	2	8	3	2	3	2	6	5	152
Number of gobies		0	0	0	12	0	0	2	0	0	0	0	32	22	4	0	2	1	3	1	3	1	0	0	0	0	0	1	0	1	0	0	85

* Site was assessed however no seining was attempted due to low water.

Appendix B. Fish and other aquatic species identified as present at sampling sites at the ORU 2012.

Site	Date	Tidewater Goby	Threespine Stickleback	Pacific Staghorn Sculpin	Saddleback Gunnel	Starry Flounder	Larval Fish Species	Unidentified Goby	Arrow Goby	Smelt Species	Amphipod Species	*Crangon* Shrimp	Juvenile Crab Species	Nudibranch Species
1	6/13/12		x	x	x							x	x	
	7/18/12		x	x	x	x					x	x	x	
2	6/13/12		x	x	x		x	x				x		
	7/11/12		x	x	x		x	x		x	x	x	x	x
3	6/15/12		x	x			x					x		
	7/18/12		x	x			x		x		x	x	x	
4	6/15/12	x	x									x		
	7/23/12		x								x	x		
5	6/15/12		x	x			x					x		
6	6/15/12													
	7/23/12		x											
7	6/15/12	x	x	x										
	7/12/12		x	x	x						x			
8	6/18/12		x											
9	6/18/12		x	x								x		
	7/17/12		x	x							x	x		
10	6/18/12		x	x										
	7/17/12													
11	6/18/12		x											
	7/17/12		x											
12	6/22/12	x	x	x										
	7/12/12	x	x								x			
	8/17/12	x	x								x	x		
13	6/22/12	x	x											
14	6/22/12	x	x	x										
	7/23/12	x	x								x			
	8/17/12	x	x											
15	6/26/12		x											
	7/31/12		x											
16	6/28/12	x	x				x							
17	6/28/12	x	x				x				x			
18	6/28/12	x	x	x								x		
	7/12/12		x								x	x		
	8/17/12	x	x								x	x		
19	7/3/12	x	x								x	x		

Site	Date	Tidewater Goby	Threespine Stickleback	Pacific Staghorn Sculpin	Saddleback Gunnel	Starry Flounder	Larval Fish Species	Unidentified Goby	Arrow Goby	Smelt Species	Amphipod Species	*Crangon* Shrimp	Juvenile Crab Species	Nudibranch Species
20	7/3/12		x				x				x	x		
	7/24/12	x	x				x				x	x		
21	7/11/12		x	x							x		x	
	7/23/12	x	x	x							x			
22	7/17/12													
23	7/17/12		x											
24	7/17/12		x											
25	7/18/12		x							x	x			
26	7/23/12		x	x	x		x	x			x	x	x	x
27	7/24/12	x	x	x							x	x		
28	7/24/12		x				x				x			
29	7/24/12	x	x				x							
30	7/30/12		x	x						x	x	x		
31	7/30/12		x											

*Unidentified gobies were determined not to be tidewater goby and were not positively identified to species.