Annual Project Performance Report

1. State: California
Grant number: F-51-R

Grant name: California Inland and Anadromous Sport Fish Management and Research

Project number and name: Project 67: Humboldt Bay Juvenile Salmonid Investigations

2. Report Period: July 1, 2006 through June 30, 2007
Report due date: September 15, 2007

3. Location of work: Humboldt Bay, Humboldt County California, State Congressional District 1

4. Costs: This is no longer required by California Nevada Operations Office (USFWS).

5. Objectives:
1. To describe the use of the tidal portion of Freshwater Creek, Humboldt Bay, by juvenile salmonids.
2. To describe the use of the tidal portion of Elk River, Humboldt Bay, by juvenile salmonids.
3. To describe the use of the tidal portion of Salmon Creek, Humboldt Bay, by juvenile salmonids.
4. To describe the use of the tidal portions of selected smaller Humboldt Bay tributaries by juvenile salmonids.

6. If the work in this grant was part of a larger undertaking with other components and funding, present a brief overview of the larger activity and the role of this project.
This work is being augmented by California Fisheries Restoration Grant Program to pay for Pacific States Marine Fisheries Commission fishery technicians to conduct the field sampling and a small portion of O&E. Aid in Sport Fish Restoration funds are being used to pay for project biologist, O&E, and a small portion of temporary help for project field work.

This project is also collecting juvenile salmonid emigration timing and relative abundance data to document existing conditions prior to marsh restoration projects already ongoing or planned in the tidal portion of Freshwater Creek Slough, Salmon Creek estuary, Rocky Gulch, Wood Creek, Jacoby Creek, Gannon Slough, and Martin Slough by other government and private agencies.

7. Describe how the objectives were met. See "Supplemental Information" for additional requirements and "Attachments" for specialized tables.

Introduction

California salmonid populations have declined considerably from historic levels (Brown et al. 1994, Weitkamp et al. 1995; Busby et al. 1996; Myers et al. 1998; CDFG 2002). Humboldt Bay tributary populations of coho salmon, *Oncorhynchus kisutch*, Chinook salmon, *O. tshawytscha*, and steelhead trout, *O. mykiss*, have been listed as threatened by NOAA Fisheries and coho salmon have been listed as threatened by the State of California. The State of California also enacted the Salmon, Steelhead and Anadromous Fisheries Program Act (SB 2261) in 1988 that directed California Department of Fish and Game (CDFG) to develop a statewide plan and program with the objective of doubling the State's natural anadromous fish production by the end of the 20th century.

Estuaries are important habitat for juvenile salmonids and other popular sport fish species. Numerous studies have documented extended estuarine residence by juvenile Chinook salmon (Reimers 1971; Healey 1982; Kjelson et al.1982; Healey 1991; Wallace 2000), coho salmon (Miller and Sadro 2003; Nielsen 1994; Tschaplinski 1982) and sea-run coastal cutthroat trout (Trotter 1997; Northcote 1997; CDFG 2000; CDFG 2001). Wallace (2006) reported that juvenile salmonids, especially young-of-the-year (yoy) coho salmon, rear in Freshwater Creek Slough for significant periods of time making this tidal area important rearing habitat for juvenile salmonids. Prior to this study virtually nothing was known about juvenile salmonid use of Humboldt Bay or the sloughs and tidal portion of its tributaries. Humboldt Bay tributaries support some of the last significant populations of wild coho salmon remaining in California (Brown et al. 1994), as well as Chinook salmon, steelhead trout, and coastal cutthroat trout. An ongoing study by California Department of Fish and Game's (CDFG) Anadromous Fisheries Resource Assessment and Monitoring Program (AFRAMP) made observations that suggest yoy coho salmon and age 1 steelhead may rear downstream of the head of the tide during the spring and summer, then migrate back into Freshwater Creek to over-winter before emigrating to the ocean the following year. Miller and Sadro (2003) documented that yoy coho migrate to the tidal portion of Winchester Creek (a tributary of South Slough, Coos Bay, Oregon) and adjacent tidal freshwater marshes and rear for up to 8 months. CDFG's Natural Stocks Assessment Project (NSA) sampled Freshwater Creek Slough in 2003 and 2004 and found that some yoy coho salmon reared throughout the summer and into the fall and that yoy Chinook salmon reared for up to 8 weeks in Freshwater Creek Slough in 2003.

The majority of tidal wetlands around Humboldt Bay have been diked and converted to pasture land during the past 150 years (HBWAC 2005). Currently, historic pieces marshland habitat around Humboldt Bay are being acquired by various public agencies and numerous marsh restoration projects are being planned or implemented near Humboldt Bay tributaries such as Wood Creek and Fay Slough (tributaries to Freshwater Creek Slough), Martin Slough (tributary to Elk River Slough), Salmon Creek, Rocky Gulch, McDaniel Slough, Jacoby Creek, and Gannon Slough. Most if not all Humboldt Bay sloughs are now contained between levees and their adjacent marshes converted to pasture lands. Restoring these marshes will likely benefit coho salmon and steelhead trout as well as juvenile Chinook salmon, coastal cutthroat trout and other estuarine fishes.

During the duration of this contract period (2006-2007) NSA continued to sample the tidal portion of Freshwater Creek Slough, Elk River Slough, and Salmon Creek estuary to document their use by juvenile salmonids. Starting in 2007 NSA began sampling smaller Humboldt Bay tributaries such as Rocky Gulch, and Wood Creek to determine if juvenile salmonids use these very small estuaries as rearing habitat or if they offer over wintering habitat during high stream flow events. By describing life history traits and habitat needs of juvenile coho salmon, Chinook salmon, steelhead trout, and sea-run coastal cutthroat trout this project hopes to provide important data to the restoration community to help restoration planning projects succeed. This

project will provide “snapshots” of juvenile salmonid use of these areas before and after restoration projects.

Methods

NSA conducted weekly sampling for juvenile salmonids in Freshwater Creek Slough and Elk River Slough, Humboldt Bay from July 2006 through June 2007 (Figure 1). In Hookton Slough/Salmon Creek NSA conducted weekly sampling from July to December 2006 and biweekly sampling from January to June 2007. NSA used a 100 ft X 5 ft seine net to capture fish in lower Freshwater Creek, Elk River, and Hookton Sloughs, and a 30 ft X 4 ft seine net to capture fish in upper Freshwater Creek, Elk River, and Salmon Creek Sloughs. I stratified sampling between the upper and lower sloughs due to differences in water salinity and the need to use different gear types between the upper and lower sections of the sloughs (Figure 1). NSA also initiated monthly sampling in numerous smaller Humboldt Bay tributaries in 2006 and 2007. We used a 100 ft X 5 ft seine net to capture fish in Martin Slough pond; a 30 ft X 4 ft seine to capture fish in the slough sections of Martin Slough and Rocky Gulch; and minnow traps baited with frozen salmon roe in sections of Martin Slough, Rocky Gulch, and Wood Creek where we were unable to seine (Figure 1). NSA also assisted AFRAMP with the operation of a juvenile fish weir set up at the Humboldt Fish Action Council (HFAC) weir site in upper Freshwater Creek Slough to capture juvenile salmonid smolts emigrating from Freshwater Creek. The HFAC weir was run in conjunction with another AFRAMP weir located about 3 km upstream in order to generate coho salmon and steelhead smolt production estimates passing each weir. This allowed us to segregate smolt production between the approximate 3 km of estuarine/freshwater ecotone between the weirs from the approximately 23 km of stream habitat above the upstream weir. NSA applied passive integrated transponder (PIT) tags to all healthy juvenile salmonids $\geq$70 mm FL to gather residency, movement, and growth information while they were in the estuary.

Results

Freshwater Creek Slough

July-December 2006. During July-December 2006 young-of-the-year (yoy) coho salmon were by far the most common salmonid captured in upper Freshwater Creek Slough (Table 1). The peak catch of yoy coho salmon was 3.92 fish/set and it occurred in late July (peak catches for the calendar year occurred in late June). Their weekly mean FL increased from 69 mm in mid July to 100 mm in mid November. Based on marked and recaptured individuals yoy coho salmon resided in the tidal freshwater portion of Freshwater Creek Slough throughout the summer. Most project marked yoy coho salmon were recaptured at the same site where they were originally marked indicating that they moved very little while residing in the slough. We also commonly captured juvenile steelhead trout in the upper slough. Their peak catch of 0.33 fish/set occurred in early July, though we captured them throughout the sampling season. We captured cutthroat trout in the upper slough throughout the year and their peak catch was 0.42 fish/set in late September. No yoy Chinook salmon or yearling and older (yearling) coho salmon were captured in the upper slough during this time period.

We captured very few juvenile salmonids in lower Freshwater Creek Slough during July-December 2006 (Table 2). We captured two yoy Chinook salmon, both in the same week in early July (0.29 fish/set), and their mean FL was 86 mm. We captured three yearling coho salmon in lower Freshwater Creek Slough from early July to early August. Their FL’s ranged from 98 to 144 mm. We captured four yoy coho salmon from early October to late November. Their FL’s ranged from 55 to 119 mm. We did not capture any other juvenile salmonids in the lower slough during this time period.

PIT Tag Results for 2006. The yoy coho salmon PIT tagged by NSA resided in the tidal freshwater portion of Freshwater Creek Slough throughout the summer. We applied PIT tags

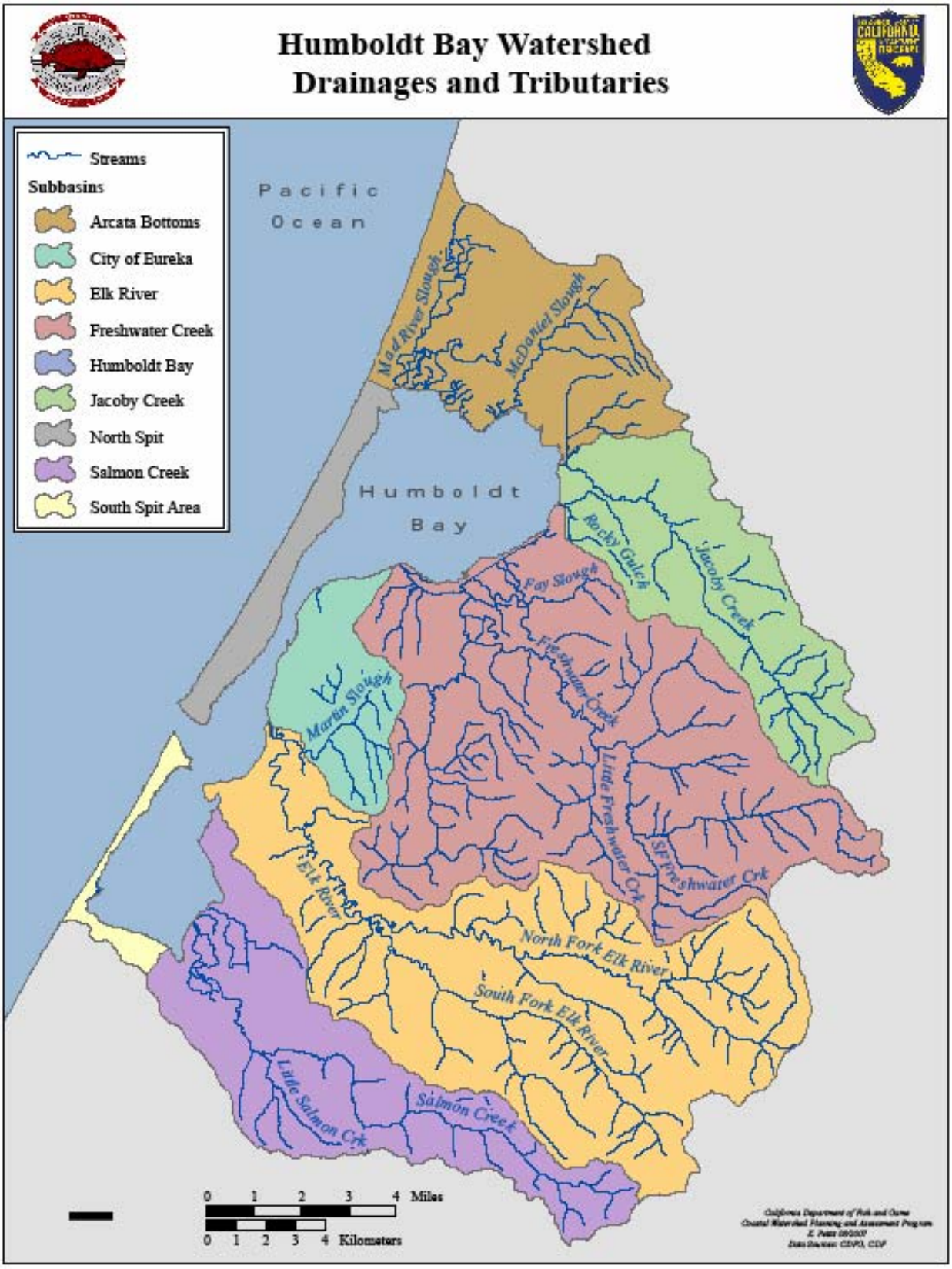

Figure 1. Map of Humboldt Bay tributaries.

Table 1. Monthly catch-per-unit-effort (CPUE) and fork length (FL) in millimeters of young-of-the-year (yoy) Chinook salmon, yoy coho salmon, yearling and older coho salmon, juvenile steelhead trout, and cutthroat trout in upper Freshwater Creek Slough, July-December 2006. CPUE is number of fish per seine haul.

		YOY Chinook			YOY Coho			Yearling Coho			Steelhead			Cutthroat		
Month	No. Sets	CPUE	Mean FL	Range	CPUE	Mean FL	Range	CPUE	Mean FL	Range	CPUE	Mean FL	Range	CPUE	Mean FL	Range
July	48	0	-	-	2.40	73	57-93	0	-	-	0.17	87	69-131	0.06	215	170-258
Aug	60	0	-	-	1.72	78	64-95	0	-	-	0.15	106	76-186	0.05	185	141-257
Sept	48	0	-	-	0.85	86	69-102	0	-	-	0.02	175	175	0.10	257	233-276
Oct	44	0	-	-	0.73	95	82-111	0	-	-	0.05	139	113-165	0.05	234	278-290
Nov	40	0	-	-	0.38	93	84-110	0	-	-	0	-	-	0	-	-
Dec	24	0	-	-	0.08	64	58-69	0	-	-	0.13	81	52-131	0.04	69	69

Table 2. Monthly catch-per-unit-effort (CPUE) and fork length (FL) in millimeters of young-of-the-year (yoy) Chinook salmon, yoy coho salmon, yearling and older coho salmon, juvenile steelhead trout, and cutthroat trout in lower Freshwater Creek Slough, July-December 2006 CPUE is number of fish per seine haul.

		YOY Chinook			YOY Coho			Yearling Coho			Steelhead			Cutthroat		
Month	No. Sets	CPUE	Mean FL	Range	CPUE	Mean FL	Range	CPUE	Mean FL	Range	CPUE	Mean FL	Range	CPUE	Mean FL	Range
July	28	0.07	86	80-92	0	-	-	0.07	118	98-137	0	-	-	0	-	-
Aug	34	0	-	-	0	-	-	0.03	144	144	0	-	-	0	-	-
Sept	28	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-
Oct	34	0	-	-	0.03	94	94	0	-	-	0	-	-	0	-	-
Nov	20	0	-	-	0.15	82	55-119	0	-	-	0	-	-	0	-	-

Table 3. Summary of residence times of young-of-the-year (yoy) coho salmon, yearling and older coho salmon, juvenile steelhead trout, and cutthroat trout based on Passive Integrated Transponder (PIT) tag data in Freshwater Creek Slough, January-December 2006. Mean days at liberty (DAL) and mean growth rates were not calculated for recaptured fish with sample sizes of less than 10. Growth rates are millimeters per day and mean growth rates were calculated for fish at large greater than 14 days except where noted.

Species	Number Tagged	Number Recaptured	Percent Recaptured	Mean DAL	Range DAL	Percent Recap at Same Site	Number With DAL >13 Days	Mean Growth Rate	Range Growth Rate
Yoy Coho	237	57	24.1	33	5-106	94.7	46	0.15	0.00-0.29
1+ Coho	81	4	4.9	-	5-11	100	0	-	-
Steelhead	73	8	11.0	-	4-339	100	4	-	0.09-0.39
Cutthroat	26	2	7.7	-	62-385	100	2	-	0.15-0.16

to 237 yoy coho in 2006 and recaptured 57 (24.1%) of them (Table 3). Their mean length of residence was 33 days and ranged from 5 to 106 days. Based on the arrival of yoy coho to the slough in April and the little movement they showed it is very likely that yoy coho resided in the slough one to two months before they were large enough to tag. Therefore, the residence times reported in this report should be considered minimum residence times. Fifty four out of 57 (94.7%) project marked yoy coho salmon were recaptured at the same site where they were originally marked indicating that they moved very little while residing in the slough. The mean growth rate of the 46 recaptured yoy coho salmon at large for at least two weeks was 0.15 mm/day and ranged from 0 to 0.29 mm/day (Table 3). We applied PIT tags to 81 yearling coho in 2006 and recaptured four (4.9%) of them (Table 3). Their estuarine residence ranged from 5 to 11 days. All project marked yearling coho were recaptured at the same site where they were marked indicating that they moved very little while residing in the slough. We also captured another 30 yearling coho that were tagged by other projects in the Freshwater Creek basin. No PIT tagged yearling coho were at large for at least two weeks; however, the fish at large for 11 days grew 0.64 mm/day. We applied PIT tags to 73 juvenile steelhead in 2006 and recaptured eight (11.0%) of them (Table 3). They were at large for 4 to 339 days. All fish were recaptured at the same site where they were marked. We also captured another 7 juvenile steelhead that were tagged by other projects in the Freshwater Creek basin. The growth rates of the four recaptured juvenile steelhead at large for at least two weeks ranged from 0.09 to 0.39 mm/day. The fish at large for 339 days (3/8/05-2/10/06) was marked at 81 mm FL and grew to 213 mm FL. We applied PIT tags to 26 cutthroat trout in 2006 and recaptured two (7.7%) of them (Table 3). One was at large for 62 days and the other for 385 days. Both fish were recaptured at the same site where they were marked. We also captured another 5 cutthroat trout that were tagged by other projects in the Freshwater Creek basin. The growth rates of the recaptured cutthroat trout was 0.16 mm/day for the fish at large for 62 days (5/18-7/19) and 0.15 mm/day for the fish at large 385 days (7/18/05-8/7/06). It is likely that some of the cutthroat trout captured by our project were resident adult fish.

January-June 2007. We captured very few salmonids in upper Freshwater Creek Slough prior to April (Table 4). NSA captured yearling coho salmon from mid March to mid June. Their peak catches occurred in April and May with a high of 7.75 fish/set in late April and 3.58 fish/set in mid May. Their weekly mean FL's varied little throughout the spring ranging from 97 to 102 mm from mid April to mid June. NSA captured yoy coho salmon from mid April to late June and the peak catch of 2.25 fish/set occurred in mid June. Their CPUE was much higher this year than last year. Their weekly mean FL increased from 41 mm in mid April to 71 mm in late June. NSA captured yoy Chinook salmon from mid May to late June with the peak catch of 2.17 fish/set occurring in late May. Their weekly mean FL increased from 41 mm in mid May to 65 mm in late June. NSA captured a total of 24 juvenile steelhead from early April to late June with the peak catch of 0.83 fish/set occurring in late May. Their FL's ranged from 73 to 229 mm (Table 4). NSA captured 11 cutthroat trout from mid March to late June with no discernable peak catch. Their FL's ranged from 90 to 196 mm (Table 4).

We captured very few juvenile salmonids in lower Freshwater Creek Slough from January to June 2007 (Table 5). NSA captured yearling coho salmon from mid April to mid May. We captured only 11 yearling coho from January-June 2007 compared to 19 and 122 during the same time periods in 2006 and 2005, respectively. Our peak 2006 catches of yearling coho salmon occurred in mid April. Their weekly mean FL increased from 95 mm in mid April to 122 mm in late April and then decreased to 107 mm in May. NSA captured one yoy coho salmon in early May and it was 42 mm FL. NSA captured a total of eight yoy Chinook salmon from mid May to late June with the peak catch of 0.50 fish/set occurring in mid June. Their FL's ranged from 45 to 72 mm (Table 5). NSA captured a total of five juvenile steelhead from early March to mid May. Their FL's ranged from 109 to 253 mm (Table 5). NSA captured a total of four cutthroat trout from mid April to mid June. Their FL's ranged from 144 to 310 mm (Table 5).

Table 4. Monthly catch-per-unit-effort (CPUE) and fork length (FL) in millimeters of young-of-the-year (yoy) Chinook salmon, yoy coho salmon, yearling and older coho salmon, juvenile steelhead trout, and cutthroat trout in upper Freshwater Creek Slough, January-June 2007. CPUE is number of fish per seine haul.

		YOY Chinook			YOY Coho			Yearling Coho			Steelhead			Cutthroat		
Month	No. Sets	CPUE	Mean FL	Range	CPUE	Mean FL	Range	CPUE	Mean FL	Range	CPUE	Mean FL	Range	CPUE	Mean FL	Range
Jan	8	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-
Feb	0	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-
Mar	12	0	-	-	0	-	-	0.33	83	67-100	0	-	-	0.25	119	90-156
Apr	28	0	-	-	0.14	42	34-47	2.18	100	85-134	0.04	229	229	0.11	147	109-196
May	48	0.81	48	40-58	0.96	54	39-67	2.19	100	76-127	0.33	89	73-115	0.04	117	115-119
June	48	0.96	59	49-70	1.33	65	31-75	0.25	101	82-111	0.15	101	77-124	0.06	145	114-181

Table 5. Monthly catch-per-unit-effort (CPUE) and fork length (FL) in millimeters of young-of-the-year (yoy) Chinook salmon, yoy coho salmon, yearling and older coho salmon, juvenile steelhead trout, and cutthroat trout in lower Freshwater Creek Slough, January-June 2007. CPUE is number of fish per seine haul.

		YOY Chinook			YOY Coho			Yearling Coho			Steelhead			Cutthroat		
Month	No. Sets	CPUE	Mean FL	Range	CPUE	Mean FL	Range	CPUE	Mean FL	Range	CPUE	Mean FL	Range	CPUE	Mean FL	Range
Jan	0	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-
Feb	0	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-
Mar	12	0	-	-	0	-	-	0	-	-	0.08	253	253	0	-	-
Apr	21	0	-	-	0	-	-	0.38	105	83-151	0.10	145	109-181	0.10	161	144-177
May	28	0.11	46	45-47	0.04	42	42	0.11	107	95-118	0.07	118	110-125	0.04	310	310
June	20	0.25	68	66-72	0	-	-	0	-	-	0	-	-	0	-	-

We are still analyzing PIT tag information for 2007 and these results will be reported in our project's 2007/08 SFRA Annual Report.

Downstream Migrant Weir. AFRAMP estimated that 41% of the coho salmon smolt production and >90% of the steelhead exhibiting smolting characteristics upstream of the HFAC weir originated from the lower 3 km (11.5% of habitat) of the basin (Seth Ricker, CDFG, personal communication). These findings illustrate the importance of the estuarine/freshwater ecotone to juvenile salmonids. Freshwater Creek/Slough in this area is confined within a narrow channel bordered by steep banks. It has a low gradient with slow stream velocity and is relatively deep with ample small woody debris cover. The low stream velocity coupled with highly productive habitat found along the lower valley floor of Freshwater Creek and slough probably provides good over-wintering habitat for juvenile salmonids during moderate flows. Low velocity habitats such as off channel ponds, side channels, sloughs, and wetlands often produce high survival and growth of juvenile coho salmon (Sandercock 1991; Jones and Moore 2000; Quinn 2005). However, there is very little off channel habitat in this section of stream so there is little refuge from high flow events in winter.

Elk River Slough

July-December 2006. During July-December 2006 yoy coho salmon were by far the most common salmonid captured in upper Elk River Slough (Table 6). The peak catch of yoy coho salmon was 2.50 fish/set and occurred in early August. Their weekly mean FL increased from 78 mm in early July to 103 mm in mid November and then dropped to 75 mm in December (Table 6). Based on marked and recaptured individuals yoy coho salmon resided in the tidal freshwater portion of Elk River Slough throughout the summer. Most project marked yoy coho salmon were recaptured at the same site where they were originally marked indicating that they moved very little while residing in the slough. After the first significant rain event of the year in November it appeared that yoy coho redistributed themselves in the basin. We came to this conclusion because the relatively large PIT tagged coho we captured throughout the summer were replaced in our catches by much smaller unmarked yoy coho. We captured four yearling coho in the upper slough from early to mid July. Their FL's ranged from 90-113 mm (Table 6). We captured juvenile steelhead in the upper slough throughout the sampling period. Their peak catch was 0.63 fish/set in early July. Their mean FL was 149 mm and ranged from 85 to 200 mm (Table 6). We captured 28 cutthroat trout in the upper slough throughout the entire sampling period with no discernable peak in abundance. Their mean FL was 202 mm and ranged from 156 to 276 mm. NSA captured no yoy Chinook salmon during this time period.

During July-December 2006 we captured relatively few juvenile salmonids in lower Elk River Slough (Table 7). Yoy Chinook salmon and yoy coho salmon were the most common salmonids captured in lower Elk River Slough during this time period (Table 7). In lower Elk River Slough NSA captured two yearling coho salmon in mid July. They had a mean FL of 124 mm and ranged from 122 to 125 mm. NSA captured 23 yoy coho salmon in late November with a mean FL of 67 mm. This was the only week we captured yoy coho in the lower slough and it occurred after the first significant rain/flow event of the year. None of these "November" fish contained PIT tags and they were substantially smaller than the coho we captured throughout the summer in the upper slough. Again this suggests a fall redistribution of upstream coho in Humboldt Bay tributaries that has been noted in other river basins (Sandercock 1991; Jones and Moore 2000; Quinn 2005). NSA captured 11 yoy Chinook salmon from early July to late August with a peak catch of 1.00 fish/set in mid July. Their weekly mean FL increased from 86 mm in early July to 105 mm in late August. NSA captured four cutthroat trout between late July and early September. Their FL's ranged from 151-245 mm. We did not capture any juvenile steelhead in the lower slough during this time period.

Table 6. Monthly catch-per-unit-effort (CPUE) and fork length (FL) in millimeters of young-of-the-year (yoy) Chinook salmon, yoy coho salmon, yearling and older coho salmon, juvenile steelhead trout, and cutthroat trout in upper Elk River Slough, July-December 2006. CPUE is number of fish per seine haul.

		YOY Chinook			YOY Coho			Yearling Coho			Steelhead			Cutthroat		
	No.		Mean			Mean			Mean			Mean			Mean	
Month	Sets	CPUE	FL	Range	CPUE	FL	Range	CPUE	FL	Range	CPUE	FL	Range	CPUE	FL	Range
July	32	0	-	-	1.88	81	70-96	0.13	105	90-113	0.41	137	85-167	0.16	197	164-276
Aug	40	0	-	-	1.58	87	73-102	0	-	-	0.28	129	121-174	0.20	190	175-204
Sept	32	0	-	-	1.59	92	75-105	0	-	-	0.13	169	140-186	0.19	189	156-215
Oct	32	0	-	-	0.63	99	85-114	0	-	-	0.16	165	144-200	0.16	226	186-258
Nov	28	0	-	-	0.25	103	99-108	0	-	-	0	-	-	0.07	209	198-220
Dec	8	0	-	-	0.25	75	61-88	0	-	-	0.13	186	186	0.25	217	208-226

Table 7. Monthly catch-per-unit-effort (CPUE) and fork length (FL) in millimeters of young-of-the-year (yoy) Chinook salmon, yoy coho salmon, yearling and older coho salmon, juvenile steelhead trout, and cutthroat trout in lower Elk River Slough July-December 2006. CPUE is number of fish per seine haul.

		YOY Chinook			YOY Coho			Yearling Coho			Steelhead			Cutthroat		
	No.		Mean			Mean			Mean			Mean			Mean	
Month	Sets	CPUE	FL	Range	CPUE	FL	Range	CPUE	FL	Range	CPUE	FL	Range	CPUE	FL	Range
July	23	0.35	87	79-93	0	-	-	0.09	124	122-125	0	-	-	0.09	165	151-178
Aug	20	0.15	102	97-106	0	-	-	0	-	-	0	-	-	0.05	227	227
Sept	20	0	-	-	0	-	-	0	-	-	0	-	-	0.05	245	245
Oct	24	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-
Nov	15	0	-	-	1.53	67	54-81	0	-	-	0	-	-	0	-	-
Dec	0	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-

Table 8. Summary of residence times of young-of-the-year (yoy) coho salmon, yearling and older coho salmon, yoy Chinook salmon, juvenile steelhead trout, and cutthroat trout based on Passive Integrated Transponder (PIT) tag data in Elk River Slough, January-December 2006. Mean days at liberty (DAL) were not calculated for sample sizes less than 10. Growth rates are millimeters per day and mean growth rates were calculated for fish at large at least 14 days except where noted.

Species	Number Tagged	Number Recaptured	Percent Recaptured	Mean DAL	Range DAL	Percent Recap at Same Site	Number With DAL >13 Days	Mean Growth Rate	Range Growth Rate
Yoy Coho	107	41	38.3	39	6-128	100	30	0.19	0.07-0.39
1+ Coho	150	7	4.7	-	6-106	71.4	1	-	-
Yoy Chinook	9	2	22.2	-	6-13	100	1*	-	0.85
Steelhead	50	5	10.0	-	13-112	100	?	-	0.21-0.31
Cutthroat	39	8	20.5	-	13-150	100	?	-	0.05-0.29

* this fish at large 13 days

PIT Tag Results for 2006. NSA applied PIT tags to 107 yoy coho in 2006 and recaptured 41 (38.3%) of them (Table 8). The PIT tagged yoy coho salmon resided in the tidal freshwater portion of Elk River Slough throughout the summer. Their mean length of residence was 39 days (n=41) and ranged from 6 to 128 days. All project marked yoy coho salmon were recaptured at the same site where they were originally marked indicating that they moved very little while residing in the slough. The mean growth rate of the 30 recaptured yoy coho at large for at least two weeks was 0.19 mm/day and ranged from 0.07 to 0.39 mm/day. We applied PIT tags to 150 yearling coho in 2006 and recaptured seven (4.7%) of them (Table 8). They were at large for 6 to 106 days. Five of the fish were recaptured at the same site where they were marked. One fish was marked on February 14 and recaptured on May 31. It moved from tidal freshwater habitat in the upper slough to brackish water habitat in the lower slough. We applied PIT tags to nine yoy Chinook in 2006 and recaptured two (22.2%) of them (Table 8). They were at large for 6 to 13 days and were both recaptured at the same site where they were marked. The fish at large for 13 days had a growth rate of 0.85 mm/day. We applied PIT tags to 50 juvenile steelhead in 2006 and recaptured five (10.0%) of them (Table 8). They were at large for 13-112 days and had growth rates of 0.21-0.31 mm/day. They were all recaptured at the same site where they were originally marked. We applied PIT tags to 39 cutthroat trout in 2006 and recaptured eight (20.5%) of them (Table 8). They were at large for 13-150 days and had growth rates of 0.05-0.29 mm/day. They were all recaptured at the same site where they were originally marked. It is likely that some of the cutthroat trout captured by our project were resident adult fish.

January-June 2007. Due to high stream flows we conducted little quantitative sampling in upper Elk Slough January to April 2007. During January-June 2007 yearling and yoy coho salmon were the most common salmonids captured in upper Elk River Slough (Table 9). NSA captured yearling coho salmon from early May to late June and their peak catch of 4.14 fish/set occurred in mid May. We did capture a yearling coho in mid March during some qualitative sampling. Their weekly mean FL was 123 mm in early May and then ranged between 101 to 107 mm throughout the rest of the sampling period. NSA captured yoy coho salmon from early May to late June and their peak catch of 5.38 fish/set occurred in late June. Their weekly mean FL increased from 34 mm in early May to 66 mm in late June. NSA captured four yoy Chinook salmon, all after late May. Their FL's ranged from 50 to 73 mm (Table 9). NSA captured 17 juvenile steelhead, 11 of which were captured in June. Their FL's ranged from 89-180 mm (Table 9). NSA captured four cutthroat trout, three of which were captured in late May and early June. Their FL's ranged from 133 to >300 mm (Table 9).

During January-June 2007 yearling coho salmon were the most common salmonid captured in lower Elk River Slough (Table 10). NSA captured yearling coho salmon from mid March to late June. Their peak catches occurred in May with a high of 26.80 fish/set in mid May. The much higher CPUE in 2007 compared to past years was mostly due to the inclusion of a new seining site to replace an old site that had filled in with sediment. We captured high numbers of salmonids in this new site this year and during qualitative sampling in past years. Their weekly mean FL increased from 113 mm in mid March to 129 mm in late April and then decreased to 105-110 mm in mid to late June. NSA captured one yoy coho salmon in early May and it was 42 mm FL. NSA captured four yoy Chinook salmon in late June and their FL's ranged from 64-78 mm FL (Table 10). NSA captured seven juvenile steelhead from early March to mid June. The captured steelhead FL's ranged from 133 to 241 mm. NSA captured nine cutthroat trout, all from early May to mid June. Their FL's ranged from 135-193 mm.

We are still analyzing PIT tag information for 2007 and these results will be reported in our project's 2007/08 SFRA Annual Report.

Table 9. Monthly catch-per-unit-effort (CPUE) and fork length (FL) in millimeters of young-of-the-year (yoy) Chinook salmon, yoy coho salmon, yearling and older coho salmon, juvenile steelhead trout, and cutthroat trout in upper Elk River Slough, January-June 2006. CPUE is number of fish per seine haul.

		YOY Chinook			YOY Coho			Yearling Coho			Steelhead			Cutthroat		
	No.		Mean			Mean			Mean			Mean			Mean	
Month	Sets	CPUE	FL	Range	CPUE	FL	Range	CPUE	FL	Range	CPUE	FL	Range	CPUE	FL	Range
Jan	8	0	-	-	0	-	-	0	-	-	0	-	-	0.13	183	183
Feb	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mar	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Apr	5	0	-	-	0	-	-	-	-	-	-	-	-	-	-	-
May	31	0.03	50	50	1.00	54	34-70	2.16	109	80-139	0.19	102	89-122	0.06	135	133-137
June	32	0.09	73	72-73	4.03	62	45-82	0.44	104	86-125	0.34	110	86-180	0.03	>300	>300

Table 10. Monthly catch-per-unit-effort (CPUE) and fork length (FL) in millimeters of young-of-the-year (yoy) Chinook salmon, yoy coho salmon, yearling and older coho salmon, juvenile steelhead trout, and cutthroat trout in lower Elk River Slough, January-June 2007. CPUE is number of fish per seine haul.

		YOY Chinook			YOY Coho			Yearling Coho			Steelhead			Cutthroat		
	No.		Mean			Mean			Mean			Mean			Mean	
Month	Sets	CPUE	FL	Range	CPUE	FL	Range	CPUE	FL	Range	CPUE	FL	Range	CPUE	FL	Range
Jan	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Feb	3	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-
Mar	16	0	-	-	0	-	-	0.31	113	108-119	0.13	219	197-241	0	-	-
Apr	15	0	-	-	0	-	-	1.07	127	109-139	0.27	182	175-194	0	-	-
May	20	0	-	-	0.05	42	42	11.95	119	91-183	0	-	-	0.35	144	135-160
June	15	0.27	73	64-78	0	-	-	0.67	109	86-125	0.07	133	133	0.13	182	171-19

Martin Slough

July-December 2006. On August 10 and September 21, 2006 we conducted some qualitative sampling in Martin Slough (tributary to Elk River Slough) on Eureka Municipal Golf Course property. On August 10 we made two seine hauls with a 100 foot seine net in the pond adjacent to the 17th hole and captured two cutthroat trout with a mean FL of 212 mm (range 209-214 mm). We also made four hauls in Martin Slough downstream of the pond and captured no salmonids. Finally, we sampled Martin Creek upstream of tidal influence just downstream of the Fairway Drive crossing about ¼ mile upstream of the 17th hole pond. We made two seine hauls and captured five juvenile coho salmon. Their FL's ranged from 90 to145 mm. We also captured one juvenile steelhead that was 270 mm FL. On September 21 we made seine hauls in and downstream of the 17th hole pond and did not capture any salmonids. We also made two seine hauls in Martin Creek just downstream of Fairway Drive crossing and captured one coho salmon that was 144 mm FL.

January-June 2007. Starting in January 2007 we began a standard monthly sampling effort in the tidal portion of Martin Slough, therefore, we did not continue to sample Martin Creek just below Fairway Drive. Juvenile coho salmon were the most abundant salmonids captured in Martin Slough (Table 11). Based on their size and appearance they were probably yearling and older fish but we did not examine scales to confirm this. On average the coho we captured in Martin Slough were larger than those captured in any other Humboldt Bay tributary. Between January and June we applied PIT tags to 83 coho salmon and recaptured one tagged fish. The recaptured fish was at large from May 10 to June 18 (39 days) and grew 40 mm (1.03 mm/day). It was recaptured at the same site where we originally tagged it. We also captured threespine stickleback, prickly sculpin, and Pacific staghorn sculpin.

Rocky Gulch

January-June 2007. Starting in February 2007 we began a standard monthly sampling effort in the tidal portion of Rocky Gulch. Juvenile coho salmon were the most abundant salmonids captured in Rocky Gulch (Table 11). Based on their size and appearance the coho captured from February-April were probably yearling and older fish and the coho captured in June was a yoy fish, but we did not examine scales to confirm this. Between February and June we applied PIT tags to 62 yearling coho salmon, one juvenile steelhead, and 14 cutthroat trout and recaptured eight coho and two cutthroat trout containing PIT tags. All fish were marked and recaptured in Rocky Gulch. Three coho were at large from March 13 to March 23 (10 days) and grew from 0.20 to 0.30 mm/day. One coho was at large from March 23 to April 19 (27 days) and grew 0.41 mm/day. Four coho were at large from March 13 to April 19 (37 days) and grew from 0.27 to 0.38 mm/d. . One cutthroat trout was at large from March 23 to May 25 (63 days) and grew 0.29 mm/d. The other cutthroat trout was at large from May 25 to June 29 (35 days) and grew 0.58 mm/d. We also captured tidewater goby, bay goby, starry flounder, threespine stickleback, and Pacific staghorn sculpin.

Wood Creek

We began standard monthly sampling in the tidal portion of Wood Creek in February 2007. Juvenile coho salmon were the most abundant salmonids captured in Wood Creek (Table 11). Based on their size and appearance most of the coho captured from February-June were probably yearling coho except for a couple of yoy coho captured in May and June, but we did not examine scales to confirm this. Between February and June we applied PIT tags to 92 yearling coho salmon, one juvenile steelhead, and four cutthroat trout and recaptured seven tagged coho. Two coho were tagged by NSA in July 2006 in Freshwater Slough at the most upstream site over a mile upstream of Wood Creek. One was at large from July 27, 2006 to February 26, 2007 (213 days) and grew 0.12 mm/day. The other fish was at large from July 19, 2006 to March 27, 2007 (251 days) and also grew 0.12 mm/day. Four other coho were marked and recaptured at the same sites in Wood Creek. Two were at large in Wood Creek from March 27 to May 1 (35 days) and one grew 0.34 mm/d and the other 0.43 mm/d. The

Table 11. Summary of the number and fork length (FL) information of juvenile salmonids captured in Martin Slough, Rocky Gulch, and Wood Creek, July 2006 through June 2007.

Martin Slough

Date	Coho Salmon			Steelhead/RT			Cutthroat Trout		
	No.	FL	Range	No.	FL	Range	No.	FL	Range
8-10-06	5	130	90-145	1	270	270	2	212	209-214
9-21-06	1	144	144	0	-	-	0	-	-
1-18-07	3	83	68-94	0	-	-	0	-	-
2-23-07	1	97	97	0	-	-	0	-	-
4-05-07	39	113	92-134	0	-	-	0	-	-
5-10-07	18	114	95-138	0	-	-	1	>300	>300
6-18-07	14	127	108-144	0	-	-	2	147	147

Rocky Gulch

Date	Coho Salmon			Steelhead/RT			Cutthroat Trout		
	No.	FL	Range	No.	FL	Range	No.	FL	Range
2-08-07	26	81	70-119	0	-	-	0	-	-
3-13-07	22	91	75-107	0	-	-	2	75	73-77
3-23-07	20	97	71-130	0	-	-	3	88	82-97
4-19-07	28	101	85-115	0	-	-	3	91	80-101
5-25-07	0	-	-	1	115	115	5	102	90-119
6-29-07	1	69	69	0	-	-	5	118	101-130

Wood Creek

Date	Coho Salmon			Steelhead/RT			Cutthroat Trout		
	No.	FL	Range	No.	FL	Range	No.	FL	Range
11-14-06	4	96	83-108	0	-	-	0	-	-
11-30-06	1	122	122	0	-	-	0	-	-
2-26-07	25	95	77-127	0	-	-	0	-	-
3-27-07	59	91	72-115	0	-	-	2	109	103-115
5-01-07	24*	97	75-115	0	-	-	0	-	-
6-13-07	5*	102	81-118	1	135	135	2	115	110-119

* includes one yoy coho not included in size information

other two were at large from May 1 to June 13 (43 days) and both grew 0.14 mm/d. Finally, one coho not PIT tagged by NSA was captured in Wood Creek on May 1. It was likely tagged by CDFG's AFRAMP project in Freshwater Creek or by Green Diamond Resources biologists in Ryan Creek upstream of the estuary. We also captured threespine stickleback.

Hookton Slough/Salmon Creek

July-December 2006. Juvenile steelhead were the only salmonid captured by NSA during this time period, and none were captured in Hookton Slough (Tables 12 & 13). NSA captured 12juvenile steelhead with their peak catches occurring in mid November (0.86 fish/set). Their FL's ranged from 53-79 mm. We applied PIT tags to two juvenile steelhead during this time period and did not recapture any fish containing PIT tags.

January-June 2007. Due to high stream flows and crew availability we conducted a limited amount of seining in Hookton Slough/Salmon Creek estuary during this time period (Tables 14 & 15) NSA captured 11 juvenile steelhead with their peak catches occurring in late March and early May (both 2.00 fish/set). Their FL's ranged from 66-107 mm. We also captured 18 yoy trout, all in June. Their FL's ranged from 38-58 mm.

In order to determine if juvenile salmonids were using Hookton Slough/Salmon Creek estuary during high flows we conducted some qualitative sampling using minnow traps baited with frozen salmon roe March-May 2007. We fished these traps in deeper water or more heavily vegetated habitat near our normal seining sites. We captured one yearling coho, 64 juvenile

Table 12. Monthly catch-per-unit-effort (CPUE) and fork length (FL) in millimeters of young-of-the-year (yoy) Chinook salmon, yoy coho salmon, yearling and older coho salmon, juvenile steelhead trout, and cutthroat trout in Salmon Creek estuary, July-December 2006. CPUE is number of fish per seine haul.

		YOY Trout			YOY Coho			Yearling Coho			Steelhead			Cutthroat		
Month	No. Sets	CPUE	Mean FL	Range	CPUE	Mean FL	Range	CPUE	Mean FL	Range	CPUE	Mean FL	Range	CPUE	Mean FL	Range
July	12	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-
Aug	12	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-
Sept	12	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-
Oct	6	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-
Nov	16	0	-	-	0	-	-	0	-	-	0.75	63	53-79	0	-	-
Dec	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 13. Monthly catch-per-unit-effort (CPUE) and fork length (FL) in millimeters of young-of-the-year (yoy) Chinook salmon, yoy coho salmon, yearling and older coho salmon, juvenile steelhead trout, and cutthroat trout in Hookton Slough, July-December 2006. CPUE is number of fish per seine haul.

		YOY Trout			YOY Coho			Yearling Coho			Steelhead			Cutthroat		
Month	No. Sets	CPUE	Mean FL	Range	CPUE	Mean FL	Range	CPUE	Mean FL	Range	CPUE	Mean FL	Range	CPUE	Mean FL	Range
July	6	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-
Aug	6	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-
Sept	6	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-
Oct	3	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-
Nov	9	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-
Dec	0	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-

Table 14. Monthly catch-per-unit-effort (CPUE) and fork length (FL) in millimeters of young-of-the-year (yoy) Chinook salmon, yoy coho salmon, yearling and older coho salmon, juvenile steelhead trout, and cutthroat trout in Salmon Creek estuary, January-June 2007. CPUE is number of fish per seine haul.

Seining

		YOY Trout			YOY Coho			Yearling Coho			Steelhead			Cutthroat		
	No.		Mean			Mean			Mean			Mean			Mean	
Month	Sets	CPUE	FL	Range	CPUE	FL	Range	CPUE	FL	Range	CPUE	FL	Range	CPUE	FL	Range
Jan	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Feb	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mar	2	0	-	-	0	-	-	-	-	-	2.00	91	68-107	-	-	-
Apr	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
May	3	0	-	-	0	-	-	0	-	-	2.00	76	66-97	0	-	-
June	12	1.50	46	38-58	0	-	-	0	-	-	0.08	92	92	0	-	-

Minnow Traps

		YOY Trout			YOY Coho			Yearling Coho			Steelhead			Cutthroat		
	No.	No.	Mean			Mean		No.	Mean		No.	Mean		No.	Mean	
Month	Traps	Caught	FL	Range	CPUE	FL	Range	Caught	FL	Range	Caught	FL	Range	Caught	FL	Range
Jan	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Feb	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mar	7	0	-	-	0	-	-	1	105	105	35	85	64-156	1	84	84
Apr	4	0	-	-	0	-	-	0	-	-	13	100	79-116	0	-	-
May	2	0	-	-	0	-	-	0	-	-	16	92	74-120	0	-	-
June	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 15. Monthly catch-per-unit-effort (CPUE) and fork length (FL) in millimeters of young-of-the-year (yoy) Chinook salmon, yoy coho salmon, yearling and older coho salmon, juvenile steelhead trout, and cutthroat trout in Hookton Slough, January-June 2007. CPUE is number of fish per seine haul.

		YOY Chinook			YOY Coho			Yearling Coho			Steelhead			Cutthroat		
	No.		Mean			Mean			Mean			Mean			Mean	
Month	Sets	CPUE	FL	Range	CPUE	FL	Range	CPUE	FL	Range	CPUE	FL	Range	CPUE	FL	Range
Jan	3	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-
Feb	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mar	3	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-
Apr	6	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-
May	3	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-
June	9	0	-	-	0	-	-	0.11	116	116	0	-	-	0	-	-

steelhead, and one cutthroat trout in the minnow traps which showed that juvenile salmonids were utilizing the lower portion of Salmon Creek (Table 14). The mean monthly FL's of juvenile steelhead peaked in April at 100 mm and individual FL's ranged from 64-156 mm. We applied PIT tags to three juvenile steelhead captured by seining. We also applied PIT tags to one yearling coho salmon, 53 juvenile steelhead, and one cutthroat trout and recaptured seven juvenile steelhead captured with minnow traps. Steelhead mean residence time was 27 days (range 9-51 days) and their mean growth rate was 0.19 mm/day (range 0.05-0.29 mm/day).

Summary of Project Results:

Project objectives were met.

Project documented that yoy coho salmon rear in the tidal freshwater portion of Humboldt Bay tributaries for up to 4 months. In Freshwater Creek Slough/Wood Creek complex we observed two individuals that reared in the estuary/freshwater ecotone for up to 8 months.

Project also captured individual juvenile steelhead and cutthroat trout that reared for nearly a year in the freshwater/estuary ecotone.

Project documented that juvenile coho moved to low velocity or off channel habitat such as Martin Slough pond and Wood Creek during winter presumably to escape high velocity flows in the main channel.

Project documented that juvenile coho salmon will utilize appropriate habitat adjacent to mainstem channels and collected basic habitat information about these areas. This includes tidal meanders, dead end sloughs, salt marshes, non-natal streams, and even pond habitat on an active golf course. Therefore this Project can provide information to the marsh restoration community to help design projects to create these types of habitat to increase rearing habitat for juvenile coho salmon.

Project results show that yoy coho salmon that rear in the estuary grow larger than their cohorts rearing in stream habitat farther upstream in the basin. Based on other studies larger size at ocean entry usually results in higher ocean survival.

In conjunction with AFRAMP, Project documented that the estuarine/freshwater ecotone located between the estuary and canyon stream habitat is extremely important to coho and especially steelhead smolt production.

Questions generated by Project:

The average size of yearling coho smolts leaving Freshwater Slough is smaller than reported from other Pacific coast estuaries. So do these smaller smolts rear in Humboldt Bay for significant periods of time before entering the ocean?

The project has captured juvenile salmonids in areas containing eel grass beds. What role does eel grass play in life history of salmonids?

One study in Oregon (Miller and Sadro 2003), showed that after rearing in the estuary for the summer yoy coho salmon migrate back upstream to over-winter. Another study in British Columbia (Tschaplinski 1982), showed that after rearing in the estuary for the summer yoy coho salmon migrated to the ocean. This project made some observations suggesting that both of the above scenarios may be occurring in Humboldt Bay tributaries. What is the dominate life history strategy of yoy coho salmon in Humboldt Bay tributaries?

Will creation of low water velocity habitat i.e. side channels, freshwater or saltwater marshes, ponds increase over-wintering and spring/summer rearing habitat?

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8. Discuss differences between work anticipated in grant proposal and grant agreement, and that actually carried out with Federal Aid grant funds; include differences between expected and actual costs.

No significant difference in work or cost between grant proposal and grant agreement.

9. List any publications or in-house reports resulting from this work. Provide citations, including status (indicate if not completed), note any that are included with this report, and note where reports or publications may be obtained.

Wallace, M. 2006. Juvenile salmonid use of Freshwater Slough and tidal portion of Freshwater Creek, Humboldt Bay, California. 2003 Annual Report. Final Report for contract P0210710 to California Department of Fish and Game Fisheries Restoration Grants Program. March 2006. 32pp.

Wallace, M. 2006. Juvenile salmonid use of Freshwater Slough and tidal portion of Freshwater Creek, Humboldt Bay, California. 2003 Annual Report. California Department of Fish and Game, Inland Fisheries Branch Administrative Report No. 2006-04.

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10. Name, title, phone number, and e-mail address of person compiling this report

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