Annual Project Performance Report

1. State: California

Grant number: F-122-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, 2008 through June 30, 2009

Report due date: September 15, 2009
Date prepared: August-September 2009

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

4. Objectives:

1. To monitor the effects of marsh restoration projects in Wood and Salmon Creeks on juvenile salmonid use and basic water quality conditions, specifically in the newly created off channel ponds (contingent on successful grant application to FRGP).
2. Better describe use of entire Freshwater Creek stream-estuary ecotone by monitoring juvenile salmonid entry timing, movement, and use of Freshwater Creek Slough, Wood Creek, and Ryan Creek/Slough (contingent on successful grant application to FRGP).
3. To determine the proportion of the population of coho salmon smolts originating from the stream/estuary ecotone of Freshwater Creek (contingent on State's resumed payment to PSMFC to allow us to hire temporary field staff).
4. To describe the use of the tidal portion of smaller Humboldt Bay tributaries such as Martin Slough, Jacoby Creek/Gannon Slough, and Rocky Gulch by juvenile salmonids.

5. Part of Larger 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 agencies and private and non-profit groups.

6. Describe how the objectives were met:

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.

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), steelhead trout (Bond 2006), and sea-run coastal cutthroat trout (Trotter 1997; Northcote 1997; CDFG 2000; CDFG 2001). Wallace (2006) and Wallace and Allen (2007) 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 2003 through 2006 and Elk River 2005 and 2006 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 (Wallace and Allen 2009; Wallace and Allen 2007; CDFG 2008; CDFG 2007; Wallace 2006; CDFG 2006).

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. Prior to CDFG's Natural Stocks Assessment Project (NSA) studies virtually nothing was known about juvenile salmonid use of Humboldt Bay or the sloughs and tidal portion of its tributaries. Recent studies conducted by CDFG in the tidal portions of Humboldt Bay tributaries have shown that juvenile salmonids heavily utilize stream-estuary ecotone habitat. In 2007, CDFG's Anadromous Fisheries Research and Monitoring Program (AFRAMP) and NSA estimated that 41% of coho salmon smolts and over 90% of large steelhead smolts originated from the stream-estuary ecotone of Freshwater Creek. In 2008, AFRAMP and NSA estimated that 38% of coho salmon smolts and 82% of large steelhead smolts originated from the stream-estuary ecotone of Freshwater Creek. These studies also showed that juvenile salmonids using this habitat experience faster growth, obtained a larger size, and likely experienced increased marine survival over juvenile salmonids rearing in stream habitat (Wallace and Allen 2009; Wallace and Allen 2007; CDFG 2008; CDFG 2007; Wallace 2006; CDFG 2006; CDFG 2005; CDFG unpublished data). Wallace (2006) reported that juvenile salmonids, especially young-of-the-year (yoy) coho salmon, rear in Freshwater Creek Slough for months. Subsequent surveys in the tidal portion of other Humboldt Bay tributaries such as Elk River Slough, Martin Slough, Salmon Creek estuary, Wood Creek, and Rocky Gulch showed that juvenile salmonids, especially coho salmon, rear in the stream-estuary ecotone of these streams for months at a time and are especially important over-winter habitat.

Restoring estuary function for the benefit of coho salmon has been identified as a range wide and Eureka Plain recommendation in the State's coho recovery plan (CDFG 2004) and for

Humboldt Bay in particular (HBWAC 2005). Similarly, the Steelhead Restoration and Management Plan for California (CDFG 1996) also identified estuary function as a primary factor for the decline in steelhead productivity. These plans encouraged numerous estuary and marsh habitat restoration projects around Humboldt Bay and the Eel River estuary. However, few if any of these projects have measured the response of salmonid use or water quality to their restoration measures. Specifically, ongoing restoration projects in Wood Creek and Salmon Creek, Humboldt Bay, CA have proposed to improve habitat by constructing off channel ponds to increase the number, size, and survival of juvenile salmonids, especially during the winter months. Pacific States Marine Fisheries Commission in cooperation with NSA has received a grant from Fisheries Restoration Grants Program (FRGP) to monitor the effects of marsh restoration projects in Wood and Salmon Creeks on juvenile salmonid use and basic water quality conditions, specifically in the newly created off channel ponds. We will submit our findings and recommendations to resource managers and the restoration community to assist in their planning, prioritization, and implementation of future estuary restoration projects.

The majority of tidal wetlands around Humboldt Bay have been diked and converted to pasture land during the past 150 years. 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. This project, by describing life history traits and habitat needs of juvenile coho salmon, Chinook salmon, steelhead trout and sea-run coastal cutthroat trout will play an important role in providing important data to help these restoration projects succeed. Lower Freshwater Creek/Slough and the tidal portion of most other Humboldt Bay tributaries are presently 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 and coastal cutthroat trout with their better described estuarine dependence.

During the duration of this contract period (2008-2009) 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. NSA also sampled smaller Humboldt Bay tributaries such as Jacoby Creek/Gannon Slough, Martin Slough, 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

When stream and weather conditions allowed NSA conducted weekly sampling for juvenile salmonids in Freshwater Creek Slough and Elk River Slough in July and August 2008 and biweekly sampling the rest of the year (Figure 1). In Hookton Slough/Salmon Creek NSA attempted biweekly sampling from July 2008 to June 2009. 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 Jacoby Creek/Gannon Slough, Martin Slough and Rocky Gulch; and minnow traps baited with frozen salmon roe in sections of Gannon Slough, Martin Slough, Rocky Gulch, and Wood Creek where we were unable to seine (Figure 1). In the spring of 2009 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. This weir

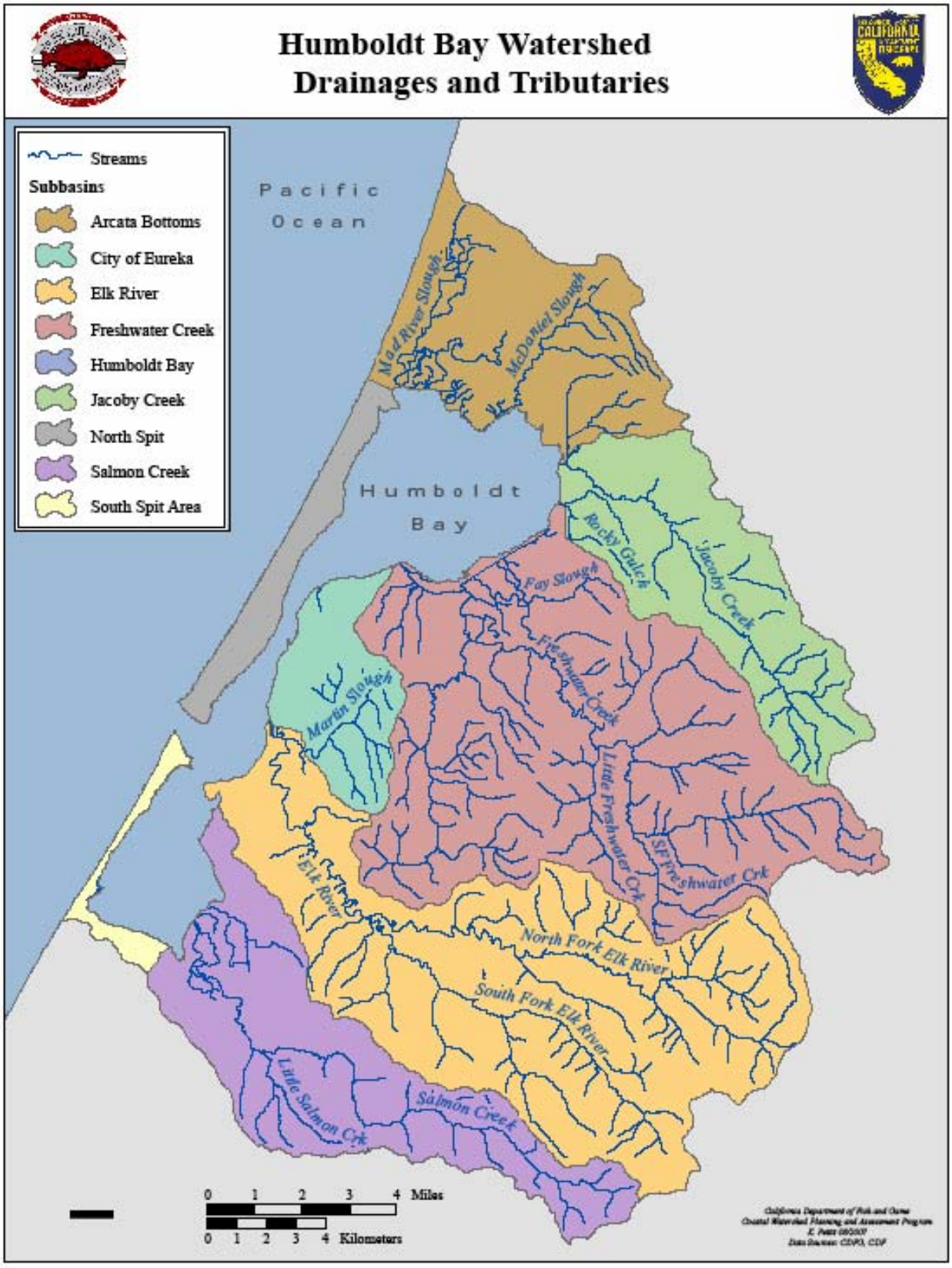

Figure 1. Map of Humboldt Bay tributaries.

was supposed to be 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. Unfortunately a series of fiscal constraints conspired to make it impossible to run the upstream weir (See Question 7 in this report). NSA applied passive integrated transponder (PIT) tags to all healthy juvenile salmonids ≥55 mm FL to gather residency, movement, and growth information while they were in the estuary.

Results

Freshwater Creek Slough

July-December 2008. During July-December 2008 we only captured seven young-of-the-year (yoy) coho salmon in upper Freshwater Creek Slough (Table 1) and none in the lower slough (Table 2). This is by far the lowest catch of yoy coho recorded by our project. June yoy coho CPUE in upper Freshwater Slough was also the lowest on record (Table 3). The peak catch of yoy coho salmon was 0.17 fish/set and it occurred in late July. During the same time period, peak CPUE of yoy coho salmon was 1.33 in 2007 and 3.92 fish/set in 2006 and they both occurred in late July (CDFG 2008 & 2007). Their FL's were similar to past years. For the first time since we began PIT tagging coho in 2004 we were unable to estimate length of residency due to the very low numbers of tagged and recaptured fish (Table 4). We captured one yoy Chinook salmon in July and it was 72 mm FL (Table 1). We captured four 1+ coho salmon, all in July (Table 1). Their mean FL was 112 mm. Juvenile steelhead trout was the most commonly captured salmonid by our project in the upper slough (Table 1). We captured them throughout the sampling season. Their peak catch of 0.50 fish/set occurred in early July. We captured cutthroat trout in the upper slough from early July to late October and their peak catch was 0.33 fish/set in early July and late September.

The only juvenile salmonids we captured in lower Freshwater Creek Slough during July-December 2008 was one yoy Chinook salmon 72 mm FL, one 1+ coho 94 mm FL, three steelhead ranging from 174 to 176 mm FL in early July and mid September, and two cutthroat trout ranging from 197 to 205 mm FL in early to mid July (Table 2).

PIT Tag Results for 2008. We captured far fewer coho salmon this year, especially yoy coho, so therefore tagged and recaptured fewer coho this year compared to past years. We applied PIT tags to 11 yoy coho in 2008 and did not recapture any of them (Table 4). Yoy mean length of residence was 68 days in 2007 and 33 days in 2006 (CDFG 2008 & 2007). We applied PIT tags to 27 yearling coho in 2008 and recaptured 1 (3.7%) of them (Table 4). Its estuarine residence was 28 days and was recaptured at the same site where we marked it. We also captured another 13 yearling coho that were tagged by other projects in the Freshwater Creek basin. We applied PIT tags to 43 juvenile steelhead in 2008 and recaptured seven (16.3%) of them (Table 4). They were at large for 6 to 108 days. All seven of the project marked steelhead were recaptured at the same site where they were marked. We also captured another four juvenile steelhead that were tagged by other projects in the Freshwater Creek basin. The growth rates of the seven recaptured juvenile steelhead at large for at least 13 days ranged from 0.27 to 0.72 mm/day. We applied PIT tags to 13 cutthroat trout in 2008 and recaptured three (23.1%) of them (Table 4). They were at large from 40 to 110 days. All three fish were recaptured at the same site where they were marked. We also captured another four cutthroat trout that were tagged by other projects in the Freshwater Creek basin. The growth rates of the three recaptured cutthroat at large for at least 13 days ranged from 0.04 to 0.37 mm/day. It is likely that some of the cutthroat trout captured by our project were resident adult fish.

January-June 2009. During January to June 2009 yoy coho salmon were the most common salmonid captured in upper Freshwater Creek Slough (Table 5). Our catches of yearling coho in 2008 were similar to the same time period last year. In 2009 NSA captured yearling coho salmon from early February to mid June. Their peak catches occurred in April with a high of 1.25 fish/set in late April. In 2008 their peak catches occurred in May with a high of 0.70 fish/set

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 2008. 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	60	0.02	72	72	0.07	81	76-85	0.07	112	105-117	0.22	81	60-167	0.08	181	132-209
Aug	48	0	-	-	0.04	86	83-89	0	-	-	0.19	87	74-104	0.06	169	155-180
Sept	36	0	-	-	0.03	94	94	0	-	-	0.08	98	84-122	0.11	227	193-272
Oct	24	0	-	-	0	-	-	0	-	-	0.29	116	96-152	0.13	197	183-213
Nov	12	0	-	-	0.08	119	119	0	-	-	0.17	150	143-157	0	-	-
Dec	12	0	-	-	0	-	-	0	-	-	0.25	151	101-215	0	-	-

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 2008. 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	33	0.03	92	92	0	-	-	0.03	94	94	0.06	175	174-176	0.06	201	197-205
Aug	23	0	-	-	0	-	-	0	-	-	-	-	-	0	-	-
Sept	14	0	-	-	0	-	-	0	-	-	0.07	175	175	0	-	-
Oct	7	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-
Nov	0	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-
Dec	0	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-

Table 3. Effort, number captured, and catch-per-unit-effort of young-of-the-year coho salmon in upper Freshwater Creek Slough during June, 2003-2009.

Year	# Seine Hauls	# Caught	CPUE (fish/set)
2003	48	478	9.96
2004	60	335	5.58
2005	59	447	7.58
2006	48	161	3.35
2007	48	64	1.33
2008	44	4	0.09
2009	34	106	3.12

in mid May (CDFG 2008). Their monthly mean FL's from April to June varied little ranging from 106 to 110 mm (Table 5) which was similar to last year. Our catches of yoy coho were markedly higher than last year (Table 3). NSA captured yoy coho salmon from late April to late June and the peak catch of 3.83 fish/set occurred in mid to late June. In 2007 NSA captured yoy coho salmon from mid April to late June and the peak catch of 0.20 fish/set occurred in late May and early June (CDFG 2008). Their weekly mean FL increased from 34 mm in late April to 70 mm in late June. NSA captured two yoy Chinook salmon in late June (Table 5). Their mean FL was 69 mm. NSA captured a total of 18 juvenile steelhead from late January to late June with the peak catch of 0.75 fish/set occurring in mid to late June. Their FL's ranged from 50 to 170 mm (Table 5). NSA captured four cutthroat trout from between early April and mid June with no discernable peak catch. Their FL's ranged from 148 to 200 mm (Table 5).

We captured mostly yearling coho salmon and juvenile steelhead in lower Freshwater Creek Slough from January to June 2009 (Table 6). We captured yearling coho between early March and mid May 2009. We captured a total of 12 yearling coho in 2009 compared to 9, 11, 19 and 122 during the same time periods in 2008, 2007, 2006 and 2005, respectively. Our peak 2009 catches of yearling coho salmon occurred in late April. Their weekly mean FL ranged from 96 to 113 mm in 2009 (Table 6). NSA captured three yoy Chinook salmon in mid to late June and they were 70 to 73 mm FL (Table 6). NSA captured a total of 10 juvenile steelhead between early March and early June. Their FL's ranged from 132 to 215 mm (Table 6). NSA captured two cutthroat trout in late April and one in early June. Their FL's ranged from 174 to 193 mm (Table 6). We did not capture any yoy coho salmon or yoy Chinook salmon in the lower slough.

We are still analyzing PIT tag information for 2009 and these results will be reported in our project's 2009/10 SFRA Annual Report.

Downstream Migrant Weir. Due to the delay in executing a contract amendment by CDFG administration and the Governor's Executive Order S-09-09 NSA was not able to conduct the scheduled downstream migrant work in the spring of 2009.

AFRAMP estimated that 38% of the coho salmon smolt production passing the HFAC weir in 2008 originated from the lower 3 km (11.5% of habitat) of the basin (Seth Ricker, CDFG, personal communication). In 2007, AFRAMP estimated 41% of the coho smolt production originated in the lower 3 km of habitat (CDFG 2007). AFRAMP also estimated that 82% of the steelhead smolts originated in the lower 3 km in 2008 compared to 2007 when they estimated >90% of the steelhead smolts originated from this area (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

Table 4. 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 2008. 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 ≥13 days except where noted.

Species	Number Tagged	Number Recaptured	Percent Recaptured	Mean DAL	Range DAL	Percent Recap at Same Site	Number With DAL >12 Days	Mean Growth Rate	Range Growth Rate
Yoy Coho	11	0	0	-	-	-	-	-	-
1+ Coho	27	1	3.7	28	28	100	1	0.27	0.27
Steelhead	43	7	16.3	-	6-108	100	7	-	0.27-0.72
Cutthroat	13	3	23.1	-	40-110	100	3	-	0.04-0.37

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 upper Freshwater Creek Slough, January-June 2009. 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	12	0	-	-	0	-	-	0	-	-	0.17	81	72-89	0	-	-
Feb	16	0	-	-	0	-	-	0.06	78	78	0.19	90	52-65	0	-	-
Mar	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Apr	24	0	-	-	0.08	34	34-34	0.63	110	90-127	0.13	105	84-125	0.04	200	200
May	20	0	-	-	0.50	42	35-48	0.25	106	93-114	0.55	108	85-141	0.05	148	148
June	34	0.06	69	67-70	3.15	64	40-85	0.12	106	100-110	0.53	109	50-170	0.06	151	127-175

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 lower Freshwater Creek Slough, January-June 2009 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	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Feb	14	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-
Mar	7	0	-	-	0	-	-	0	-	-	0.14	215	215	0	-	-
Apr	13	0	-	-	0	-	-	0.85	110	90-130	0.54	173	160-183	0.15	184	174-193
May	14	0	-	-	0	-	-	0.07	96	96	0.07	132	132	0	-	-
June	13	0	-	-	0	-	-	0	-	-	0.08	140	140	0.08	176	176

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 2008. During July-December 2008 yoy coho salmon were by far the most common salmonid captured in upper Elk River Slough (Table 7). The peak catch of yoy coho salmon was 7.00 fish/set and occurred in mid July. In limited sampling in early December their CPUE was 11.50 fish/set. During July-December 2007 the peak catch of yoy coho salmon was 5.13 fish/set and occurred in mid July (CDFG 2008). Their weekly mean FL increased from 69 mm in early July to 111 mm in December and individual FL's ranged from 58-124 mm (Table 7). 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. We captured five yearling coho in the upper slough in early to mid July and one in late August (Table 7). Their FL's ranged from 101-141 mm (Table 7). We captured a total of eight juvenile steelhead in the upper slough from early July to early December. Their FL's ranged from 118-190 mm (Table 7). We captured 11 cutthroat trout in the upper slough from mid July to early December with no discernable peak in abundance. They ranged in size from 142 to 231 mm FL (Table 7). We did not capture any yoy Chinook salmon in the upper slough during this time period.

During July-December 2008 we captured relatively few juvenile salmonids in lower Elk River Slough (Table 8). Yoy Chinook salmon were the most common salmonids captured in lower Elk River Slough during this time period (Table 8). NSA captured 45 yoy Chinook salmon from early July to mid September with a peak catch of 6.00 fish/set in mid July. Their weekly mean FL's ranged from 84 to 108 mm between early July and mid August and individual FL's ranged from 74-127 mm (Table 8). Field crews captured 25 yearling coho salmon, all in July and their FL's ranged from 111-141 mm (Table 8). We did not capture any other juvenile salmonids in the lower slough during this time period.

PIT Tag Results for 2008. We applied PIT tags to 331 yoy coho in 2008 and recaptured 104 (31.4%) of them (Table 9). The PIT tagged yoy coho salmon resided in the tidal freshwater portion of Elk River Slough throughout the summer and fall. Their mean length of residence was 58 days (n=104) and ranged from 6 to 168 days. All but two 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 88 recaptured yoy coho at large for at least two weeks was 0.29 mm/day and ranged from 0.04 to 0.68 mm/day. We applied PIT tags to 206 yearling coho in 2008 and recaptured 19 (9.2%) of them (Table 9). They were at large for 5 to 25 days. All but two fish were recaptured at the same site where they were marked. One fish was marked on May 16 and recaptured on June 10 and moved from tidal freshwater habitat in the upper slough to brackish water habitat in the lower slough. The other fish was marked on June 24 and recaptured on July 2 and moved from brackish water habitat in the lower slough to tidal freshwater habitat in the upper slough. We also recaptured one yearling coho on May 16, 2008 that we marked on July 26, 2007. It was at large 294 days, grew from 95 mm FL to 124 mm FL, and increased in weight from 11.0 to 22.1 grams. We also recaptured four yearling coho in lower Elk River Slough that contained PIT tags marked by other projects. They most likely tagged by CDFG's AFRAMP project in Freshwater Creek or by Green Diamond Company fish biologists in Ryan Creek. In 2007 we captured two PIT tagged yearling coho from Freshwater Creek basin in lower Elk River (CDFG 2008). We applied PIT tags to 23 yoy Chinook in 2008 and did not recapture any of them (Table 9). We applied PIT tags to 17 juvenile steelhead in 2008 and recaptured one (5.9%) of them (Table 9). It was at large for 28 days and had a growth rate of 0.25 mm/day. It was recaptured at the same site

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 upper Elk River Slough, July-December 2008. 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	40	0	-	-	5.03	74	58-97	0.13	118	101-141	0.05	125	118-131	0.08	144	142-146
Aug	30	0	-	-	2.77	84	67-102	0.03	118	118	0.03	178	178	0.03	208	218
Sept	22	0	-	-	1.73	90	74-101	0	-	-	0.05	143	143	0.05	229	229
Oct	16	0	-	-	2.25	94	76-111	0	-	-	0.06	184	184	0.13	200	170-231
Nov	6	0	-	-	5.00	96	86-112	0	-	-	0	-	-	0.17	166	166
Dec	4	0	-	-	11.50	111	80-124	0	-	-	0.75	175	158-190	0.25	174	174

Table 8. 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 2008. 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	19	2.11	94	78-127	0	-	-	1.32	128	111-141	0	-	-	0	-	-
Aug	20	0.20	90	74-96	0	-	-	0	-	-	0	-	-	0	-	-
Sept	5	0.20	125	125	0	-	-	0	-	-	0	-	-	0	-	-
Oct	10	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-
Nov	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dec	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 9. 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 2008. 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 13 days except where noted.

Species	Number Tagged	Number Recaptured	Percent Recaptured	Mean DAL	Range DAL	Percent Recap at Same Site	Number With DAL >12 Days	Mean Growth Rate	Range Growth Rate
Yoy Coho	331	104	31.4	58	6-168	98.1	88	0.29	0.04-0.68
1+ Coho*	206	19	9.2	14	5-25	89.5	11	0.37	0.17-0.72
Yoy Chinook	23	0	0	-	-	-	-	-	-
Steelhead	17	1	5.9	-	28	100	1	-	0.25
Cutthroat	9	3	33.3	-	20-110	100	3	-	-0.15-0.42

*Does not include one coho marked on 7/26/07 and recaptured on 5/16/08. This fish was at large for 294 days and grew from 95 to 124 mm and in weight from 11.0 g to 22.1 g.

where it was originally marked. We applied PIT tags to nine cutthroat trout in 2008 and recaptured three (33.3%) of them (Table 9). They were at large for 20-110 days and had growth rates of -0.15-0.42 mm/day. They were all recaptured at the same site where they were originally marked.

January-June 2009. Due to high stream flows and State budgetary restrictions, we conducted little sampling in upper Elk Slough in January and March 2009. Yearling and yoy coho salmon were the most common salmonids captured in upper Elk River Slough (Table 10). NSA captured yearling coho salmon from late January to late June and their peak catches of 15.57 fish/set occurred April 30- May 1. In 2008 NSA captured yearling coho salmon from early April to late June and their peak catch of 4.38 and 4.25 fish/set occurred in late April and mid May, respectively (CDFG 2008). Their monthly mean FL's were 71 mm in January and 69 mm in February (Table 10), indicating that small sized coho rearing in stream habitat upstream of the stream-estuary ecotone had moved into the area to over-winter. Their monthly mean FL's ranged from 103 to 107 mm April through June and individual FL's ranged from 64-138 mm (Table 10). NSA captured yoy coho salmon from mid April to late June and their peak catch of 7.00 fish/set occurred in late June. In 2008 NSA captured yoy coho salmon from late April to late June and their peak catch of 7.13 fish/set occurred in late June (CDFG 2008). Their weekly mean FL increased from 37 mm in mid April to 66 mm in late June and individual FL's ranged from 36-82 mm (Table 10). NSA captured nine yoy Chinook salmon from late May to late June. Their weekly mean FL's increased from 50 mm in late May to 67 mm in late June and individual FL's ranged from 45-73 mm (Table 10). NSA captured 13 juvenile steelhead with no discernable peak in abundance (Table 10). Their FL's ranged from 108-201 mm (Table 10). NSA captured 11 cutthroat trout, eight between mid April and mid June. Their FL's ranged from 137-249 mm (Table 10).

During January-June 2009 yearling coho salmon were the most common salmonid captured in lower Elk River Slough (Table 11). NSA captured yearling coho salmon from mid February to late May. Their peak catches occurred in May with a high of 8.80 fish/set in late May. Their weekly mean FL increased from 73 mm in mid February to 114 mm in mid to late May and individual FL's ranged from 65-132 mm (Table 11). In 2008 NSA captured yearling coho salmon from early January to late June. Their peak catches occurred in May and June with a high of 8.75 fish/set in late June. In 2009 we did not capture any yearling coho in lower Elk River slough in June (Table 11). In past years high CPUE in June was mostly due to high catches in the two sites closest to the river mouth. The high catches at these sites likely include coho from other Humboldt Bay tributaries. In 2007, two yearling coho salmon marked in Freshwater Creek basin were recaptured by our project in lower Elk River Slough. One of the coho was tagged at the Humboldt Fish Action Council (HFAC) weir on May 8, 2007, recaptured at HFAC on May 10, and then captured in Elk River Slough (about 1/4 to 1/2 mile upstream of the mouth of Elk River) on May 21. It was 107 mm FL when it was tagged and 108 mm FL when captured in Elk River Slough. The other coho was tagged in Cloney Gulch (tributary to Freshwater Creek) on April 8, 2007, recaptured in Cloney Gulch on April 9, and then captured in Elk River Slough (about 1/4 to 1/2 mile upstream of the mouth of Elk River) on May 21. It was 103 mm FL when it was tagged and 126 mm FL when recaptured in Elk River Slough. This was the first confirmation that juvenile salmonids from other Humboldt Bay tributaries move into lower Elk River slough on their way to the ocean. Also, the size of coho captured at the two lower sites (especially in June) were substantially larger than outmigrating coho captured upstream or in other Humboldt Bay tributaries suggesting they have been rearing in Humboldt Bay. USFWS found that in 2007 coho salmon smolts resided for an average of two weeks and as long as four weeks in Humboldt Bay (Bill Pinnix, USFWS, presentation at the 2008 Humboldt Bay Symposium). In 2008, we also recaptured four yearling coho in lower Elk River Slough that contained PIT tags marked by other projects. They were most likely tagged by CDFG's AFRAMP project in Freshwater Creek or by Green Diamond Company fish biologists in Ryan Creek. This information suggests that juvenile salmonids will utilize non-natal sloughs and

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 upper Elk River Slough, January-June 2009. 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	-	-	0.38	71	68-73	0.38	194	190-199	0.38	238	231-249
Feb	14	0	-	-	0	-	-	0.79	69	64-78	0.07	201	201	0	-	-
Mar	0	-	-	-	-	-	-	-	-	-	0	-	-	0	-	-
Apr	16	0	-	-	0.06	37	37	3.63	106	88-138	0.13	152	133-171	0.06	198	198
May	23	0.17	50	45-54	2.74	48	36-64	9.00	107	84-131	0.09	144	128-160	0.26	163	140-191
June	16	0.31	60	50-73	6.94	62	44-82	0.56	103	92-118	0.31	140	108-178	0.06	137	137

Table 11. 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 2009 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	10	0	-	-	0	-	-	0.20	73	65-80	0	-	-	0	-	-
Mar	5	0	-	-	0	-	-	1.00	82	69-93	0	-	-	0	-	-
Apr	5	0	-	-	0	-	-	0.20	122	122	0	-	-	0	-	-
May	10	0	-	-	0	-	-	6.30	114	89-132	0	-	-	0.30	183	163-194
June	10	0.10	88	88	0	-	-	0	-	-	0	-	-	0	-	-

marshes while rearing or migrating through Humboldt Bay. NSA captured one yoy Chinook salmon in early June and it was 88 mm FL (Table 11). NSA captured three cutthroat trout, all in late May and their FL's ranged from 163-194 mm (Table 11). NSA did not capture any yoy coho salmon or juvenile steelhead in lower Elk River slough.

We are still analyzing PIT tag information for 2009 and these results will be reported in our project's 2009/10 SFRA Annual Report.

Martin Slough

July-December 2008. Juvenile coho salmon were the most abundant salmonids captured in Martin Slough (Table 12). Based on their size and appearance they were probably yoy 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. Their monthly mean FL increased from 82 mm in July to 121 in December and individual FL's ranged from 74-129 mm (Table 12). We also captured one juvenile steelhead in December and it was 219 mm FL (Table 12). We caught 10 cutthroat trout and their FL's ranged from 109 to 262 mm FL (Table 12). We also captured numerous adult cutthroat trout.

We also captured a total of six invasive Sacramento pikeminnow in Martin Slough. The first was captured in August and the other five were captured in October and November. CDFG and other cooperating agencies conducted a number of pikeminnow eradication sampling culminating with a large effort in November that included draining a pond where five of the six were found (CDFG 2008a). As of August 2009 we have captured no additional pikeminnow.

January-June 2009. Juvenile coho salmon were by far the most abundant salmonids captured in Martin Slough (Table 12). Based on their size and appearance most were probably yearling and older fish but we did not examine scales to confirm this. We did capture a few of what were clearly yoy fish in May. On average the coho we captured in Martin Slough were larger than those captured in any other Humboldt Bay tributary (Table 12). Our juvenile coho catches remained high throughout the winter and into spring indicating coho were using Martin Slough primarily as over-winter habitat. Their monthly mean FL's increased from 80 mm in January to 112 mm in June and individual FL's ranged from 44-153 mm (Table 12). February through March smaller sized coho appeared in Martin Slough and many of our other sample sites around Humboldt Bay, after storms increased stream flows. Also, three of the tagged coho recaptured in Martin Slough were originally tagged in upper Elk River Slough. This proves that some juvenile coho salmon residing upstream in Humboldt Bay tributaries redistribute themselves in the fall to the stream-estuary ecotone seeking low velocity over-winter habitat. In 2008 recaptured PIT tagged coho grew 0.09-0.51 mm/day (see below). We also captured one juvenile steelhead in April and it was 153 mm FL (Table 12). We also captured seven cutthroat trout, all between April and June. Their FL's ranged from 115-245 mm.

During the entire year we also captured adult cutthroat trout, tidewater goby, threespine stickleback, prickly sculpin, Pacific staghorn sculpin, tree frog, Northwest salamander, and rough skin newt.

PIT Tag Results for 2008. We applied PIT tags to 22 yoy and 177 yearling and older coho salmon and recaptured 28 (14.1%) PIT tagged coho. The tagged coho were at large for an average of 55 days (range 9-195). Eleven of the recaptured coho were collected during our Sacramento pikeminnow eradication efforts so no size information was gathered from these fish. Fourteen of the 28 recaptured coho were captured at different sites from where they were originally marked. This is much different from our observations in Freshwater Creek and Elk River Sloughs where we observe very little movement by coho. Three of the tagged coho recaptured in Martin Slough were originally tagged in upper Elk River Slough. This proves that some juvenile coho salmon residing upstream in Humboldt Bay tributaries redistribute

Table 12. Summary of the number and fork length (FL) information of juvenile salmonids captured in Martin Slough, Rocky Gulch, Wood Creek, and numbers only for Gannon Slough, and Jacoby Creek, July 2008 through June 2009. (MT=minnow trap)

Martin Slough

Date	Coho Salmon			Steelhead/RT			Cutthroat Trout		
	No.	FL	Range	No.	FL	Range	No.	FL	Range
7-10-08	4	82	74-90	0	-	-	1	230	230
8-07-08	3	89	89-90	0	-	-	0	-	-
10-9-08	0	-	-	0	-	-	2	230	216-243
11-6-08	10	109	89-121	0	-	-	3	193	109-249
12-2-08	7	121	104-129	1	219	219	4	247	231-262
1-13-09	30	80	65-131	0	-	-	0	-	-
2-10-09	326	91	63-153	0	-	-	0	-	-
3-05-09	78	95	66-139	0	-	-	0	-	-
4-07-09	143	105	80-139	1	153	153	3	208	173-245
5-07-09	88	107	44-132	0	-	-	1	115	115
6-04-09	15	112	103-128	0	-	-	3	156	138-168

Rocky Gulch

Date	Coho Salmon			Steelhead/RT			Cutthroat Trout		
	No.	FL	Range	No.	FL	Range	No.	FL	Range
7-31-08	0	-	-	0	-	-	2	130	129-130
8-28-08	0	-	-	0	-	-	2	137	131-143
9-26-08	0	-	-	0	-	-	2	125	104-145
11-5-08	0	-	-	0	-	-	2	108	67-149
12-10-08	0	-	-	0	-	-	4	118	94-150
1-16-09	4	76	69-82	0	-	-	3	86	82-91
2-11-09	9	89	78-103	0	-	-	1	97	97
3-26-09	15	94	72-116	0	-	-	11	91	74-110
5-01-09	3	98	90-113	0	-	-	13	117	84-160
6-03-09	0	-	-	0	-	-	9	108	87-129

Wood Creek

Date	Coho Salmon			Steelhead/RT			Cutthroat Trout		
	No.	FL	Range	No.	FL	Range	No.	FL	Range
7-03-08	1	76	76	0	-	-	0	-	-
8-07-08	0	-	-	0	-	-	1	119	119
9-08-08	0	-	-	0	-	-	3	124	116-132
10-10-08	0	-	-	0	-	-	2	138	132-144
11-04-08	1	139	139	0	-	-	2	133	133-133
12-03-08	4	108	101-113	0	-	-	2	151	146-156
1-09-09	4	98	83-115	0	-	-	0	-	-
2-09-09	22	84	69-96	0	-	-	0	-	-
3-04-09	20	95	76-115	0	-	-	0	-	-
4-09-09	8	102	91-110	0	-	-	2	135	129-140
5-08-09	8	102	83-123	0	-	-	3	125	98-148
6-02-09	6	76	50-116	0	-	-	1	106	106

Gannon Slough

Date	Effort		Coho	SH	Cutt
	MT	Seine			
7-9-08	6	5	0	0	3
8-21-08	6	4	0	0	1
9-22-08	4	6	0	0	0
10-23-08	4	6	0	0	0
12-16-08	5	6	0	0	0
1-29-09	5	6	0	0	0
2-26-09	5	6	0	0	0
3-19-09	5	6	1	0	0
4-28-09	6	4	0	0	0
5-27-09	6	4	0	0	0
6-30-09	5	4	0	0	0

Jacoby Creek

Date	Effort	Coho	SH	Cutt	Yoy Trout
	Seine				
7-9-08	2	0	0	0	0
8-21-08	2	14	6	0	0
9-22-08	2	0	1	0	0
10-23-08	2	0	0	0	0
12-16-08	2	0	1	0	0
1-29-09	2	0	0	0	0
2-26-09	2	2	1	0	0
3-19-09	2	0	0	0	0
4-28-09	2	50	3	0	0
5-27-09	2	19	0	0	1
6-30-09	2	0	0	0	0

themselves in the fall to the stream-estuary ecotone seeking low velocity over-winter habitat. This relatively active movement in Martin Slough suggests that these coho have not set up territories and may be more nomadic in nature once they redistribute themselves downstream than the fish residing here in the summer. The mean growth rate of the 17 recaptured coho at large for at least two weeks was 0.30 mm/day and ranged from 0.09 to 0.51 mm/day. Their mean weight gain was 1.06% of their initial body weight per day (range -0.22 to 2.44%), which is higher than any other Humboldt Bay tributary we sample.

We are still analyzing PIT tag information for 2009 and these results will be reported in our project's 2009/10 SFRA Annual Report.

Rocky Gulch

July-December 2008. Cutthroat trout were the only salmonid captured in Rocky Gulch during this time period (Table 12). Their FL's ranged from 67 to 150 mm. We also captured tidewater goby, threespine stickleback, prickly sculpin, Pacific staghorn sculpin, starry flounder, and Gambusia spp. (mosquitofish).

January-June 2009. Juvenile coho salmon and cutthroat trout were the most abundant salmonids captured in Rocky Gulch (Table 12). The coho were captured from January to May and their peak catch occurred in April. Based on their size and appearance the coho captured were probably yearling fish, but we did not examine scales to confirm this. Their monthly mean FL increased from 76 mm in January to 98 mm in May and individual FL's ranged from 69-116 mm (Table 12). It appeared that all yearling coho salmon had emigrated from Rocky Gulch by late June since our catches dropped to 0 fish in June. NSA captured cutthroat trout from January to June and their peak catch occurred in May (Table 12). Their FL's ranged from 74-160 mm.

During the entire year we also captured tidewater goby, threespine stickleback, prickly sculpin, Pacific staghorn sculpin, starry flounder, Gambusia spp. (mosquitofish), red legged frog, and Northwest salamander.

PIT Tag Results for 2008. We applied PIT tags to 34 yearling coho salmon and recaptured two (5.9%) PIT tagged yearling coho. Both yearling coho were at large 30 days between March 19 and April 18, and they grew 3-4 mm. Their mean growth rate was 0.12 mm/day and ranged from 0.10 to 0.13 mm/day. One of the fish moved one sampling site upstream and the other was marked and recaptured in the site where we originally tagged it. We also applied PIT tags to 12 cutthroat trout and recaptured one (8.3%) of them. The cutthroat trout was at large for 28 days and its growth rate was 0.04 mm/day. We also applied a PIT tag to one juvenile steelhead and did not recapture it.

Wood Creek

July-December 2008. Juvenile coho salmon and cutthroat trout were the only salmonids captured in Wood Creek (Table 12). Based on their size and appearance the coho were probably yoy fish but we did not examine scales to confirm this. We captured one coho in July and November and four in December (Table 12). Their FL's ranged from 76-139 mm (Table 12). We also captured 10 cutthroat trout from August to December that ranged in size from 119-156 mm FL (Table 12).

January-June 2009. Juvenile coho salmon were by far the most abundant salmonids captured in Wood Creek with peak catches occurring February and March (Table 12). Based on their size and appearance they were probably yearling and older fish but we did not examine scales to confirm this. Our juvenile coho catches remained high throughout the winter and into spring indicating coho were using Wood Creek as over-winter habitat. Their monthly mean FL's increased from 84 to 102 mm between January and May. Smaller sized coho appeared in Wood Creek in February and March after large storm flows providing more evidence that

juvenile coho salmon residing upstream redistribute themselves in the fall to the stream-estuary ecotone seeking low velocity over-winter habitat. A new cohort of yoy coho appeared in Wood Creek in June. In 2008 recaptured PIT tagged coho grew 0.05-0.32 mm/day (see below). We also captured six cutthroat trout between April and June. Their FL's ranged from 98-148 mm (Table 12).

During the entire year we also captured threespine stickleback and prickly sculpin.

PIT Tag Results for 2008. We applied PIT tags to 145 yearling and five yoy coho salmon and recaptured seven (4.8%) PIT tagged yearling coho and no yoy coho salmon. We also captured three yearling coho tagged by our project in 2007 in Wood Creek. Two were at large from November 16, 2007 to March 6, 2008 (110 days) and grew 0.12-0.17 mm/day. The other fish was at large from August 12, 2007 to November 4, 2008 (449 days) and grew 0.10 mm/day. All three fish were recaptured at the same site where we originally tagged them. The overall length of residence for the 10 tagged yearling coho ranged from 28 to 449 days (mean=95 days). Excluding the fish at large for 449 days the coho residence ranged from 28-110 days (mean= 56 days). While at large they grew 3-44 mm (0.05-0.32 mm/day). Two of the yearling coho were marked and recaptured at different sites from where we originally tagged them. We also applied PIT tags to 12 cutthroat trout and recaptured three (25.0%) of them. The cutthroat trout were at large for 57 to 86 days (mean=69 days). Their mean growth rate was 0.22 mm/day and ranged from 0.17 to 0.30 mm/day. All of the fish were recaptured at the same site where we originally tagged them. We also applied a PIT tag to one juvenile steelhead and did not recapture it.

Gannon Slough/Jacoby Creek

July-December 2008. In Gannon Slough we captured three adult cutthroat trout in July and one 222 mm FL cutthroat in August (Table 12). In Jacoby Creek we captured 14 juvenile coho salmon, all in August (Table 12). Based on their size and appearance the coho were probably yoy fish but we did not examine scales to confirm this. Their mean FL was 83 mm and ranged from 78 to 94 mm. We also captured eight juvenile steelhead, with a peak catch of six in August (Table 12). Their FL's ranged from 70-189 mm.

January-June 2008. NSA captured one juvenile coho captured in March and it was 83 mm FL (Table 12). Based on its size and appearance it was probably a yearling fish, but we did not examine scales to confirm this. It was the only salmonid caught in Gannon Slough during this time period. In Jacoby Creek we captured juvenile coho salmon in February and then relatively large numbers of them in April and May (Table 12). The yearling coho FL's ranged from 75-82 mm in February, 85-131 mm in April, and 94-111 mm in May. Nineteen of the 69 coho we captured in April and May were yoy coho and their FL's ranged from 36-51 mm. We also captured four juvenile steelhead with three being captured in April (Table 12). Their FL's ranged from 67-131 mm. We captured one yoy trout in May and it was 32 mm FL.

During the entire year in Jacoby Creek we also captured tidewater goby, starry flounder, Pacific staghorn sculpin, threespine stickleback, and surfsmelt. In Gannon Slough we also captured tidewater goby, starry flounder, English sole, Pacific staghorn sculpin, prickly sculpin, coast range sculpin, threespine stickleback, surfsmelt, topsmelt, unidentified larval smelt, saddleback gunnel, shiner surfperch, bay pipefish, Gambusia spp., juvenile Dungeness crab, red legged frog, and rough skin newt.

Hookton Slough/Salmon Creek

July-December 2008. While seining during this time period, NSA captured one juvenile steelhead in Salmon Creek in September and it was 155 mm FL (Table 13) and no salmonids in Hookton Slough (Table 14). Because of the success we had last year we conducted qualitative sampling using minnow traps baited with frozen salmon roe again in 2008 and 2009. We fished these traps in deeper water or more heavily vegetated habitat near our normal seining sites.

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 Salmon Creek estuary, July 2008-June 2009. CPUE is number of fish per seine haul.

Seining

		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	10	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-
Aug	18	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-
Sept	12	0	-	-	0	-	-	0	-	-	0.08	155	155	0	-	-
Oct	6	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-
Nov	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dec	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jan	4	0	-	-	0	-	-	0	-	-	-	-	-	0	-	-
Feb	6	0	-	-	0	-	-	0	-	-	0.17	60	60	0	-	-
Mar	0	-	-	-	0	-	-	0	-	-	-	-	-	-	-	-
Apr	12	0	-	-	0	-	-	0	-	-	0.25	80	77-83	0	-	-
May	12	0	-	-	0	-	-	0	-	-	0.17	99	82-116	0	-	-
June	12	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-

Minnow Traps

		Trout			YOY Coho			Yearling Coho			Steelhead			Cutthroat		
Month	No. Traps	No. Caught	Mean FL	Range	No. Caught	Mean FL	Range	No. Caught	Mean FL	Range	No. Caught	Mean FL	Range	No. Caught	Mean FL	Range
July	4	0	-	-	0	-	-	0	-	-	1	100	100	0	-	-
Aug	6	0	-	-	0	-	-	0	-	-	3	119	100-136	0	-	-
Sept	4	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-
Oct	2	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-
Nov	0	-	-	-	-	-	-	-	-	-	-	-	-	0	-	-
Dec	2	0	-	-	0	-	-	0	-	-	1	85	85	0	-	-
Jan	2	1	51	51	0	-	-	0	-	-	4	66	58-80	0	-	-
Feb	2	0	-	-	0	-	-	0	-	-	4	72	64-83	0	-	-
Mar	1	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-
Apr	4	0	-	-	0	-	-	2	102	95-109	9	86	66-108	0	-	-
May	4	0	-	-	0	-	-	0	-	-	5	96	80-123	0	-	-
June	3	0	-	-	0	-	-	0	-	-	8	100	89-113	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 Hookton Slough, July 2008 to June 2009. CPUE is number of fish per seine haul.

		YOY Trout			YOY Chinook			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	8	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-
Sept	6	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-
Oct	0	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-
Nov	0	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-
Dec	0	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-
Jan	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Feb	3	0	-	-	0	-	-	0*	-	-	0	-	-	0	-	-
Mar	3	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-
Apr	6	0	-	-	0	-	-	0	-	-	0.17	131	131	0	-	-
May	6	0	-	-	0.17	88	88	0	-	-	0	-	-	0	-	-
June	6	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-

*One adult coho captured

We captured five juvenile steelhead ranging in size from 85-136 mm FL (Table 13). The peak catches for steelhead occurred in August.

January-June 2009. While seining in Salmon Creek during this time period NSA captured four juvenile steelhead (Table 13). Their FL's ranged from 60-116 mm. Because of the success we had last year we conducted qualitative sampling using minnow traps baited with frozen salmon roe again in 2008 and 2009. We captured two yearling coho salmon, 30 juvenile steelhead, and one unidentified yoy trout (Table 13). The coho were caught in April and ranged from 95-109 mm FL. The peak catches for steelhead occurred in April and June and individual FL's ranged from 58-123 mm (Table 13). The yoy trout was captured in January and was 51 mm FL. In Hookton Slough we captured one juvenile steelhead in April and it was 131 mm FL. We also captured one yoy Chinook salmon in May and it was 88 mm FL (Table 14).

PIT Tag Results for 2008. We applied PIT tags to 40 juvenile steelhead and recaptured four (10.0%) of them. This includes fish collected by seining and in minnow traps. The steelhead were at large 40 to 69 days and grew 5-18 mm (0.09-0.45 mm/day). All the steelhead were marked and recaptured in the site where we originally tagged them. We did not apply PIT tags to any other juvenile salmonid species.

Summary of Project Results:

Project objectives were met.

Project documented that yoy coho salmon rear in the tidal freshwater portion of Humboldt Bay tributaries throughout the summer. Some coho continue to rear in the stream/estuary ecotone over the winter bringing their total rearing time to over a year. This is a life history trait has only been rarely documented in California for coho salmon (Nielsen 1994). However, recent information collected by Yurok Tribal biologists found that coho salmon from the middle Klamath River tributaries move into lower Klamath tributaries such as Waukell Creek to over-winter in low gradient habitat.

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 stream/estuary ecotone located between the estuary

and canyon stream habitat is extremely important to coho and especially steelhead smolt production. Roughly 40% of the coho salmon smolts and about 80-90% of the steelhead smolts originated from the stream/estuary ecotone of Freshwater Creek in 2007 and 2008.

Project cooperated with USFWS which found that the mean length of residence of coho salmon smolts in lower Freshwater Creek Slough was about two weeks and as long as four weeks. They also found that coho smolts residence time in Humboldt Bay was about two weeks and ranged about four weeks.

Project documented that some coho salmon smolts from Freshwater Creek basin would move into lower Elk River Slough while rearing in Humboldt Bay.

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? (See answer from USFWS above)

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 showing that some yoy coho move downstream into the tidal portions of non-natal streams to over-winter. 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?

Management Recommendations:
Juvenile salmonids in Freshwater Creek Slough should continue to be monitored on a year-round basis to determine seasonal and annual variation in their use of estuarine habitat.

Surveys in Humboldt Bay should be conducted to determine if juvenile salmonids use the bay for rearing, and if so, determine how long do they stay and what habitats (e.g. eel grass beds) do they utilize.

Downstream migrant traps should be established at the upstream and downstream borders of the freshwater/estuary ecotone to conduct a mark-recapture study on coho salmon smolts. This study will determine the number of coho salmon smolts originating from the freshwater/estuary ecotone and the number from the rest of the Freshwater Creek basin upstream.

An inventory of small streams entering the tidal portion of the major Humboldt Bay tributaries should be made to determine if they could provide suitable summer rearing habitat for yoy coho salmon and other estuarine organisms. The establishment of cool freshwater habitat at the mouths of small streams entering Freshwater Creek Slough (presently behind tidegates) could potentially increase the rearing area for yoy coho salmon during the summer. These

same areas could also provide a refuge from high velocity flows for yearling coho in the winter and early spring.

Tidal lands adjacent to Humboldt Bay tributaries should be restored as the opportunity arises since it appears that juvenile salmonids will use tide channel habitat adjacent to the mainstem slough if it is available.

Habitat restoration projects to improve stream-estuary ecotone habitat should be monitored to assess their effectiveness and provide feedback to the restoration community to improve future restoration projects.

Water temperatures in lower Freshwater Creek and Hookton Sloughs become too high to support salmonids by mid summer. This is probably due to the heating of mud flats and shallow water in and adjacent to the sloughs and exasperated by the lack of tidal circulation within the levied sloughs. Therefore management efforts to reduce water temperatures by conducting riparian planting, increasing tidal circulation, and reducing warm water runoff from adjacent agricultural lands should be pursued whenever possible and appropriate.

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7. Discuss differences:
Due to the ongoing fiscal crisis in the State of CA:

The State of CA separated all CDFG seasonal workers and implemented a hiring freeze in 2008 which resulted in our inability to retain or hire Scientific Aids to conduct scheduled field and office work.

The State of CA implemented a spending freeze in 2008 which resulted in our inability to purchase essential items such as PIT tag antenna arrays.

Beginning in November 2008 we attempted to amend an existing contract to allow this project to hire contract workers to conduct our downstream migrant sampling in Freshwater Creek Slough in the spring of 2009. CDFG administration was not able to complete the paperwork to execute this amendment until June 2009 which was too late to conduct the scheduled downstream migrant work.

The CA Governor enacted Executive Order S 09-09 which cancelled the above contract amendment resulting in our inability to hire additional fish technicians to complete scheduled field and office work or buy essential field equipment.

The State of CA either delayed payments or issued IOU's to the Pacific States Marine Fisheries Commission which resulted in a stop work order to existing PSMFC technicians working on this project. It also resulted in an ongoing hiring freeze of future technicians and a spending freeze on PSMFC contract funds. All of this resulted in missed field work, delays in data entry, analysis, and report writing, and our inability to purchase needed project supplies.

8. List any publications or in-house reports resulting from this work:
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.

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